

A central image of a globe, rendered in a mosaic style with various colored tiles. A rainbow arc is positioned above the globe. The globe shows continents and oceans. The background is a dark, textured mosaic of blue, green, and yellow tiles.

**ENVISION THE
FUTURE:**

**INTERDISCIPLINARY
APPROACHES TO
GLOBAL INJUSTICE**

**TRANSDISCIPLINARY
TENETS**

AS A COLLECTIVE OF MESH BOUNDARY SPANNERS, WE BELIEVE PLANETARY HEALTH MUST COEXIST WITH SUSTAINABLE OPTIMISM. WE ARE CO-CREATING FRAMEWORKS OF HOLISTIC PRACTICES WHILE LEARNING HOW TO SUPPORT LOCAL AND GLOBAL ENVIRONMENTAL JUSTICE EFFORTS. THIS CO-CREATION IS THE FUTURE IN WHICH WE CAN BUILD WITH OUR HANDS. LET'S REACH OUT AND CREATE IT TOGETHER!

THE 1ST MESH COHORT / 2024

Dear Reader,

We are excited to present the first edition of a magazine that arose out of the first group of graduates from the Master's program *Engineering, Sustainability, and Health* (MESH) ([link](#)). For almost two years, our diverse group has been learning in the interwoven fields of water-, energy-, waste-, food-, health-, and just human systems while applying this knowledge to their self-chosen fields of interests. Some of us stayed with one subject, while others moved their focal point around. The capstone papers presented in this magazine sprang out of a deep dive into our final project areas throughout four months of exclusive capstone project time.

Since this was an online program, all of us were able to stay connected to our local roots and apply the knowledge of this program to aspects of our lives that mattered most to us. Our group of 13 students spanned generational boundaries with vastly different backgrounds ranging from linguistics to civil engineering, international relations, economics, and everything in between. Our differences were our strengths.

Out of this international & transdisciplinary container, new unseen forms of cooperation and learning emerged. In the face of world-wide natural and social destruction, we see great value continuing to weave our collective multi-textured fabric for resilience and adaptive change.

We hope that the following papers give you an insight into the vast landscapes of project work and thought that we embarked on individually, while enmeshed in the collective exchange and learning processes. Some of us worked on community projects, others explored topics through invested research journeys. We envision that this first issue of final papers is only the beginning of a continued effort to work across trans-disciplinary boundaries yet stay connected as human beings. This magazine is a simple collection that does not necessarily represent the web-like structure connecting our work. We may have to learn how to represent our web of work to the audience of this magazine more effectively; a quest for future MESH classes tentatively explored in Leon's paper ([link](#)).

We recommend that you skim the entire table of contents. You may click on the respective paper titles to jump to the sections.

With hopes to bring forth systemic healing & justice,

The editorial team

Christian Clarence

Mahtaub Golab

Leon Santen

May 2024

MESH

Master of Science in Engineering, Sustainability and Health

Co-defining Problems and Co-creating Solutions



Heroes of Positive Change

Christian Clarence
Jack Joslin
Jon Colon
Jonea Parks
Kelsey Pelton
Lauren Closs
Leon Santen

Lilian Wanjala
Mahtaub Golab
Marleigh Mitchum
Shai Ehrmann
Vivian Andrade
Xochitl Morales

April 2024

Our Capstone Projects

In no particular order - we recommend you skim through the table
to see our diversity in project work

Page- 5

Speaking the Terra Dialect: Developing Multilingual Environmental Education Through Community Narratives
Xochitl Morales

Page- 24

Addressing Food Waste and Environmental Sustainability: Insights from Community-Based Research in the Convoy District
Vivian Andrade

Page- 44

interconnected: an ethnographic framing of energy assessment methodology
Shai Ehrmann

Page- 75

Justice Unleashed: Transforming the Tijuana River Watershed through Socio-Environmental Empowerment *Marleigh Mitchum*

Page- 96

Reimagining Agriculture: Integrating Indigenous Knowledge and Human Experience for Socio-Ecological Transformation
Lauren Closs

Page- 117

Filling in Gaps: Prioritizing Top Three Environmental Burdens to Public Health and Understanding The Factors Behind Categorizing Specific Populations as Vulnerable
Kelsey Pelton

Page- 145

The Unequal Distribution of Air Pollution Impact in San Diego County: Identifying Intersectional Issues Through A Community Lens
Jonéa Parks

Page- 176

Learning from the past and present, how can we implement better water conservation practices for tomorrow's water climate? A Southern California Perspective (with a focus on Riverside County - Inland Empire region)
Jon C Colón

Page- 195

From Observations to Action: Breaking Beyond the Paradox of Unsustainable Food Conditions
An Urban Lower-Income Story
Ceon Heck

Page- 226

Farm Aid and Abet: Agriculture Subsidies in the United States
Christian Clarence

Page- 245

Beyond the Packaging: Engineering Sustainable Solutions to Plastic Pollution in Tijuana
David Garcia

Page- 266

Are Cattle or Bison More Effective at Mitigating the Climate Crisis Using Holistic Management?
Jack Joslin

Page- 276

Re-learning how to tend to our garden of communication - How do we nurture caring and cooperative social fields to heal our planet as globally distributed change-makers?
Leon Santen

Page- 322

Repurposing Construction and Demolition (C&D) Waste to Improve the Built Environment of Informal Settlements in Nairobi.
Lilian Wanjala

Page- 361

An Exploration of Palestinian Educators and Advocates, Educational Capacity Building and the Right to Self Determination for Palestinian Youth
Mahtaub Golab

**Speaking the Terra Dialect: Developing Multilingual Environmental Education Through
Community Narratives**

Xochitl Morales

University of San Diego MESH Program

April 14, 2024

Abstract

Environmental issues are as diverse as the people they affect; the people that these issues affect also come from a variety of linguistic and cultural backgrounds. In the United States alone, there are over [350 languages](#) present, despite English being the lingua franca. With such a variety of people who communicate differently, the transfer of information can be an issue. For my project focusing on the development of a multilingual environmental education program (MEE), I conducted interviews with a several individuals who shared their experiences and level of environmental knowledge with me, as well as their potential interest in participating in environmental program that offers learning opportunities, by means of cross-cultural and cross-linguistic community collaboration– in other words, the use of language services, products, and multilingual/translated educational materials to share environmental knowledge across language barriers. The results of these interviews contributed further to the need for such a program in our respective communities. More importantly, the interviews mark the beginning phases of a potential multilingual environmental education program which I aim to develop in the future, when opportunities for further community engagement arises,

Introduction

Environmental Knowledge and Linguistic Diversity

I started out in the [MESH](#) program with the idea that maybe, somehow there could be a community-led program that fosters environmentally conscious individuals. This is something that I haven't seen in the public sphere, even less so with a diverse set of people. Living in a largely Hispanic, Spanish speaking neighborhood, I noticed the various [linguistic barriers a non-native English speaker \(NNE\) may face on a daily basis](#). An English-dominant society ultimately puts its NNE population at a disadvantage, barring them from accessing necessary information, such as doctor's notes or community resources for low-income families. The same could be said for speakers of other languages as well and even monolingual English speakers who may wish to converse with their neighbors, but can't because of language differences. A potential MEE bridge the language gap, therefore facilitating communication across NNE's and monolinguals while diversifying environmental knowledge through collaborative efforts.

Community/global efforts gain as much traction as its supporters allow. I've come to realize that there can be many more environmental stewards in a neighborhood if their [access to a variety of learning resources were improved](#). This access is reduced to extracurricular activities for younger learners and a few volunteering opportunities for adults. And while these opportunities offer increased environmental awareness for participants, I find that they can be limited in terms of knowledge and skill-building for more [cohesive community efforts](#). The MEE program can potentially open up transformative environmental education opportunities to neighborhoods that don't usually get to learn about the ever-growing issues regarding the physical world. This may include neighborhoods considered [low-income, underrepresented, and/or BIPOC](#). During my weekly observations and online searches for reputable environmental organizations in my own region, I found that several of them were headquartered in more affluent neighborhoods, oftentimes in coastal areas. Even "eco-friendly" services, like trash can

sanitization, limited its service to high-income regions. As a researcher, I found that upsetting; in fact, I struggle to be an environmentally conscious individual as well, due to the limited services and organizations available to my own community.

The potential program would also aim to help communities understand that environmental knowledge should be regarded as a subject that carries as much importance as other, more prioritized subjects, such as math, language arts, or the increasingly popular computer science. STEM education has become a big thing in recent years, yet environmental studies are not taken into serious consideration, so I'd like to create a program which does just that— make the environment matter and encourage people to see the importance of building environmental knowledge for the sake of individual, community, and international well-being.

Furthermore, there are people who may not consider English as their dominant or preferred language— I will refer to them as non-native English speakers or NNE's for short. This population may not have as many opportunities to engage in environmental learning, either due to inaccessible monolingual texts or expensive academic programs. As a result, increasing access to environmental learning will require the implementation of a multilingual approach to learning about the environment. By increasing translation/interpretation efforts through a potential MEE program, there can be an increase in basic environmental awareness which may then grow into community environmental consciousness at a large scale. Such a feat could then improve participation in an international environmental movement, where communities eventually come together to create the much-needed change our planet needs for the sake of environmental restoration, conservation, preservation, and sustainability. I think the poor variety of accessible learning resources (e.g. English-only videos, books, Western environmental teaching) is one of the reasons why we haven't gained worldwide change that tackles the globe's growing climate catastrophes, a majority of which are human-driven and exacerbated by failure to reduce pollutive industrial activity. Coupled with inaccessible learning opportunities, people from various backgrounds will be ill-equipped to adapt to the changing climate and much less have sufficient community strategies and resources to restore the damage done to the physical environment.

The issues mentioned above can be better addressed if we bridge the language gap between English and non-English populations. Within the project, this goal can be achieved through volunteer interpreters, literary translators, and community members looking to improve their language skills. This is an approach that would make such a program engaging while allowing potential members to work together and investigate environmental issues, while embracing their linguistic backgrounds, rather than experience it as a roadblock to learning new concepts. I believe that solving the world's climate and pollution issues can be facilitated by bridging the language barrier while emphasizing the importance of building environmentally conscious communities. On another note, this coming together could also improve the connection between different demographics, helping to develop a reliable cross cultural and cross linguistic network of people that are working towards the same goal while empowering each other to make a substantial contribution to the most pressing environmental crises affecting communities near and far.

Typically, multilingual efforts are done for the sake of supporting a globalized economy and encouraging monetary growth. I realized that if we can translate an ad for the newest phone, why not do the same for rising temperatures, melting glaciers, and the like? Both language accessibility and learning opportunities regarding the environment would benefit from a multilingual approach to community knowledge building.

Literature Review

Influence of Western Thought: Acknowledging Bias

I must say that my ideas are heavily driven by European/Western thought when it comes to research and, well, my whole outlook on life, really. I enjoy European history, art, and language. I have an ever-growing affinity for the Renaissance, the Romantic era, and classical language studies. The more I spoke with my participants, the more I realized that my world is built on white societies, past and present. I think a lot of us could say something similar. After all, big parts of the globe were colonized by European countries. Western thought can be seen practically everywhere; it is present in my everyday life, from the way I speak, to my ideals, and even the goals I applied to my project. The work [that I was initially trying to do involved bringing Western environmental ideology](#) to non-English speaking groups through potential translations of English-only texts. Going further into the program, I realized that alternative knowledge was missing from my multilingual education goals. I didn't see a strictly European way of thought as a bad thing; more importantly, I wasn't fully aware of how much of a Western thinker I was. The potential of bringing biased outcomes was not clear yet. With the added support of multilingual individuals, however, an MEE program can bring a greater mix of minds to ["pluralize"](#) knowledge in environmental discussions, therefore diversifying approaches to different kinds of issues, from climate change to alternative energy.

It was especially difficult to understand that even the different branches of science could hold biases against other knowledge types, with its overbearing authority brought on to the strict adherence to cold hard facts that could be seen, smelled, heard, touched and tasted. Western science is very rational and logical in nature. It attempts to separate truth from falsehood— real science from pseudoscience. That's good, to an extent. Unfortunately, this obsession with visibly observable truth pushes out knowledge that non-white or non-European communities create outside of traditional research centers. We lose a wealth of information, stories, experiences that could put environmentalism at the forefront of our lives and make it truly matter.

Research papers and labs only go so far as to produce results that excite other researchers. Of course we've had world-shaking breakthroughs like smallpox and polio vaccines. But other than that, the "products" of research don't enter the public knowledge sphere; many papers and ideas are left sitting in a few dozen pages in a journal.

Similar issues happen with alternative knowledge, especially those tied to culture, religion, and traditions. Not only is it pushed out of public consciousness by traditional scientific and European knowledge, it's made to be inferior to it as well— something to be entertained by, rather than taken as a valuable educational resource. However, even these kinds of knowledge can be biased by outright denying valuable information created by traditional ways of thought that I mentioned before. [There's little harmony among all these schools of thought](#) and that is preventing us from moving forward in both local and global community settings. As a result, developing MEE would require diverse dialogues between different people from a variety of knowledge backgrounds, especially non-native English speakers who may prefer to learn and express themselves in their native language.

Disrupting Hegemonic Environmental Thought

It's crucial that the MEE project be a dynamic entity, unified by multicultural and multilingual individuals. I want the program to be a human form of [Indra's net](#), where our success is supported by the constant exchange of ideas that reflect different types of knowledge and experiences, all the while being facilitated by a multilingual approach to accessing and understanding the environment. In such a way, we can transition away from the learned concept

that [“western man has developed a relationship to the natural world which is based on manipulation and domination”](#). Barbara Thayer-Bacon points out how dominant Western or “Euro-western” thought raises the ecological status of humans over practically every other living being on our planet. As a result, the biodiversity of plants and animals suffer, and even other people, [specifically those in the Global South](#), where much of the North’s resources and overall wealth are extracted from. [Industrial revolutions have been taking place for decades](#)—centuries, actually— and each one places the environmental weight on the countries and its citizens, constantly exploiting them for the benefit of Northern countries. Meanwhile those in the North stay on top economically and sociopolitically.

In certain occasions, Thayer-Bacon utilizes the term “man” to clarify when, in situations, males tend to be the main demographic responsible for the environmental effects that are driven by this dominant ecological philosophy, much of which continues the destruction of the natural world and depletion of its resources. The author states that women, “in general, have held a different relationship to nature as they are connected to nature through their reproductive role in societies; I would agree to the statement to a certain point.

[A study done by Kleespies and Dierkes](#) revealed a slightly higher prevalence of connection with nature (e.g. emotional connection, overall concern, stewardship, etc.). The authors further analyze their results by pinpointing the potential *cultural* variables that may affect the different environmental behaviors between men and women.”While males are socialized to be more autonomous and competitive, females are socialized to be more protective, caring and charitable [63].” Due to the way men and women are raised and the expectations held by their relative culture/society, the level of nature connectedness in women is somewhat “facilitated”. Thayer-Bacon’s statement on the relationship between women and environment may be accurate to a certain degree. But the extent to which both men and women might be involved in environmental projects may very well be similar. Despite the correlation that both studies show, Kleespies and Dierkes go on to say that “these characteristics attributed to women because of gender roles are part of [relational values] but not the connection to nature.”

In my own study, the participants' responses towards dedicating a portion of their time to the environment were minimal; I was told by a majority that although they did have interest in the MEE program, they wouldn’t be able to commit to joining one, at least for the time being. I expected similar answers to pop up throughout the interviews conducted; environmental issues just don’t seem to be a top priority, at least for the people I spoke to. Throughout my local neighborhood, I saw more similarities than differences in the way people engage in their environment, in addition to the degree of responsible management. On one occasion, for example, I observed the commingling of recyclable materials and trash in the nearby laundromat. This waste commingling may be due to the fact that the laundry facility lacked separate bins, yet people preferred to throw away everything, even containers with [CRV](#) markings.

An MEE program may be able to help foster that much needed behavioral shift among individuals to get individuals thinking about the state of their local environment. Cleanliness, tidiness, hygiene— these are all practices that can be learned which are not entirely dependent on language or gender. In fact, they’re social and cultural in our world. Just as we are dependent on the earth to thrive, it depends on us to keep it healthy and liveable.

In the laundromat I visited, men and women disposed of their spent materials indiscriminately which somewhat contradicts the previous authors’ explanation that women tend to be more environmentally conscious. Regardless of gender, the people I observed at the laundromat displayed similar behavior when managing the trash accumulated as they washed

their clothes. It had me wondering that if regular citizens aren't aware of their own environmental behaviors or fail to improve them, it'd be difficult to encourage enough people to drive a large-scale movement to tackle the largest CO2 emitters and waste producers out there.

Developing Pro-Environmental Knowledge and Ethics

Incorporating mixed learning, or rather, incorporating alternative forms of knowledge into an MEE, would invite participants to [both think outside of how they usually perceive the world](#) while sharing what they themselves know with other learners in a potential program. One alternative form that deviates from traditional science-based environmental learning is [“Traditional Ecological Knowledge”](#) or “TEK” for short. Also known as Indigenous knowledge, TEK, involves pre colonial environmental teachings about the relationship between people and our physical environment. Additionally, TEK goes outside the boundaries of traditional technical sciences through the employment of sustainable ecological management approaches, such as [prescribed burning](#). Indigenous knowledge can play a transformative role in shifting a community's potential assumptions about environmental studies, which is usually perceived through a technical, logical, and data-driven lens. I think that the idea that environmental studies are strictly data-driven may be part of the reason regular citizens have a reduced understanding and distant relationship with their surrounding world. Compared to Western environmental science, TEK can provide program participants with a holistic approach to learning, as opposed to one that is textbooks and lab work.

[In their paper, Duarte et al.](#), explain that “Indigenous knowledge” and “traditional knowledge” function as paradigmatic boundary spanners, allowing for convergences across disparate research areas.” I find their statement to be quite accurate and related to the multilingual environmental program. Overall, the researchers do thorough work in portraying the beneficial application of TEK across different disciplines– TEK can go beyond what “technoscientific” disciplines can't. I would, however, add that TEK approaches to addressing and restoring the environment has the potential to expand community understanding of environmental issues due to its transdisciplinary qualities. TEK may include traditional data collection but more importantly, it utilizes learning approaches such as storytelling to help individuals diversify the skills necessary to look at environmental issues at several angles, not just a numerical one. The general public might not possess typical research skills or lab work; environmental learning in MEE can make use of TEK practices to expand the potential pool of participants, going beyond those accustomed to traditional Western scientific methods of numerical data collection.

Encouraging Community Participation Through Multilingualism

Part of the success of the MEE is determined by the support of individuals who speak two or more languages and need to develop the skills to facilitate communication amongst multilingual members. My focus at this point of MEE development is on bilingual individuals, since their potential role can support the co-creation of learning resources or project work between English and non-native English monolinguals– two very important groups who would greatly benefit from cross-linguistic and cross-culture collaborative opportunities. Researchers Chen & Padilla [demonstrate the social virtues of being bilingual and bicultural](#):

In short, bilingualism and biculturalism serve as additional positive and meaningful assets for connecting with a broader community of people from different cultures and linguistic backgrounds. As a result, being bilingual and/or bicultural can contribute to reinforcing one's social bond and building positive relationships with people from different cultural backgrounds.

This is what has hit me since the beginning of my project efforts: to get close to nature, we need to get closer to the people around us. If we don't, environmental participation and action will be difficult to carry out at a greater scale. As stated above, bilingualism/biculturalism fosters stronger, positive relationships— a thing we are increasingly lacking in our neighborhoods these days. The researchers offer valuable insight into the positive side of bilingualism; the combination of diverse language skills and active engagement in community collaboration is just what my program needs to efficiently bridge the gap between different language groups. But where do we start? Well, it starts with reaching out to the community to initiate conversations about forming effective relationships, hopefully sparking interest and increased engagement in topics that are not normally discussed in our daily lives.

Early in the process, I wanted to make a quick environmental and language survey to gather some basic information on people's thoughts and level of engagement with the environment, but the results were limited in my trial runs. It was successful in terms of receiving immediate responses, but I know that multilingual communities need a better way to create meaningful conversations, so I took on the process of interviewing a handful of people within my own neighborhood, just to get a sense of the different kinds of people I might encounter later on in the future.

Before I could gather any participants for any preliminary interviews, however, I had to remind myself to keep any potential biases in check. I mentioned earlier that my worldview is largely Western/European in nature, yet the people I might encounter might have different perspectives, especially with environmental topics. As a result, I knew I had to go through a “decolonizing process” to ensure that my own biases wouldn't interfere with the questions I formulated or the dialogue between the participant and myself, therefore allowing a more welcoming and engaging experience with each participant to create rich storytelling.

[Sandy Grande's Red Pedagogy](#) helped tackle the concept of dominant education practices that are still present today. While Grande focuses on the effects of 21st Century education on Native students, I think it can be applied to all non-white/European individuals who have been historically placed at a disadvantage, simply due to their “[race, color, national origin, sex, and religion](#)”. Red pedagogy challenges and rejects racism and other forms of discrimination in schools and society and accepts and affirms the pluralism (ethnic, racial, linguistic, religious, and gender, among others) that students, their communities, and teachers represent.” For this to work in an MEE setting, the application and regular practice of utilizing multilingual resources would facilitate the development of a pluralistic educational system across both cultural *and* language boundaries. In my own way, I attempt to echo the decolonization efforts of red pedagogy through a linguistic approach, breaking down the barriers of a predominantly monolingual English-speaking society inhabited by mainly a hefty mix of non-native English and heritage language speakers who would otherwise not have a place to learn alternative forms of knowledge, all the while applying their own teachings by means of sharing experiences through practices like storytelling.

Similar to Sandy Grande, Paulo Freire's [Pedagogy of the Oppressed](#) illustrates the importance of critical pedagogy in the context of reconstructing environmental knowledge, but through the practice of *conscientização* or “conscientization”. Conscientisation, according to Freire, is the “critical awareness of the material, social, political, cultural and ideological conditions in which we find ourselves, conditions which almost always generate divisions that make it difficult to construct ideals of change and transformation”. In other words, it's the process of becoming aware of the different facets of life that ultimately stop people, namely

underrepresented people from moving forward and improving their current situations, like their quality of education and environmental conditions.

In my potential program, I would aim to raise public awareness of a community's physical surroundings to jumpstart the inner transformation needed to engage people in the environmental movement. This is not possible, though, without the inclusion and participation of a variety of community members. Community cohesion can only be achieved through effective communication across different demographics. But when these groups speak different languages, the process of communication makes it difficult to get the message across, therefore stalling community conscientization. The added effects of a dominant educational system that disregards environmental studies while promoting a 'banking' methods of education" where "students are regarded as empty receptacles waiting to be filled with the educator's knowledge" inevitably pushes away the possibility of intellectually liberating historically marginalized people, keeping them in the same "socio-ecological" place as they have been years before. Just as Paulo Freire's critical pedagogy aims to liberate people from oppressive educational environments, an MEE program provides the additional layer of language diversity and inclusion to facilitate the much needed flow of within and across multilingual people.

Methodology

Interviewing Heritage Language Bilinguals

To start the research, I decided to try and find out what people initially thought about the realm of environmentalism— topics like the climate crisis, pollution, and plant-based diets, for example. I also wondered, "*Does anybody think about the environment at all?*" I thought people might have certain [assumptions or negative opinions about environmentalism, or even potential stereotypes about environmentalists as well.](#) There is pretty limited research into the topic of environmental assumptions/stereotypes, so I made an effort to provide some insight into people's perceptions. The way one group is portrayed ultimately affects how others will perceive them, as is the case with environmentalists, some of whom may be seen as "tree huggers" and "hippies" who try to enforce their beliefs on others. But environmental science is more than that, so I conducted these interviews with the hope that my questions would help turn the mental gears or rather, begin basic environmental conscientization within my participants as I gathered their stories.

Since the proposed MEE is a combination of community language diversity and culture, the research's theoretical lens is partly based on the red pedagogy as mentioned earlier, specifically the aspect of multicultural education which would support the needs of potential participants within the context of their own worldview, yet allowing them to be exposed to other cultural perceptions from people outside their own demographic.

Language is intrinsically tied to social and cultural aspects of our lives, so the resulting research touched quite heavily on society, culture and language. Ultimately, what we believe in or learn through our respective communities will influence how we understand different concepts, like environmental issues, so in the future, I'll have to shape the program in a way that allows participants to fully express those aspects of their experiences with the local environment. By attaching a critical lens to the interviews, I was able to look at how the public gains knowledge on environmental issues and figure out how their respective ideologies may influence their relationship with and perspectives towards the environment.

An effective environmental education program relies on looking at the way people think based on their background and developing a structure that deconstructs previous biases, as well as restrictive learning methods as well as understanding people's relationship and experiences

with the physical world. The resulting interviews expressed the need to do just that— deconstruct the way we previously thought about the environment while opening up to various community perspectives in order to come up with innovative ideas for combating environmental issues, starting at the local level and eventually expanding to global efforts.

Initially, the goal was to interview native Spanish speakers in Northern San Diego County; however, my pool of participants ended up consisting of bilingual heritage speakers of different languages and cultural backgrounds, including Spanish speakers, thus resulting in the effort to answer the following:

What can community narratives tell us about the level of environmental knowledge and engagement in the bilingual heritage language speaking community in San Diego County and how can the process of constructing these narratives also form the building blocks for a multilingual environmental education program?

I structured the interview in a [semi-structured manner](#) to create more fluid dialogue, so that participants did not feel pressured to provide a “correct” answer. I also attempted to see if this structure helped bring out conversations about the linguistic and cultural influences that potentially drove their perceptions, or knowledge regarding environmental science and its related topics. I was able to gauge their potential interest in participating in a multilingual environmental education as well to some extent.

The [romantic conception of interviewing](#) proved to be the most reliable approach to talking with participants, in tandem with semi-structured qualitative interview questions. I started off each interview by expressing my reasons for developing a potential MEE by explaining the importance of community voices since they are the ones who would be the ones benefiting from such a program. Efforts to establish an amicable relationship with the participants allowed them to be more comfortable with sharing their experiences, from their environment growing up to the current environmental situations they are in today.

As for ethics, I did not conduct an IRB review since I was not going to collect any personal identifiable information. Privacy was the top priority when conducting these interviews. I notified the participants of this in advance to ensure their anonymity. My main goal was to collect individuals’ experiences to gather insight into what an MEE program would look like in the future. I didn’t see the need to go further than collect these experiences with their personal information.

In terms of the archival research process, I must note that my search for similar papers on multilingual environmental education came out to be somewhat limited. There were papers that focused on multilingual education and papers that examined environmental education, but did not manage to find any that combined the two. The search for a preexisting MEE program did not lead to fruitful results. Due to this, I think my research plays an important role in combining multilingual and environmental education. The participants were rather surprised when I explained the type of program I was aiming to develop as well, since they haven’t heard of an environmental program that combined a multilingual approach to both learning and collaboration. The more I spoke with the participants about creating an MEE program, the more I realized that it was still a new concept to many, which further emphasized the need for such a program to come into existence.

Results and Discussion

As mentioned earlier in the methodology section, I wasn't aiming to interview HS individuals at first— the goal was to meet more non-native English speakers (NNE). This was because I believed they would be the ones to benefit from an alternative form of environmental

education. After talking to the participants, however, I realized that heritage speakers could be the key piece of the project that I overlooked when it came to facilitating multilingual community collaboration. The official MEE interviews involved a total of four heritage speakers (HS) in San Diego County, each with a different heritage language: Romanian, Spanish, Cantonese, and Korean. I must note that I'll be referring to each participant by their heritage language since they are all native English speakers.

It's kind of funny, I didn't think of adding bilingual heritage speakers' voices to the mix until after I started engaging with them. They hold the skills and background to be "eco-linguistic boundary spanners"-- exactly the kind of residential member an environmental program would need to facilitate communication across different individuals in their community.

To be able to engage NNE's and monolinguals, we need to have someone in the middle that facilitates learning and collaboration between the two groups. What better candidates can we have for that role than bilingual speakers (or anyone who speaks more than one language)? This specific group has the experience of living among diverse community members who on their own might have difficulty interacting with each other due to their different language profiles. An MEE program may be just the place for bilinguals to increase their language and communication skills while helping their community build the collective environmental knowledge necessary to combat issues relating to climate, pollution, and the environment as a whole.

When asked about their relationship with their neighborhood, I noticed there was not much talk or mention of taking action when it came to environmental issues-- this was the case for a majority of participants. Awareness was there, yes, but it generally stopped there. My Romanian HS talked about increased construction, population growth, increased homelessness, and changing street conditions. The deeper environmental talk usually occurred when an individual was directly affected by crises such as the [flood that affected the Spanish HS in January](#).

It was increasingly noticeable that the light environmental talk was due to the fact that there is little exposure to environmental topics in school, work, and, or at home. As far as I can see, there are few opportunities to be involved in the environmental movement, so an MEE seems to be one solution to the lack of public participation. Luckily, I found my participants to be interested in joining such a program, regardless of their current level of environmental engagement.

I decided to take inspiration from the natural world and let my research go in its own direction, just to see what kind of results I might get. I figured that this natural flow in the research process would improve the quality of the stories I could gather. A group setting proved to be slightly challenging. One factor affecting the quality of responses during this trial run included participants' availability-- question type was another. I then decided to talk to people one-on-one to hear their stories, taking note of various aspects of their experiences from the emotional to the social.

In both situations, open-ended questions tended to require guiding dialogue and/or follow-up questions to encourage detailed responses while the close-ended questions were generally easier to answer for the participants. There is the possibility that the questions themselves, either due to the wording or the structure affected how participants answered. Well, I must say that this is still a learning process for myself as a still-evolving researcher, so I'll make sure to build upon both successes and failures during the interview process and the research as a whole.

I ran a few trial runs for the one-on-one interviews, parts of which I found just as valuable as the official interviews conducted and so, I'll incorporate the most thought-provoking response from this part of the research.

In one particular practice interview, an individual stated that he “needed to be told what to do” when it came to participating in the environmental sphere. It had me wondering why he would need to be told what to do. I proceeded to ask him and he explained that he didn't know where to start when it came to addressing climate issues or taking initiative on environmental issues as a whole. I can see where he was coming from since there are limited opportunities to be exposed to the environmental movement outside of what we usually see. In this case, the participant mentioned that he doesn't “really think about it that much”. It led me to see the limitations of our current educational systems when it comes to environmental learning opportunities. My test participant did not have much time to go further into detail, so that was the end of our interview session. Still, it left me thinking about how others might respond similarly. I then went on to select more participants from diverse backgrounds.

Results and Discussion

Bilingual individuals growing up in a diverse society within the U.S. navigate two different linguistic and cultural worlds, typically the world of NNE's at home and monolingual English speakers at work and/or school. It's an experience that allows them to be exposed to different identities, traditions, perceptions, etc. compared to individuals growing up speaking one language or in a more homogeneous cultural environment. Moving between these two different socio-linguistic environments isn't always easy, though.

My Spanish heritage speaker talked about how she would have mixed feelings growing up bilingual due to her fluency level in Spanish and rather Americanized cultural identity as a child who often traveled to see family in Mexico. In this kind of situation, the differences in the level of culture and language immersion affected how she perceived her bilingualism to be more of a disadvantage at the time.

As she got older, however, the participant recalled that she would receive a lot of positive comments at school, especially with children of both monolingual parents and heritage speaking parents who did not teach their child the language. She mentions that they were kind of jealous of her since she could speak English and Spanish. Working in a medical setting that greatly benefits from bilingual individuals further solidified her confidence in being able to speak two languages.

This interview with the Spanish HS required me to look at the potential difficulties a bilingual speaker could face when learning to be an eco-linguistic boundary spanner. Language immersion and fluency skills might be a challenge for a potential participant with similar experiences as the Spanish speaker. In an ideal program, the boundary spanner would have to be well-equipped with both language skills and some form of environmental knowledge to efficiently relay information from one party to another. But looking at it closely, there are few opportunities to improve such skills in both regular academic and community settings. I think this situation emphasizes the need for the revitalization of education that offers a multicultural and multilingual approach, which would meet the needs of people who come from more than one language background.

The Spanish HS then talked about how she had limited engagement with environmental projects/organizations as she came from a background in medicine and dedicated a large portion of her time to the field. I questioned how the MEE could support the boundary spanners themselves in order to better serve their community when they already have many commitments.

It can be difficult to deeply transform a community's level of environmental consciousness and participation when they are preoccupied with other aspects of their lives.

Listening to stories like the Spanish speaking participant's experiences of her bilingual world eventually encouraged me to interview a few more bilingual individuals and their level of environmental engagement, this time talking with a Cantonese speaker who recalled quite a few details regarding his past and present neighborhood environments.

When asked about growing up in his childhood home, this participant referred to the neighborhood as a suburb that was "slummy and the streets weren't incredibly well-maintained. The pavement was pretty cracked and dilated." He then talked about his quality of access to resources, saying "It wasn't like there was a struggle for essential resources like food or housing". In comparison to his childhood home, the Cantonese HS described his residence as considerably better. I asked about how he thought his local government was maintaining the conditions of his current neighborhood and whether they were addressing any relevant environmental issues efficiently. According to him, they were responding moderately well, at least for issues that potentially pose a risk to human life like their responses to flash fires in the summer due to extremely dry conditions.

His responses demonstrated a rather safe environment with relatively normal levels of exposure to hazardous conditions, such as potholes and general neighborhood safety. In this case, my Cantonese participant covered more of the social aspects, while lightly talking about language experiences and environmental engagement. In comparison, the Spanish HS noted difficulties navigating two different cultural and linguistic worlds, one American and the other Mexican. Even among people from the same county, experiences differed greatly and their topic of conversation varied. There was still little conversation between us about environmental education. Most of the responses I had so far expressed interest in joining a potential MEE program, but in the future when they had the freedom and opportunity to do so. As of now, both saw the MEE program as something they would not have the time to dedicate themselves to.

At this point in the interview process, I wondered if my interview was the issue that brought on limited environmental dialogue. I'd have to shift the focus to questions that followed Paulo Freire's conscientization process, encouraging a little more eco-conscious conversation this time.

In another effort to incorporate a higher level of environmental dialogue, I asked how the Cantonese HS could make a difference in his community with respect to environmental problems in the region. He replied that it would have to come from a coordinated community effort, and saw individual efforts as "rather limited" when addressing environmental issues. The interview ended there. I tried to discover a deeper connection between language, education, and environment in this interview session, but like the Spanish HS, there was light conversation around the topic. At this point, I saw that gathering environmental stories was proving to be more challenging than I realized. Getting individuals interested was a start to environmental dialogue, at the very least.

My Korean heritage speaker seemed to be conscious of her personal environmental footprint to a higher degree, both at the individual and the community level. She explained that her community is very conscious of how they take care of their environment. In addition, she makes it a habit to recycle whenever she is able to. When asked about her environment growing up, she told me this:

I grew up near Downtown LA and there was a lot of smog and streets smelled of great food. However, the streets were not as clear as San Diego's. We lived in a humble neighborhood

and the neighborhood was very diverse. I do not consider where we lived as the safest, but we learned to be very careful.

It seems that the Korean HS's experiences matched somewhat with the previous participants with regards to street cleanliness and neighborhood safety. I detected a fairly high level of environmental awareness with my Korean participant and wondered how her upbringing might have influenced such behavior. In her current residence, the Korean HS described "a sense of community effort in taking care of their surroundings." I asked her to specify what kind of neighborhood she resided in and it happened to be in one of the more affluent parts of San Diego County. Going back to my own community observations, I remembered how certain environmental services and organizations were located along coastal regions. The correlation between affluence and environmentalism can be seen in both contexts.

With regards to making a difference in her community, the participant practiced common waste management practices on her own, picking up street litter and recycling at every opportunity she gets. She added that she wishes every place had separate bins for proper waste disposal. Her personal efforts were largely based on traditional sustainability measures, relying on the traditional waste hierarchy that many municipal facilities follow when disposing of different waste streams. This part of the interview posed a rather important aspect in terms of the state of environmental goals today. Much of our current goals revolve around widely accepted waste practices, but not innovative solutions that offer more efficient alternatives. It is yet another element that can be added on to the MEE program which aims to challenge long-standing environmental practices, much of which don't address or attempt to prevent excessive waste production.

My interview with the Korean HS posed valuable insights into the way an individual currently practices sustainable behavior at the individual and community level. Yet, their practices don't go beyond the traditional narrative of reduce, reuse and recycle. As a result, I think the future MEE program would benefit from the implementation of alternative waste practices that go beyond the 3R's which may raise community environmental consciousness to a level that allows potential participants to address current waste issues outside of what they've been taught their entire lives. The interview ended here and so I prepared for my final participant.

I interviewed a Romanian heritage speaker for the last interview; she had some similar experiences as the previous interviewees in terms of her past and present neighborhood experiences. When asked about the difference between her childhood and current environments, the Romanian participant did not observe any noticeable changes. Everything was pretty much the same, save for the population increase and rise in homelessness. Overall, she described her neighborhood as a safe place to be. There was not much of a difference between her past neighborhood and present which indicates a rather stable quality of life. She also practiced basic pro-environmental behaviors, like the Korean participant. Like the other participants, environmental talk only reached the surface of the topic.

I then asked her if she would one day be interested in joining a future MEE program, to which she answered yes, "but not right now." Additionally, she stated "I don't see how I would benefit from the multilingual- or- the language part." I mentioned that it would give her the opportunity to collaborate with people she wouldn't normally interact with, given the potential language resources that would be developed for the sake of facilitating multilingual learning opportunities within such a program. After that clarification, she showed a higher level of interest in joining an MEE program in the future.

Our conversation ended abruptly but, like the previous interviews, I saw that there was potential interest in participating in the potential MEE program.

Opening up the opportunity to talk to bilingual participants has definitely enhanced the diversity of voices that I include in my work. I found that bilingual individuals play an essential role in the development of an eco-conscious community through the creation of accessible resources, as well as a space to facilitate collaboration across linguistic and culturally diverse groups. Even though the interviews only touched the surface of environmental conversation, I realized that each participant displayed some form of awareness about their environment, each with a unique experience that shape their perceptions on their life situations and level of environmental knowledge

Overall, the participants' observations about their respective local environment revolved around the social, economic, and linguistic aspects of their experiences while indirectly mentioning the physical environmental conditions of their neighborhoods. Based on the participants' responses, I was hoping I'd be able to develop an environmental education structure that not only provides multilingual opportunities for non-native English speakers but also deconstruct potential stereotypes and skewed narratives regarding environmentalism. The results of the interviews I conducted could only provide details at the surface of each individual's experiences with their environment, but they expressed social and linguistic experiences in deeper detail.

Conclusion

The ultimate mission for the multilingual environmental education project is to get people to truly care *about* and care *for* this physical world that we all depend on to live. While us regular folk are not the ones responsible for corporate carbon emissions and other forms of pollution, we are the key to creating environmental change. However, this cannot be made possible without generating a movement that spans across communities near and far in order to generate that much needed change and gain traction in a widespread movement that goes beyond recycling.

There is a genuine need for MEE, especially the need for it to be adaptive, evolving in form and function, according to the needs of the environment and the people that power the program. For the participants in this research, time was a main concern, despite showing interest in joining an MEE program. Based on these four participants alone, I observed the need to build collective environmental awareness within a given community. At the very least, if people start to notice the conditions of their environment, then they will be encouraged to do something more in the global effort to preserve, conserve, and restore our Earth.

Bibliography

- Alvesson, M. (2003). Beyond neopositivists, romantics, and localists: A reflexive approach to interviews in Organizational research. *The Academy of Management Review*, 28(1), 13–33. <https://doi.org/10.2307/30040687><https://www.jstor.org/stable/30040687>
- America Latina. (2021, November 5). Lo que los pueblos indígenas nos enseñan sobre el cuidado del planeta. <https://america-latina.hivos.org/blog/lo-que-los-pueblos-indigenas-nos-ensenan-sobre-el-cuidado-del-planeta/>
- Berkowitz, A. R., Ford, M. E., & Brewer, C. A. (2005). A framework for integrating ecological literacy, civics literacy, and environmental citizenship in environmental education. *Environmental education and advocacy: Changing perspectives of ecology and education*, 227, 66.
- Cabello, S. J. P. & A. M. (2022, February 25). What Japan can teach us about cleanliness. *BBC*. <https://www.bbc.com/travel/article/20191006-what-japan-can-teach-us-about-cleanliness>
- Chen, X., & Padilla, A. M. (2019). Role of Bilingualism and Biculturalism as Assets in Positive Psychology: Conceptual Dynamic GEAR Model. *Frontiers in psychology*, 10, 2122. <https://doi.org/10.3389/fpsyg.2019.02122>
- Chernyishkova, N. V., Sukhorukova, D. V., & Арошидзе, М. (2021). Intercultural communication: English dominance. *SHS Web of Conferences*, 125, 01001. <https://doi.org/10.1051/shsconf/202112501001>

Costa, G. D. S., Mallows, D., & Costa, P. L. S. (2020). Paulo Freire, The Decolonial curriculum and the experience of the Professional Masters in Youth and Adult Education in Bahia, Brazil. *Adult Learner: The Irish Journal of Adult and Community Education*.

<http://files.eric.ed.gov/fulltext/EJ1272415.pdf>

Droz, L., Brugnach, M., & Pascual, U. (2023). Multilingualism for pluralising knowledge and decision making about people and nature relationships. *People and Nature*, 5, 874–884.

<https://doi.org/10.1002/pan3.10468>

Duarte, M. E., Vigil-Hayes, M., Littletree, S., & Belarde-Lewis, M. (2019). “Of Course, Data Can Never Fully Represent Reality”: Assessing the Relationship between “Indigenous Data” and “Indigenous Knowledge,” “Traditional Ecological Knowledge,” and “Traditional Knowledge.” *Human Biology*, 91(3), 163–178.

<https://doi-org.sandiego.idm.oclc.org/10.13110/humanbiology.91.3.03>

Ferrell, C. (2023, November 9). Feeling “invisible”: How language barriers worsen environmental injustice. *EHN*. <https://www.ehn.org/language-justice-2666172479.html>

Geddes, A. (2021, January 3). *1.4 How Western science views the environment*. Pressbooks.

<https://openoregon.pressbooks.pub/terrestrialenvironment/chapter/1-3-environment-sustainability/>

GES DISC Data in Action: Heavy atmospheric river rains cause flooding in San Diego on January 22, 2024. (n.d.).

<https://disc.gsfc.nasa.gov/information/data-in-action?title=Heavy%20atmospheric%20river%20rains%20cause%20flooding%20in%20San%20Diego%20on%20January%202022,%202024>

Grande, S. (2004). *Red Pedagogy: Native American social and Political thought*.

<http://ci.nii.ac.jp/ncid/BA71233476>

Indian Affairs (IA). (n.d.). *Traditional Ecological Knowledge | Indian Affairs*.

<https://www.bia.gov/service/fuels-management/traditional-knowledge>

Indigenous Fire Practices Shape our Land - Fire (U.S. National Park Service). (n.d.).

<https://www.nps.gov/subjects/fire/indigenous-fire-practices-shape-our-land.htm>

Jarwar, M. A., Dumontet, S., & Pasquale, V. (2024). The Natural World in Western Thought.

Challenges (20781547), 15(1), 17.

<https://doi-org.sandiego.idm.oclc.org/10.3390/challe15010017>

Keh, A. (2022, December 18). At the World Cup, Japan Takes Out the Trash, and Others Get the

Hint. *The New York Times*.

<https://www.nytimes.com/2022/11/27/sports/soccer/japan-fans-clean-up-world-cup.html>

Klas, A., Zinkiewicz, L., Zhou, J., & Clarke, E. J. R. (2019). "Not All Environmentalists Are

Like That ... ": Unpacking the Negative and Positive Beliefs and Perceptions of

Environmentalists. *Environmental Communication*, 13(7), 879–893.

<https://doi-org.sandiego.idm.oclc.org/10.1080/17524032.2018.1488755>

Kleespies, M. W., & Dierkes, P. W. (2020). Impact of biological education and gender on

students' connection to nature and relational values. *PloS one*, 15(11), e0242004.

<https://doi.org/10.1371/journal.pone.0242004>

Mashuri, S., Sarib, M., Alhabsyi, F., & Ruslin, R. (2022). Semi-structured Interview: a

methodological reflection on the development of a qualitative research. . . *ResearchGate*.

https://www.researchgate.net/publication/358893176_Semi-structured_Interview_A_Met

[Methodological Reflection on the Development of a Qualitative Research Instrument in Educational Studies](#)

Mazzocchi F. (2006). Western science and traditional knowledge. Despite their variations, different forms of knowledge can learn from each other. *EMBO reports*, 7(5), 463–466.

<https://doi.org/10.1038/sj.embor.7400693>

Morales, A. G. (2021, June 21). *Non-English speakers must have a say in their communities*.

Conservation Law Foundation.

<https://www.clf.org/blog/fighting-language-discrimination-east-boston/>

Official language of the United States. *USAGov*. (n.d.).

<https://www.usa.gov/official-language-of-us>

Suri, S. (2023, June 28). *It's time for climate Justice- a Global South perspective on the fight against the climate crisis*. orfonline.org.

<https://www.orfonline.org/research/a-global-south-perspective-on-the-fight-against-the-climate-crisis>

Svendsen E. (2011). Cultivating health and well-being through environmental stewardship.

American journal of public health, 101(11), 2008.

<https://doi.org/10.2105/AJPH.2011.300370>

Thayer-Bacon, B. J. (2017). SKY: INDRA'S NET. *Counterpoints*, 505, 89–104.

<http://www.jstor.org/stable/45177697>

Zhang, Y., Xiao, X., Cao, R., Zheng, C., Guo, Y., Gong, W., & Wei, Z. (2020). How important is community participation to eco-environmental conservation in protected areas? From the perspective of predicting locals' pro-environmental behaviours. *Science of the Total Environment*, 739, 139889.

<https://doi.org/10.1016/j.scitotenv.2020.139889>

**Addressing Food Waste and
Environmental Sustainability:
Insights from Community-Based
Research in the Convoy District**

Vivian Andrade

Abstract:

This research explores the multifaceted issue of food waste and its implications for environmental sustainability within the Convoy District, a vibrant cultural and economic enclave in San Diego, California. Drawing on principles of Community-Based Participatory Research (CBPR), the study engages directly with community members to understand their perceptions, behaviors, and challenges related to food waste management and environmental awareness. Through face-to-face interviews and immersive participant observation, key themes emerge regarding community attitudes and practices. Firstly, there exists a limited understanding among community members regarding the environmental and health impacts of food waste, highlighting the need for education and awareness initiatives. Despite this, participants demonstrate behaviors aligned with waste reduction and sustainability, such as reusing single-use plastics and creatively repurposing leftover ingredients. However, practical barriers such as cost, availability, and limited inventory hinder community participation in food waste services, indicating the importance of addressing logistical challenges to foster greater engagement. Furthermore, the concept of the circular economy resonates with community values, presenting an opportunity to leverage existing behaviors to promote more sustainable practices. Overall, this research underscores the importance of community engagement and collaboration in addressing food waste and advancing environmental sustainability. By identifying knowledge gaps, overcoming logistical barriers, and leveraging existing behaviors, it is possible to foster a culture of waste reduction and circularity that benefits both the community and the environment in the Convoy District and beyond. This research contributes valuable insights into the complex issue of food waste within the Convoy District community, highlighting opportunities for education, infrastructure improvements, and collaborative action to promote environmental sustainability. By involving local stakeholders in the research process we can highlight the importance of community engagement and collaboration in addressing food waste and advancing environmental sustainability.

Introduction

When I was completing my undergrad, I worked as a food service worker in the dining halls and witnessed the absurd amount of food wasted daily. Trays of food would often end up in the trash, rather than being donated or offered to workers. While there were rare occasions when our manager allowed us to take food home, it was not the norm. One particular incident stands out vividly in my memory. While working at the deli station, a student accidentally used the tongs meant for regular lunch meat to pick up a kosher item, rendering the kosher items non-kosher and needing replacement. Instead of placing the contaminated meat into the regular section, the student manager in charge disposed of it in the compost bin. This was the first time I had seen such a large amount of food wasted. Every four hours, we rotated dishes, and any old trays were deemed unsafe for human consumption and disposed of. I often wondered where the discarded food ended up, but I never imagined the severity of the situation. A significant quantity of food is discarded daily in restaurants across the country. Leftover items such as unconsumed portions on plates, uneaten stacks of pancakes, or meals returned by dissatisfied customers contribute to this waste. Unfortunately, much of this discarded food ends up in landfills. The EPA's Wasted Food Scale emphasizes the importance of preventing and diverting wasted food from entering landfills. Preventing food waste in the first place is the most environmentally friendly option. Donation is the preferred option, ensuring that wholesome food is given away or distributed to feed people, thereby saving both the food and the resources used to

produce it. Composting wasted food generates rich soil and enhances soil health, while landfilling is one of the least preferred options due to the loss of valuable nutrients.

Environmental pollution has led to an increase in environmental inequality within marginalized and underserved communities, resulting in physical and mental health impacts and a decreased quality of life. While air and water pollution are commonly recognized forms of environmental degradation, the role of landfill pollution is often overlooked. Landfill pollution contributes to both air and water pollution. Landfills emit harmful greenhouse gasses such as carbon and methane, contributing to air pollution. Additionally, organic waste seeps into the soil in landfills, and during periods of heavy rain, runoff from landfills can carry contaminants into nearby waterways, further polluting them. This pollution poses significant risks to nearby communities and habitats. Exposure to these pollutants can lead to various health issues, including diseases, displacement, and even violence within affected communities. Therefore, addressing landfill pollution is crucial for mitigating environmental inequality and improving the well-being of marginalized populations.

The Convoy District:

The Convoy District, renowned as one of the largest Pan-Asian business hubs in the United States, pulsates with cultural diversity and economic vibrancy. Nestled within Kearny Mesa, this dynamic enclave

thrives with bustling businesses, tantalizing eateries, and vibrant cultural offerings. However, amid its bustling activity lies a pertinent environmental concern – its close proximity to the Miramar Landfill. The Miramar Landfill, sprawling across 1,500 acres, stands as the primary waste disposal site for the City of San Diego, accommodating the disposal needs of its 1.4 million inhabitants. While engineered with meticulous care and equipped with impermeable liners to mitigate groundwater contamination, the landfill faces the ongoing challenge of containing methane emissions, a significant contributor to climate change. Despite adhering to stringent regulatory and environmental standards, the landfill's operational complexities have resulted in occasional fines and environmental concerns over the years. In light of these environmental dynamics, I embarked on an ethnographic research journey to delve deep into the thoughts and experiences of the Convoy District community. Through face-to-face interviews and immersive participant observation, I sought to unravel the community's perceptions, concerns, and lived experiences regarding their proximity to the landfill and their interactions with waste management practices.

By engaging directly with community members, I aimed to gain insights into their attitudes towards waste disposal, recycling efforts, and environmental sustainability initiatives. Additionally, I endeavored to identify gaps in information accessibility and explore avenues for empowering the community with knowledge and resources to address their environmental concerns effectively. Through this ethnographic

exploration, I aspire to foster a deeper understanding of the Convoy District's environmental landscape and catalyze meaningful dialogue and collaborative action towards fostering a more sustainable and resilient community. By amplifying community voices and co-creating tailored solutions, we can pave the way for a greener, healthier, and more environmentally conscious Convoy District.

Community District:

The Convoy District, officially recognized as the Convoy Pan Asian Cultural & Business Innovation District, is a bustling enclave nestled within Kearny Mesa, San Diego. What sets this district apart is its rich tapestry of Asian culture and commerce, with an eclectic mix of businesses representing diverse Asian ethnicities such as Chinese, Korean, Japanese, Vietnamese, and Thai. The district's story traces back to its humble beginnings in 1979 when the Woo Chee Chong grocery store and Zion Korean market established their presence on Convoy Street. These ventures laid the foundation for the district's identity, drawing in more Asian-owned shops and eateries over the years. In 1986, Nijiya Market, a renowned Japanese market, further solidified the district's reputation as a hub for Asian cuisine and merchandise. With subsequent expansions to multiple locations across California and Hawaii, Nijiya Market played a pivotal role in shaping the Convoy District's landscape. As the district's allure continued to grow, it attracted the attention of larger Asian chain stores like 99 Ranch

Market, Mitsuwa, and H Mart, further enhancing its vibrancy and appeal.

The culmination of these efforts came to fruition on October 20, 2020, when the Convoy District was officially designated as the Convoy Pan Asian Cultural & Business Innovation District. This milestone was achieved through the collaborative efforts of local businesses, tenants, storeowners, and nonprofit organizations. Advocacy initiatives led by community members garnered support from key stakeholders, including San Diego City Council Member Chris Cate and Assembly member Todd Gloria, culminating in the successful implementation of the name change. Today, the Convoy Pan Asian Cultural & Business Innovation District continues to thrive, buoyed by the support of various community-based organizations and fundraisers. The Convoy District Partnership, a prominent advocacy group, spearheaded fundraising campaigns to promote the district's visibility. Through their efforts, over \$30,000 was raised to fund the installation of six highway signs strategically placed to showcase the district's offerings and attract visitors.

The Convoy District stands as a testament to the vibrancy and resilience of Asian culture and entrepreneurship in San Diego. Its evolution from a modest neighborhood enclave to a bustling cultural and economic hub reflects the spirit of innovation and collaboration that defines the community. As it continues to flourish, the Convoy Pan Asian Cultural & Business Innovation District serves as a beacon of diversity, creativity, and inclusivity, welcoming all who seek to experience the

rich tapestry of Asian heritage and hospitality.

Environmental Pollution:

As this community lives in close proximity to the largest landfill in San Diego County, we must consider what the risks are. Environmental pollution poses significant threats to public health, with diseases such as typhoid, cholera, cancer, and asthma being directly linked to various pollutants. According to The World Bank Organization, low-income countries bear the heaviest burden of pollution-related health issues, with approximately 90% of related deaths occurring in these regions. Air and water pollution are particularly prevalent in such areas, while rapidly developing economies face their own challenges, including chemical and pesticide toxicity. Human activities, including technological interventions, contribute extensively to environmental pollution, spanning energy-related pollutants like light, heat, and sound, as well as various chemical contaminants. Urbanization and industrialization exacerbate these issues by introducing harmful substances into the environment, thereby compromising the air quality essential for sustaining life on Earth. Pollutants manifest in various forms, such as particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide in the air, while water pollution gives rise to waterborne diseases like typhoid and amoebiasis. Toxic elements like mercury, lead, and cadmium further exacerbate health risks by accumulating in ecosystems and adversely impacting living organisms. Of particular concern are potentially toxic elements (PTEs), notorious for their

persistence and toxicity, which accumulate in soil and water sources.

In a study conducted to review the connection between toxic elements in the environment and human health it was reported that exposure pathways to PTEs include absorption through the skin, ingestion via food and water, and inhalation of contaminated air, leading to long-term health complications, especially among children, such as disabilities and premature deaths. To combat environmental pollution, countries implement waste disposal methods such as open dumping and landfilling.

(Niede & Benbi, 2022) Landfills, categorized as municipal, industrial, or hazardous, aim to isolate waste from the surrounding environment using clay or synthetic liners. However, despite efforts to manage waste, landfills pose significant risks to air, water, and soil quality, with gases produced within them negatively impacting neighboring communities and contributing to various health issues, including respiratory illnesses, asthma, and cancer. Given the widespread practice of landfilling and its associated risks, understanding the environmental and health impacts associated with landfills is imperative for addressing pollution-related challenges and safeguarding public health.

Waste Management: Community Taking an ethnographic approach in this research necessitates considering community-level food waste management. The following proposals won't eradicate food waste entirely, but they hold promise in reducing landfill input. Much of the food waste in our communities stems from grocery stores discarding expired products or making room for new ones. Typically,

this waste ends up in landfills, left to decompose. Redirecting edible produce slated for disposal to local pantries or shelters could significantly curb waste while aiding community members. This initiative, already underway in several Californian cities, is championed by the California Grocers Association, facilitating connections and donations. In Santa Clara and San Mateo counties, the Second Harvest Food Bank's Grocery Rescue program salvages healthy food for distribution to those in need. By participating, grocery stores not only cut disposal costs but also gain tax incentives, exemplifying a people-first approach over waste disposal.

In addition to such initiatives, online platforms like Imperfect Foods have emerged to combat food waste. Imperfect Foods collaborates with farmers to rescue visually imperfect yet edible produce, offering them at reduced prices. While this redistributes rather than eliminates waste and isn't accessible everywhere, it's a commendable step toward both addressing hunger and reducing waste. For non-edible food waste, eco-feeding presents a viable solution, particularly for heavy livestock areas. Originating in Japan to mitigate expensive imported feed costs, eco-feeding transforms food waste into livestock feed, notably for pigs. This method, increasingly adopted, utilizes food from the processing industry and supermarkets, significantly diverting waste from landfills. By sourcing waste from grocery stores and channeling it to local farms, this practice benefits both parties, eliminating disposal costs for stores and reducing feed expenses for farmers. (Nakaishi & Takayabu, 2022)

When food waste isn't fit for human or animal consumption, composting emerges as an environmentally sound option. Compost enriches soil, enhancing fertility and productivity while reducing

environmental pollution and production costs. However, its adoption faces hurdles such as resource constraints and lack of knowledge, particularly among local farms. Vermicomposting, employing red worms to process organic matter, offers a scalable solution, ideal for various settings like schools or small offices. CalRecycle provides valuable resources like the California EEI Curriculum and "[The Worm Guide](#)," aiding educators and students in understanding and implementing sustainable practices. Further insights into global food waste dynamics underscore the need for systemic changes across various sectors. The hospitality industry, among others, contributes significantly to food waste, necessitating proactive measures to address this challenge.

Environmental Racism:

Studies on environmental racism shed light on how marginalized communities bear disproportionate burdens, such as landfill pollution. Historical cases, like [Warren County's](#) struggle against PCB-contaminated soil, underscore the intersectionality of environmental and racial injustices. Understanding and addressing white privilege are crucial in dismantling structural inequalities perpetuating environmental disparities. (Abdelfatah et al.,) Addressing food waste requires multifaceted approaches, encompassing community initiatives, technological innovations, and environmental justice advocacy. By fostering collaborations, raising awareness, and challenging systemic inequalities, we can progress towards a more sustainable and equitable food system. Expanding on the proposed solutions for food waste management and environmental justice, it's crucial to delve deeper into the systemic issues at play and explore additional strategies for addressing them.

Regarding Laura Pulido's article,

"Rethinking Environmental Racism," her analysis underscores the pervasive influence of racism in shaping environmental inequalities. She argues that environmental injustices are not merely accidental occurrences but are deeply embedded in historical and systemic structures of oppression. Pulido highlights how communities of color and marginalized groups bear disproportionate burdens of environmental hazards and pollution, while affluent white communities often benefit from environmental privileges and protections. Pulido's discussion of white privilege elucidates how systemic advantages and benefits accrue to white individuals by virtue of their race, perpetuating environmental disparities. This privilege extends beyond overt acts of discrimination to encompass broader societal structures and policies that prioritize the interests of white populations at the expense of marginalized communities. By critically examining the intersection of race, power, and environmentalism, Pulido's work prompts us to challenge existing systems of privilege and advocate for more equitable and inclusive environmental policies and practices. Recognizing the role of white privilege in perpetuating environmental injustices is essential for fostering meaningful change and advancing environmental justice for all communities, regardless of race or socioeconomic status. Environmental racism is a crucial lens through which to conduct this research, ensuring that the identities and histories of communities are fully acknowledged and respected.

Incorporating an understanding of environmental racism, we can highlight the resilience and strength of these communities, reframing them not as victims but as active agents in their own

narratives. This perspective allows us to

recognize the disproportionate environmental burdens faced by marginalized communities, often due to systemic inequalities and injustices. By acknowledging these realities, we can better understand the complexities of environmental issues and their impacts on communities' well-being and quality of life.

Circular Economy:

The concept of the circular economy holds immense promise for communities, offering a sustainable approach to economic activity while minimizing environmental impact. Recent research delves into how this shift affects households, particularly in the context of food waste practices. A recently conducted study engages directly with community members to understand their everyday experiences and challenges related to food waste management. Through face-to-face interviews and participant observation, researchers uncover the ethical dimensions of food consumption and waste reduction efforts within local households.

The results showcase the community attitudes and behaviors. While there's a growing awareness of the importance of reducing food waste, ingrained habits and practical barriers often hinder progress. Transitioning to a circular economy requires more than just awareness; it demands active participation and ongoing transformation from individuals within the community. Community members grapple with competing moral principles and practical concerns, such as food safety and the unpredictability of daily life. Yet, amidst these challenges, there's a shared desire to do better and make a positive impact. (Lehtokunnas et al., 2020)

Local initiatives, such as

community-led workshops and grassroots campaigns, play a vital role in driving change from the ground up.

These efforts not only raise awareness but also provide

tangible solutions and support for individuals looking to embrace circular economy principles in their daily lives. By fostering a sense of community ownership and empowerment, these initiatives pave the way for a more sustainable future. The transition to a circular economy is not just about implementing new technologies or systems; it's about fostering a collective mindset and sense of responsibility within communities to create a more sustainable and resilient future for all.

Methodology

Research Design:

When deciding on my research design I wanted to follow the principles and methods of Community-Based Participatory Research (CBPR), emphasizing its collaborative and equitable approach to research. It highlights that CBPR involves various study designs, data collection and analysis methods, partnership structures, and process methods tailored to each community's unique needs and contexts. The text aims to showcase that there is no one-size-fits-all approach to CBPR and that flexibility and responsiveness to local dynamics are essential.

The nine principles of CBPR are outlined as follows:

1. CBPR acknowledges the community as a unit of identity.
2. CBPR builds on strengths and resources within the community.

3. CBPR facilitates a collaborative, equitable partnership in all research phases, emphasizing empowering and power-sharing processes to address social inequalities.
4. CBPR fosters co-learning and capacity building among all partners.
5. CBPR integrates and balances knowledge generation and intervention for the mutual benefit of all partners.
6. CBPR focuses on the local relevance of public health problems and ecological perspectives, considering multiple determinants of health.
7. CBPR involves systems development using a cyclical and iterative process.
8. CBPR disseminates results to all partners and involves them in wider dissemination efforts.
9. CBPR requires a long-term commitment to sustainability.

These principles underscore the importance of community involvement, empowerment, and sustainability in CBPR endeavors, guiding researchers in conducting ethical, culturally sensitive, and impactful research that addresses community needs and promotes social justice. With these principles in mind, I am determined to achieve my objective of comprehensively understanding the current knowledge and practices within the community. By fostering collaboration and inclusivity, I aim to collectively devise solutions and alternatives that effectively reduce food waste in landfills while enhancing the overall quality of life for community

members.

Selection of Participants:

When embarking on the process of identifying suitable candidates for interviews and surveys, I placed a strong emphasis on capturing a wide spectrum of perspectives present within the community. Recognizing the importance of diversity, I carefully considered various demographic factors, including age, gender, socioeconomic status, and occupation, to ensure a well-rounded and representative sample. To facilitate this, I reached out to friends and acquaintances who were familiar with the Convoy District and its inhabitants. Their insights assisted me in identifying potential interviewees who could offer diverse viewpoints. Through these networks, I was able to meet members with diverse experiences and backgrounds, spanning different age groups, professions, and cultural affiliations.

Moreover, I made an effort to engage with individuals who were directly embedded within the Convoy District community, either as residents or employees. This geographical focus was crucial in ensuring that the insights gathered were contextually relevant and reflective of the unique dynamics and challenges present within the local area. By casting a wide net and involving community members in the selection process, I aimed to foster inclusivity and authenticity in my research endeavors. This approach helped maintain investment among participants, empowering them to contribute meaningfully to the research process.

When it came to survey participation, I adopted a relaxed and inclusive approach, welcoming anyone who lived or worked in the community to take part. I reached out to community members, informing them about the survey and

inviting their voluntary participation. Additionally, I encouraged those who participated to spread the word among their acquaintances within the community, thereby expanding the reach of the survey. Throughout the process, I emphasized the importance of gathering diverse perspectives to gain a comprehensive understanding of the community's thoughts and experiences. By keeping the participation criteria open and inclusive, I aimed to ensure that a broad range of voices was represented in the survey responses. Ultimately, these approaches resulted in interviews with 5 community members, allowing for more in-depth conversations, while also garnering responses from 32 individuals through the survey, providing valuable insights into the collective views of the community.

Informed Consent:

Before commencing the interviews, I made sure to provide a clear and detailed explanation of the research objectives, the nature of participation, and the intended use of the data. It was essential for me to ensure that each participant fully understood the purpose of the research and what their involvement entailed. In order to uphold ethical standards, I obtained informed consent from every participant involved in the study. This involved explaining their

rights as participants, including their option to withdraw from the study at any point without facing any consequences. For the interviews, I obtained verbal consent from each participant, ensuring that they were fully aware of their participation and consented willingly. Similarly, for the

survey participants, I obtained consent through a written document, providing them with the opportunity to review the terms of participation and indicate their agreement before proceeding with the survey. By prioritizing informed consent and ensuring that participants were fully aware of their rights and the research process, I aimed to uphold ethical standards and respect the autonomy of each individual involved in the study.

Development of Interview Protocol:

To develop a comprehensive interview guide, I crafted open-ended questions aimed at eliciting detailed responses from participants. I paid close attention to ensuring that the questions were clear, directly related to the research objectives, and respectful of any potential cultural differences within the community. To achieve this, I conducted a thorough review of previous research conducted within similar communities to inform the development of my interview questions. During the interviews, all participants were asked a set of basic questions, providing them with the opportunity to offer more detailed responses through follow-up inquiries if they desired. This approach allowed for flexibility in the conversation while ensuring that key topics were addressed consistently across all interviews. Conversely, survey participants

were presented with the same set of questions, allowing for uniform data collection. However, they were given the freedom to provide written responses, enabling them to express their thoughts and experiences in their own words. Overall, the

questions posed to both interviewees and survey participants were structured to gather relevant information aligned with the research objectives, fostering consistency and comparability in the data collected across the study.

Pilot Testing:

I conducted a pilot test of the interview protocol with a small group of participants to identify any potential issues with the questions or interview process. The pilot testing was conducted in an informal manner, with participants drawn from individuals I knew, worked with, or encountered in the community. This approach allowed me to gather diverse perspectives and insights to refine the interview guide. Feedback from the pilot test was invaluable in identifying areas for improvement in the interview protocol. Participants provided input on the clarity of the questions, relevance of the topics covered, and overall structure of the interview process. Based on their feedback, I made adjustments to the interview guide to ensure that it was clear, comprehensive, and effectively elicited the desired information from participants.

Additionally, I reviewed case studies of

different research questions that were popular within the field. This helped me gain a deeper understanding of the types of questions that were commonly asked in similar research contexts and provided insights into best practices for conducting interviews. Drawing on these case studies, I further refined the interview guide to ensure that it addressed relevant topics and aligned with established research methodologies. By conducting pilot testing and reviewing case studies, I was able to refine the interview protocol to enhance its effectiveness in gathering comprehensive data from participants. This iterative process allowed me to fine-tune the interview guide to better meet the research objectives and ensure that it was well-suited to the needs of the community.

Data Collection:

I scheduled and conducted interviews with community members, utilizing various methods such as in-person meetings, phone calls, or video conferences, depending on their availability and preferences. Before beginning each interview, I obtained consent from participants to record the session, ensuring that their responses were accurately captured and documented.

Active Listening and Probing:

During the interviews, I made a conscious effort to engage in active listening, allowing me to fully grasp the viewpoints and insights shared by the participants. Active listening involves not just hearing what is being said, but also understanding the underlying meaning, emotions, and context conveyed

by the speaker. This approach enabled me to establish a deeper connection with the participants and gain valuable insights into their experiences and perspectives.

Additionally, I employed probing techniques throughout the interviews to encourage participants to elaborate on their responses and provide further clarification on specific points. Probing involves asking follow-up questions that delve deeper into the topic under discussion, helping to uncover underlying motivations, beliefs, and attitudes. By using probing questions strategically, I aimed to ensure that no valuable information was overlooked and that I obtained a comprehensive understanding of the participants' perspectives. Furthermore, I remained flexible during the interviews, adapting my questioning approach based on the flow of conversation and the unique insights shared by each participant. This flexibility allowed me to explore emerging themes and delve into topics of particular relevance or interest to the participants, thereby enriching the data collection process.

Transcription and Analysis: When conducting in-person interviews, I utilized speech-to-text software to transcribe the recorded interviews verbatim. Following this automated transcription process, I carefully reviewed the transcripts, manually correcting any errors to ensure accuracy and completeness. In the case of survey data, I organized the responses by reviewing the automated results generated by the survey

platform. This involved systematically analyzing the data to identify common patterns, recurring themes, and insightful observations present within the responses. Through this meticulous process of data organization and analysis, I was able to gain valuable insights from both the interview responses and survey data. By identifying patterns and themes, I was better equipped to interpret the findings and draw meaningful conclusions relevant to the research objectives. This was one of the more challenging aspects as there were some answers that were vastly different from each other.

Ethical Considerations:

Throughout my project, I had the opportunity to engage with members of my community, both old acquaintances and new faces, in meaningful conversations. Initially, my focus was on identifying resources to address food waste in our community. However, as I delved deeper into these discussions, I came to a realization: my efforts might inadvertently create more challenges than solutions. This experience was enlightening as I interacted with individuals from different age groups, each offering a unique perspective on climate change, food waste, and the impact of landfills on our community's health and environment. I take pride in these conversations and the insights gained from them. Despite having prior experience and training in community-based projects, I still grappled with uncertainties, particularly regarding ethical considerations. One such dilemma arose when deciding whether to keep the identities of interviewees anonymous. While it would have been an

honor to share their stories, I recognized that it would be inappropriate to do so without their consent. The trust bestowed upon me by each community member was invaluable, and I was hesitant to betray that trust. Yet, I also wrestled with the concern that

anonymity might diminish the significance of their experiences and fail to showcase the importance of community involvement.

In the end, I chose to prioritize the confidentiality of interviewees while striving to maintain the essence of their contributions. Despite this decision, my goal remained to shed light on the resilience of our community while addressing environmental and health challenges we face. I hope that by navigating these ethical considerations thoughtfully, I have upheld the integrity of my work and honored the trust placed in me by my fellow community members.

Results and Discussion

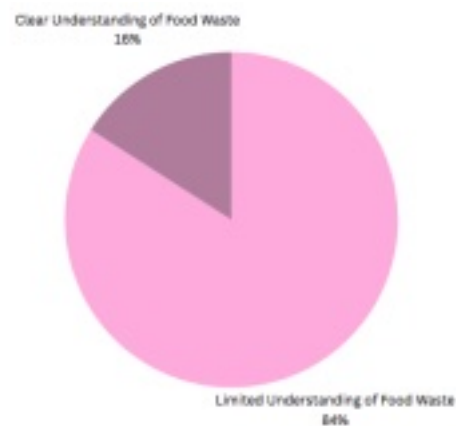
Upon reviewing the interview/survey data, several key themes emerged regarding community perceptions and behaviors related to food waste and environmental awareness.

Limited Understanding of Food Waste Impact:

Many community members expressed a lack of awareness regarding the environmental and health implications of food waste. They did not fully grasp

the connection between discarding food and its broader impact on climate change and landfill usage. This indicates a potential knowledge gap that could be addressed through education and awareness initiatives.

Over 84% of survey participants were unaware of the environmental and health implications of discarding food and its broader impact on climate change and landfill usage.

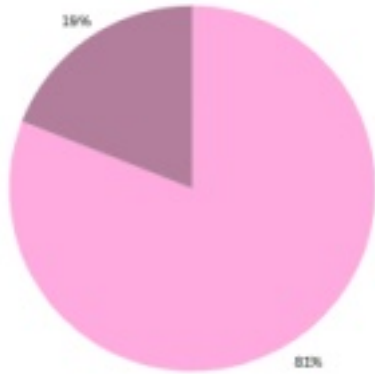


Practices to Combat Climate Change:

Despite the limited awareness of food waste's environmental impact, community members exhibited behaviors that indirectly contribute to waste reduction and environmental sustainability. For example, reusing single-use plastics and creatively repurposing leftover ingredients were common practices mentioned by participants. While these actions may not be explicitly aimed at reducing food waste, they align with broader efforts to minimize resource consumption and promote sustainability.

62% of participants had indirect

contributions to waste reduction and environmental sustainability. Examples include: Reusing single-use plastics and creatively repurposing leftover ingredients



Challenges in Accessing Food Waste Services:

Many participants cited practical barriers, such as cost, availability, and limited inventory, as reasons for not participating in food waste services. This highlights the importance of addressing logistical issues to facilitate greater community engagement in waste reduction initiatives. Improving the accessibility and affordability of such services could encourage more widespread participation among community members.

I found that 81% of participants had never heard of food waste services while the other 19% stated they were aware of their existence but found that there were barriers hindering participation like cost, availability, and limited inventory

Potential for Circular Economy Principles:

The concept of the circular economy, which emphasizes resource efficiency and waste reduction through circular design and

production processes, resonates with community members' values. While they may not be familiar with the term itself, participants demonstrated behaviors that align with circular economy principles, such as repurposing materials and minimizing waste generation. Leveraging this existing mindset could serve as a foundation for promoting more sustainable practices within the community.

Overall, the interviews shed light on both the challenges and opportunities associated with addressing food waste and promoting environmental sustainability within the community. By addressing knowledge gaps, overcoming logistical barriers, and leveraging existing behaviors, it may be possible to foster a culture of waste reduction and circularity that benefits both the community and the environment.

Interviews:

The interviews conducted in this research are important because they provide insights into how individuals perceive and interact with issues related to food waste, landfills, and health. Each interview is significant.

Food Waste Community Interview:

This interview sheds light on the prevalence of food waste in various sectors, including households, restaurants, and agriculture. It highlights the need for better practices in managing surplus food.

It reveals that while some individuals may not prioritize food waste practices when choosing restaurants, there's interest in supporting businesses that demonstrate responsible food management.

Highlight:

What do you think about food waste?

“It's bad but very common. Ah I think there's different levels to food waste and at its core I think it's foods that are produced and not consumed. I think for most individuals its [food waste} evident in our personal lives, on a day to day basis at home and at restaurants, also working in food service you see it often, but the biggest source is agriculture.”

You mentioned restaurants, how do you think they are doing in managing their waste?

“ Well at the restaurants that I used to work for they would just throw out food at the end of the night and they didn't let us take it home or donate it to people living in the streets. Unless the manager wasn't looking, it would end up in the dump”

Understanding attitudes towards food waste can inform initiatives to incentivize businesses and individuals to reduce waste, such as through donations or composting.

Landfill Community Interview:

This topic underscores the potential environmental and health implications of landfill proximity to communities. It indicates a general awareness of the negative impact of landfills, although the interviewee might not have considered its specific consequences deeply.

What do you think about the landfill?

“what do I think about it? It doesn't seem like a fun place. its probably bad for the environment but I guess I don't think about it too often.”

How do you feel about landfill proximity to communities?

“it's probably not great if its close to where people live. The land is probably cheaper . some communities are more exposed than others.”

How far do you think a landfill should be from a community?

“umm I don't think i can give a proper answer on that, I think there needs to be studies of the health effects at different radiuses. I think that in my own experience, I think I wouldn't want to know/ notice the landfill”

The interview highlights the need for research on the health effects of landfill

proximity and suggests that communities prefer not to have landfills nearby.

It emphasizes the importance of addressing issues related to waste management and pollution to safeguard public health and the environment.

Health Community Interview:

This interview explores the broader concept of health and its relationship to lifestyle factors, including diet and environmental factors like food waste and landfills.

It suggests that while individuals may not directly perceive the impact of food waste on their health, raising awareness about its environmental consequences could foster community engagement and action.

What do you think is the largest contributor to health?

“Lifestyle factors are huge when it comes to health. Eating a balanced diet and staying active are essential to keeping your body in good shape and preventing health issues down the road. And managing stress is important. I think for me it's easy to get overwhelmed, so finding healthy ways to cope is important.”

How do you think issues like food waste contribute to overall health and well-being?

“I'm not sure how it impacts me directly. I guess when food is wasted, it's not being consumed, which means potential nutrients are lost. Though I think within communities it's important to consider. Maybe raising awareness about the environmental impact of food waste and educating people about how they can reduce waste in their own homes would allow more people to talk about it”

The interviewee acknowledges the harmful effects of landfills on air and water quality, indicating a concern for environmental health.

Proposed solutions include advocating for better regulations and promoting individual actions such as recycling and composting to mitigate environmental damage.

Overall, these interviews provide valuable perspectives on interconnected issues surrounding food waste, landfill management, and their implications for public health and environmental sustainability. They highlight the need for awareness, education, and collaborative efforts to address these challenges effectively.

While diverting surplus food away from landfills represents progress in mitigating food waste, it only scratches the surface of the problem. Real change requires a paradigm shift in how we approach consumption and perceive the notion of edibility. Engaging local restaurants in food donation and recycling initiatives is a vital first step, but it's not enough. To truly tackle food waste comprehensively, we must foster a deeper understanding of the underlying issues and promote a culture of mindfulness around food consumption. This involves rethinking our relationship with food, from production to consumption to disposal. Education plays a crucial role here, as we need to raise awareness about the

environmental, social, and economic impacts of food waste.

Creating community spaces for education and dialogue can provide a platform for individuals to learn about the importance of reducing food waste and to exchange ideas and strategies for doing so. These spaces can take various forms, such as workshops, cooking classes focused on using leftovers creatively, or community gardens where people can learn about growing their own food. Moreover, advocacy for legislative measures is essential to support and incentivize food waste reduction efforts. Policies that encourage food donation, provide tax incentives for businesses to donate surplus food, or implement food waste reduction targets can all contribute to a more sustainable food system. Ultimately, our goal should be to transition towards a circular society where the issue of food waste is actively addressed and minimized. By working together at the individual, community, and legislative levels, we can move closer to achieving this vision and create a more sustainable and equitable future for all.

Objectives for Future Research:

Community-Level Initiatives: While initiatives like grocery store donations and food rescue programs are commendable, fostering community engagement is key to their success. Establishing partnerships with local organizations, such as community centers, schools, and religious institutions, can enhance outreach efforts and ensure equitable distribution of rescued food. Additionally, implementing educational programs on food waste reduction and sustainable consumption habits within these communities can foster long-term behavioral change.

Technological Innovations: Beyond Imperfect Foods, exploring other technological solutions can further mitigate food waste. For instance, mobile applications connecting consumers with surplus food from restaurants or events can divert additional edible items from landfills. Implementing smart packaging technologies in supermarkets to extend the shelf life of perishable goods can also reduce waste at the source.

Policy Interventions: Advocating for policy changes at the local and national levels is essential for creating an enabling environment for food waste reduction. This includes incentivizing businesses to donate surplus food through tax incentives and liability protections. Implementing food waste reduction targets and regulations on landfill disposal can also drive systemic change and hold businesses accountable for their waste management practices.

Community Composting Programs: Scaling up community composting initiatives can further divert organic waste from landfills while enriching local soil health. Establishing community composting hubs or decentralized composting networks in residential areas can provide convenient solutions for households and reduce transportation emissions associated with centralized composting facilities.

Environmental Justice Advocacy: Amplifying the voices of marginalized communities affected by landfill pollution is crucial for advancing environmental justice. This includes supporting grassroots movements, advocating for stricter

environmental regulations, and promoting community-led research on the health

impacts of landfill pollution. Additionally, incorporating environmental justice principles into urban planning processes can help prevent the siting of hazardous facilities in vulnerable communities.

Educational Initiatives: Integrating environmental justice education into school curricula can raise awareness among future generations about the intersections of race, class, and environmental degradation. This includes teaching students about the history of environmental racism, organizing environmental justice workshops, and providing opportunities for students to engage in community-based research projects.

By adopting a holistic approach that combines community mobilization, technological innovation, policy advocacy, and environmental justice advocacy, we can work towards a more sustainable and equitable food system for all.

Summary:

The findings of this study express the importance of adopting community-centered strategies in tackling the pervasive issue of food waste and fostering environmental sustainability within urban settings like the Convoy District. By delving into the nuances of community perceptions, behaviors, and challenges surrounding food waste management, we gain valuable insights that can inform the development of targeted interventions and initiatives. Moreover, the emphasis on community engagement and collaboration serves as a cornerstone for building collective ownership and commitment towards

addressing environmental concerns. By involving community members in decision-making processes and co-creating solutions, we not only foster a sense of empowerment but also cultivate a deeper sense of connection and stewardship towards our shared environment.

Furthermore, the identification of practical barriers and opportunities, such as logistical challenges in accessing food waste services and the potential for redirecting surplus produce to support local pantries, highlights the importance of context-specific and sustainable approaches. By leveraging existing behaviors and resources within the community, we can create meaningful change that resonates with local values and priorities. Ultimately, this research underscores the transformative potential of grassroots efforts in driving positive environmental outcomes. Through ongoing dialogue, collaboration, and collective action, we can pave the way for a greener, more resilient future where communities thrive in harmony with their surroundings. By championing community-led solutions, we not only address the immediate challenges of food waste but also sow the seeds for lasting environmental stewardship and resilience.

References:

Grocery Store - CalRecycle Home Page. (n.d.). CalRecycle. Retrieved September 26, 2022, from <https://calrecycle.ca.gov/organics/food/grocers/>

Grocery Delivery for Organic Food, Fresh Produce & More. Retrieved September 26, 2022, from <https://www.imperfectfoods.com>

Chai, A., & Kye, N. (Directors). (2017). *Wasted! The Story of Food Waste* [Film].

Racz, A., Marchesi, v., & Crnkovic, i. (2018). Economical, Environmental and Ethical Impact of Food Wastage in Hospitality and Other Global Industries.

Davis, C. (2014). Food Recovery through Donations as a Response to Food Waste: A Case Study of Two Grocery Stores Participating in a Food Recovery Program in Boulder.

Pulido, L. (2000). Rethinking Environmental Racism: White Privilege and Urban Development in Southern California. *Annals of the Association of American Geographers*, 90(1), 12–40. <http://www.jstor.org/stable/1515377>

Lins, M., Puppini Zandonadi, R., Raposo, A., & Ginani, V. C. (2021). Food Waste on Foodservice: An Overview through the Perspective of Sustainable Dimensions. *Foods (Basel, Switzerland)*, 10(6), 1175. <https://doi.org/10.3390/foods10061175>

Sakaguchi, L., Pak, N. and Potts, M.D. (2018) ‘Tackling the issue of food waste in restaurants: Options for measurement method, Reduction and Behavioral Change’, *Journal of Cleaner Production*, 180, pp. 430–436. doi:10.1016/j.jclepro.2017.12.136.

Who we are (2023) FoodCycle. Available at: <https://foodcycle.org.uk/who-we-are/> (Accessed: 11 December 2023).

The easiest way to sell your surplus food. (no date) The easiest way to sell your surplus food. - Too Good To Go. Available at: <https://www.toogoodtogo.com/en-us/user> (Accessed: 11 December 2023)

Types of composting and understanding the process | US EPA. Available at: <https://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process> (Accessed: 12 December 2023).

Wasted Food Scale | US EPA. Available at:

<https://www.epa.gov/sustainable-management-food/wasted-food-scale> (Accessed: 11 December 2023)

The circular economy and Food Waste (no date) ReFED. Available

at:https://refed.org/food-waste/circular-economy/?gad_source=1&gclid=Cj0KCQiA4NWtBhD-ARIsAFCKwWusrdiCePbRb4CMw34A-332mVW_5WOLCwdpp9xzbLfbNAUX6xCAJQsaAndjEALw_wcB (Accessed: 11 December 2023).

Nakaishi, T., & Takayabu, H. (2022). Production efficiency of animal feed obtained from food waste in Japan. *Environmental science and pollution research international*, 29(40), 61187–61203. <https://doi.org/10.1007/s11356-022-20221-1>

Niede, R., & Benbi, D. K. (2022). Integrated review of the nexus between toxic elements in the environment and human health. *AIMS public health*, 9(4), 758–789. <https://doi.org/10.3934/publichealth.2022052>

Lehtokunnas, T., Mattila, M., Närvänen, E., & Mesiranta, N. (2022). Towards a circular economy in food consumption: Food waste reduction practices as ethical work. *Journal of Consumer Culture*, 22(1), 227-245. <https://doi.org/10.1177/1469540520926252>

interconnected

an ethnographic framing of energy assessment methodology

Shai Ehrmann
University of San Diego
Shiley-Marcos School of Engineering
April 2024

Table of Contents

Acknowledgements

Abstract

Introduction

Building connections

Literature review

Methodology

Results and Discussion

Data Collection

Yucca Valley

Palm Springs

Conclusion

Summary

Bibliography

Acknowledgements

I would like to acknowledge the many collaborations that helped bring this project to the finish line. First, a special thanks to Chelsea Johnson for her unwavering positive attitude and encouragement as my advisor and mentor throughout this rocky journey. I want to thank Dr. Willy Oppenheim for facilitating an engaging and constructive platform for MESH, and always providing support and guidance. I am grateful to all the dedicated MESH faculty that worked tirelessly in all time zones to contribute to my learning. And to my cohort, an inspiring collection of change-makers: your diverse perspectives and collaborative spirit made our learning environment greater than the sum of its parts—teamwork makes the dream work. Co-director Paul Kadetz, who always entertained my critical perspective with poise. Finally, I express my deepest gratitude to Dr. Caroline Baillie, an unstoppable force, a fountain of wisdom, and a brilliant professor who always motivated me to do my best, and who inspired many new ways of seeing the world. Thank you.

Abstract

The primary goal of my capstone project is to support community resilience by identifying and addressing energy poverty. My project aims to analyze how giving definition to community energy needs helps to identify and address issues driving energy poverty. A large part of this issue is due to myriad definitions for community and energy poverty, and assumptions about populations based on quantitative assessment methods. This approach, I believe, fails to capture critical ethnographic community data, and as a result produces an incomplete assessment and dataset of the community's energy needs. Consequently, in this scenario as an example, communities struggle to get a seat at the table or at least their voices heard. Within the growing field of energy justice, I focused on issues of accessibility, affordability, and agency to frame energy issues in a broader social and cultural context, showing that current ethnographic assessment models can be applicable to technical, typically quantitative, energy assessments. Improving energy assessments to include ethnographic data result in better data available to energy decision-makers, but it is also an opportunity to document anecdotal information and create a more polyvocal and humanistic energy profile for said hypothetical community. Therefore, my goal in this project is to uncover missing quantitative and qualitative community data that will highlight where further efforts are needed to conceive of alternative and more community-focused assessment models. I believe that energy poverty is deeply entrenched in a community's culture, and that to identify it we need rich and granular (to an extent) ethnographic data to reveal the community's relationship to energy resources. The ideal outcome is to make policy- and decision-makers aware of energy problems that aren't captured in conventional assessments of community energy needs, to give the community more agency, and to identify and address instances of energy poverty; to progress these areas of energy justice.

Introduction

Energy systems in various forms are foundational elements of a healthy and sustainable community ecosystem. To give a sense of how relevant energy systems are in our daily lives, with one kilowatt-hour (kWh), a standard unit of energy, we can supply one day of potable water for the average US household

(US EPA, 2018); recycle a 750 mL glass bottle (Gaines, 1994); cook on an electric stove for an hour; pull a rush-hour commuter train 10 feet (rivaling the T in Boston), drive a mile in a conventional fuel car, bike at a high speed for 5 miles, or walk 10 miles (US DOE, 2022). All those things require one kWh. The US consumes approximately 28 *trillion* kWh per year—as in 28 followed by 12 zeroes. Water systems, food systems, public health, transportation, waste management, climate resilience—these foundational societal needs (and more) depend on energy resources to operate.

Energy technology is constantly innovated alongside ballooning energy demand. The standards and definitions of energy in our society—our relationship to energy in other words, is dynamic and heterogenous, and hard to encapsulate. This necessitates all forms of energy policy (European Climate Initiative, 2021) to provide secure and reliable [and preferably sustainable] energy, as well as persistent energy development to meet demand (Columbia, 2023). In many cases, energy insecurity correlates with risks to basic infrastructure, which is increasingly salient given current and projected effects of climate change.

Energy needs assessments, to some extent, are typically conducted to size energy projects, or to get a snapshot of regional energy trends. Often based on regional energy consumption and geographic designations, these types of assessments are inherently quantitative. They serve an important role in planning and developing energy resources and giving a snapshot view of energy needs. But whose energy needs? Ideally, energy needs assessments can determine a community's energy resource availability or lack thereof, and also contextualize that information to best represent and serve the community. However, the framing and parameters of an energy assessment depends highly on its motivation; and the aim of an energy assessment and community needs and priorities are not always aligned.

Developing energy resources could be helpful to a community's overall sustainability and presumably growth; however, the inextricable ties between energy and other societal needs also means systemic energy-related and socioeconomic both depend on each other to some extent; both can influence and dictate power structures. The various energy injustices inadequately captured in conventional energy assessments, also call attention to energy hegemony that systemically disenfranchises communities—intentional or not.

Unfortunately, there are discriminating lines drawn in parallel with those of socioeconomic justice, the sad reality is that access to critical energy resources is not guaranteed for all. Energy justice has far-reaching implications that should be given more attention in my opinion. One aspect of energy justice which inspired this project is the disproportionate power (no pun intended) of for-profit utility providers. Basic vital resources should not fuel growing and lucrative energy arbitrage; this represents a conflict of interest to the detriment of the community.

Energy justice has its place in energy assessments, for example those conducted for capital public utility projects or under certain funding mechanisms often must adhere to jurisdictional reporting requirements. Much of the energy justice efforts are focused on channeling resources to underserved communities, to make energy clean, reliable, and affordable where people need it most. But there is no clear metric to tell us who needs it most, or what flavor of energy resource development is most needed, if at all. Unfortunately, energy assessments typically lack measures that better identify community characteristics that shape energy needs and provide an incomplete account of a community's relationship to energy resources. These

measures are qualitative, ethnographic, and diverse; being sociological in nature, this data is commonly recorded in public health surveys, census gathering, and other community-specific purposes.

It seems we have the collective vision; we have the tools; we have the data; what invisible forces drive energy poverty to persist? Typical criteria to assess a community's energy resources provide a high-level understanding that is efficient and serves its purpose. But lacking community-specific ethnographic data, can energy assessments actually provide realistic interpretations of a community needs? I argue that they *can*, but often *don't*, thus providing only a superficial depiction of community needs; a reductive, positivistic, and incomplete account of what constitutes a community. Ideally, analyzing this data from the framing of energy resources could shed light on specific energy needs, and help communities develop directed solutions to energy poverty. I believe a humanistic approach to assessing a community's energy resource can help communities organize and develop in a way that suits its specific needs.

I believe another root cause of this problem has to do with the challenge of defining and framing presenting problems. Energy poverty can impact a community at its very core; however, it is not always clear which issues need to be addressed, nor how to go about it. There is no standard definition for energy poverty as energy technology and demand continues to evolve. My research into the topic of energy poverty investigates how energy-focused community needs assessments can better represent community needs and provide a more useful tool to inform equitable energy resource development and management.

Overall, this project focuses on community energy needs that go unaddressed and energy needs that are not represented in standard energy assessment models. It is an examination of pragmatic energy needs assessments through a sociographic or ethnographic lens.

Building connections

Utility poles stand banal and homely, frankly. They are woven into the visual lexicon of our contemporary landscape, dotting streets and highways and impossibly steep ascents at regular intervals. They collectively support an electric conduit emblematic of our nature to connect.

Although we understand energy as a resource, for the most part, we must also contend with energy as a commodity and a source of power, no pun intended. Today, energy is commonly associated with commodities; with utility bills; with global conflict; with drilling and development; as an economic asset. Integrated into major energy systems is economic hegemony (Perez-Sindin, 2022)—the structural distribution of power that reserves resource management decision-making for those with power. Consequently, this disenfranchises energy consumers from participation in resource development and management.

Southern California Edison's (SCE) Devers substation occupies a remote and inconspicuous, three-square-mile swath of land in Southern California's Colorado Desert. The facility is surrounded with a veritable moat (sans water), a 10-foot brick wall with security cameras every hundred feet, and threatening signs signaling that I should leave.

A recent utility project, the West of Devers upgrade, required improvements to a 48-mile transmission corridor. The improvements were intended to increase local capacity and reliability of this section of the grid and support safer and more robust utilities more broadly. Topography formed a corridor west of the Devers

substation extending to the next substation in nearby Beaumont, CA, a span of the Morongo Band of Mission Indians Reservation. The project would propose construction of transmission infrastructure straight through this corridor. As a result, the project was contingent on collaboration with Morongo Band of Mission Indian.

The benefits of this proposed project were multifaceted: to the Morongo community who would be afforded more reliable and robust energy infrastructure, and additional revenue from energy generation; and to SCE and stakeholders who would reap the benefits of an upgraded grid.

Morongo Transmission LLC was formed as an ad-hoc tribal partner in the transmission project. In exchange for being a partner in the project, the Morongo Tribe was given rights to operate a section of the upgraded line within Morongo territory. In short, this gives Morongo the power and the role of a traditional transmission operator AKA an electric utility.

Why is that a big deal you ask?

It has historically been a struggle for Native American reservations to be interconnected to the grid. The bureaucracy that governs utility operations and the prohibitive cost to extend grid infrastructure to reach often-remote communities are largely to blame. Native American reservations don't have the jurisdiction to facilitate power grid development. Therefore, reservations typically rely on fuel, distributed energy resources, and microgrid schemes to meet community energy needs. Native American communities represent a majority of non-electrified or energy-impooverished households. Being both physically and systematically disconnected from the grid, Tribal communities cannot participate in many energy resource development funds.

Morongo Reservation now has better access to grid resources, and can operate an interconnected microgrid, and export energy to the grid as a utility for profit. Morongo is the first Native American Tribe to own and operate a section of the national power grid. This case is notable because collaboration uprooted a deep-seeded hegemonic relationship between utilities and consumers. Morongo Band of Mission Indians acquired access to reliable energy infrastructure, designed a more affordable energy system for their community, and attained agency and self-determination of energy resource management.



(Photographs I took at Morongo Reservation)

Literature review

Energy is a source of wealth and power in local and global economics (Biol, 2007), it is a lifeline for critical infrastructure (Karekezi, 2012), and for planetary health (Columbia, 2023). A lot of recent energy poverty research focuses on clean and renewable energy as a means to close energy gaps and address energy justice, and also how various technologies address environmental/social injustices, especially fossil fuels (Lee, 2019) with a large focus on cooking fuels as a global health, social, and environmental issue (USAID, 2022). Reliable energy access is a necessity for most, yet many communities lack the resources to implement energy resource development or improvements in their best interest.

Community needs assessments are ideally motivated by equitable and participatory community data collection; there is a reasonable amount of literature available with specific instructions and resources for conducting effective and ethical community needs assessments. There are existing assessment models, yet they vary in purpose. For example, MIT's Energy Needs Assessment Toolkit "is designed to guide local organizations through the process of gathering the information needed to make informed decisions about what technologies and business models are best suited to meet the specific needs in their community through market-based initiatives" (MIT, 2017). I largely align with those goals; however, I want to highlight the mention of business models and market. Energy resources are rapidly developing, which can benefit the community and/or other stakeholders—potentially to the detriment of the community.

When conducting a community needs assessment, we make implicit assumptions about what defines a community. How *do* we define a community, in particular for the purposes of assessing energy needs? To reverse engineer the term in this context, I focused research on differences between how industrial/commercial, official, and social epistemologies characterize *community*. For example, as presented in "What Is Community? An Evidence-Based Definition for Participatory Public Health" (MacQueen, et al., 2001), community can possibly be defined by common factors; when asked what terms characterize community, the most common themes were "locus, sharing, joint action, social ties, and diversity" (MacQueen, et al., 2001).

There are countless definitions of "community"; it carries personal and cultural significance. However, for practical purposes, we can define a community as any population with similar culture, beliefs, goals, interests, locale, or other shared traits that can be grouped. Using a geographic approach simplifies the large amount of information by assuming a correlation between population demographics and geographic region. The geography and physical environment of a place may have a large influence over its culture and community dynamics. But if I may zoom out, utilizing broad metrics, such as geographic regions, to assess a nuanced population is bound to overlook potentially consequential community data. One of the goals of this study is to explore how we can reconcile the two.

It is important that energy poverty is defined in the context of this capstone project, as the term is multifaceted and sometimes vague. It may be used flexibly to discuss natural resources, energy infrastructure, legislation, yet it is also an indicator of other forms of socioeconomic and/or development gaps. Because energy justice is so expansive, I have framed my research throughout this project as *accessibility*, *affordability*, and *agency*. This framework provides guardrails to research and is useful for

comparing and classifying energy poverty indicators. And thus, energy poverty in this context can be characterized as a deficit in energy accessibility, affordability, and/or agency.

As demand and consumption of energy soar, the benchmark for individual and community energy needs continues to grow, widening the energy access gap. This form of energy poverty can be a side effect of unequal distribution of energy resource access development (Cong et al., 2022). In addition, the concept of relative “conventional” poverty has an analog within energy poverty. Energy poverty and socioeconomic poverty impact one another, and energy access can have a significant impact on a community’s socioeconomic outcomes.

Concrete data describing these invisible forces will help form a connection between energy poverty and socioeconomic poverty. Fortunately, there are already well-established links between community socioeconomics and other community metrics. From here, analysis is easier to envision and produce using existing metrics and data.

According to Sovacool’s 2014 study of research trends in energy, “the most popular category overall was energy markets (16.2 percent) followed by public policy mechanisms (13.4 percent), climate change (12 percent), and pricing and prices (11.3 percent). Land use (1.1 percent), Behavior (2.2 percent), and research and development (2.6 percent) were the least favored topics” based on a sample of approximately 30,000 peer-reviewed articles published amongst three academic energy journals. “These three journals rank among the most visible of energy studies journals [...] we expect them to attract articles on timely topics that are representative of the research being conducted in the field as a whole” (Sovacool, 2014). Notably, markets, policy, and climate change were garnering the most energy-related research and publication attention; the implication is that this reflects to some degree the source of funding.

According to a more recent review of publications and research by Qian et al. (2022), there has been an exponential rise in published and cited articles related to energy justice which is a relatively new phenomenon: “the EJ literature did not begin to emerge in large numbers until recent years, specifically after about 2015.” Their 2022 review, almost a decade after Sovacool’s, shows increasing attention toward energy justice, especially the terms energy sector, energy communities, systematic [energy] review, rooftop solar, climate crisis. This bibliometric does not analyze the topical data set alongside other energy topics, which the 2014 study included, such as market and technology.

However, we can infer with some confidence that research in the field of energy justice has grown in popularity, especially in a direction that reflects a common interest in climate, renewable energy, and sustainability. This is further supported in a 2023 survey of energy justice publications by Ferrall-Wolf et al. (2023), which found similar thematic trends, with top keywords in sample energy justice literature (over a broad time scale) including energy poverty, energy justice, fuel poverty, renewable energy, and energy transition.

Energy has a deeply rooted connection with socioeconomics, which is not directly attributed to modern energy developments. Studies show that energy economies are also pervasive where modern energy resources are scarce or unavailable, although they are considered energy-impooverished without reliable access to energy. In this circumstance, research indicates that energy development can contribute to

economic expansion, and greater energy access as a result (Li, 2022). With universal implementation of energy resources to a varying degree across most of the world, a lack of access to reliable energy is a determinant of poverty, and kneecaps economic access. The socioeconomic impact of energy poverty is significant and is exacerbated by an increasingly technological economy (Che, 2021).

Additionally, much of the literature approaching energy as a justice issue focused on rising energy costs and how that has affected energy's affordability, another dimension of energy access (Biol, 2007; California Energy Commission, 2024b; Institute, 2023; Karekezi, 2012; USAID 2022). This aspect of energy justice turned out to be well studied. Income and utility cost data is widely available, and many jurisdictions require affordability reviews when utilities petition to increase rates. There is not a lack of data and continued research on how affordability impacts energy poverty; though no less important, it is not specifically explored in this project.

It is important to point out that many articles I read, those particularly relevant to sociologic and ethnographic metrics used in energy modeling, described an enduring lack of literature attempting to bridge the engineering-sociology gap, and that many of the publications are attributed to small range of subject matter experts, thus potentially producing a pool of research limited in diversity (Li, 2022).

Methodology

Through my inquiry, I uncovered how ethnographic data or other qualitative forms of data can be utilized to create energy assessments that better embody the humanistic aspects of energy resources. I primarily analyzed accessibility and agency factors, which I believe hold the greatest potential to provide alternative or informal energy data. As previously noted, energy affordability is a well-researched topic; I did not include a specific study of affordability as part of my methodology.

Conventional energy needs assessment methodologies are limited by quantitative data collection; community energy needs can only be assessed insofar as community data is available. Since the intersection of engineering and sociology fields is a growing and dynamic area of interest, there have been targeted efforts to make energy development more inclusive of social science (Ryan et al., 2014; Sovacool, 2014).

My project explored this disconnect. I collected energy assessment and ethnographic community assessment reports for comparison, analyzed their strengths and weaknesses, and identified elements of sociological data that could contribute to energy data assessment. In order to get more information on the topic, I held interviews with professionals who conduct community and energy assessments and research, and compare methods and experiences, as well as attitudes toward energy justice and community. With these resources, I used a hybrid quantitative/qualitative content analysis methodology (Bengtsson, 2016) to identify data gaps and biases in energy assessments that represented an ethnographic voice. "Qualitative content analysis involves determining and considering the tone, interpretation, and context of content so as to 'expose the ideological, latent meaning behind the surface of texts'" (Sovacool, 2014).

Elements of existing community assessment models that are topically different but similar in structure and analytical methods, such as the CDC Community Needs Assessment Participant Workbook (CDC, 2013),

were be used to guide this study and validate the specific cases I included in this project; I believe an energy assessment should be adaptable enough to capture more community-specific indicators.

I believe some of the elements that are missing from equitable and inclusive energy needs assessments lie in the model that is used. Too quantitative a model, and the spirit of the community may be overlooked; too qualitative a model, and results might lack tangible data to facilitate action. But as I am exploring, these do not have to be mutually exclusive, the ideal solution should likely contain elements of both.

I reviewed a number of community needs assessment models, and ultimately chose the Centers for Disease Control and Prevention (2013) Community Health Needs Assessment workbook (CDC CHNA) as a good reference for community assessment data, since it is a comprehensive guide to conducting community assessments equitably, including planning and analysis, community engagement strategies, and many questions aimed at collecting a wide range of data—with the caveat it is intended for public health assessments. Still, many of the questions pertain to behavior and community conditions, which are also pertinent to energy needs, (CDC, 2013) CHNA Appendix B) and could therefore provide a good basis for additional measures or strategies to support energy assessments.

The CDC CHNA recommends a community needs assessment should follow this basic structure:

Step 1: Define community – including shared ownership and jurisdiction.

Step 2: Define the objective and scope of the assessment.

Step 3: Collect and analyze data, identify community assets, and community engagement.

Step 4: Determine key findings.

Step 5: Share findings.

Step 6: Set priorities and develop a community action plan.

I reviewed a hefty energy assessment to see how the above CDC CHNA structure could be used to bolster energy assessment data collection methodology. No need to reinvent the wheel. See results and discussion for a more detailed analysis.

To assess the topic of accessibility, I analyzed different factors affecting the equitable development of electric grid infrastructure. I delved into how distributional injustices can exacerbate energy poverty by hindering safe, reliable access to electricity resources. To show the implications as they relate to energy needs assessments, I analyzed case studies where unaddressed or overlooked community needs impacted access to reliable energy resources. In terms of agency, I particularly focused on community-driven data and participatory action as key elements of energy justice. To depict the extent to which representational justice and self-determination play a part in energy poverty, I analyzed the systemic shortfalls that impede grid access for Native American communities across the entire US power grid—except for one trailblazing tribal community: the Morongo Band of Mission Indians. More details can be found in the previous section titled “Building Connections.”

Results and Discussion

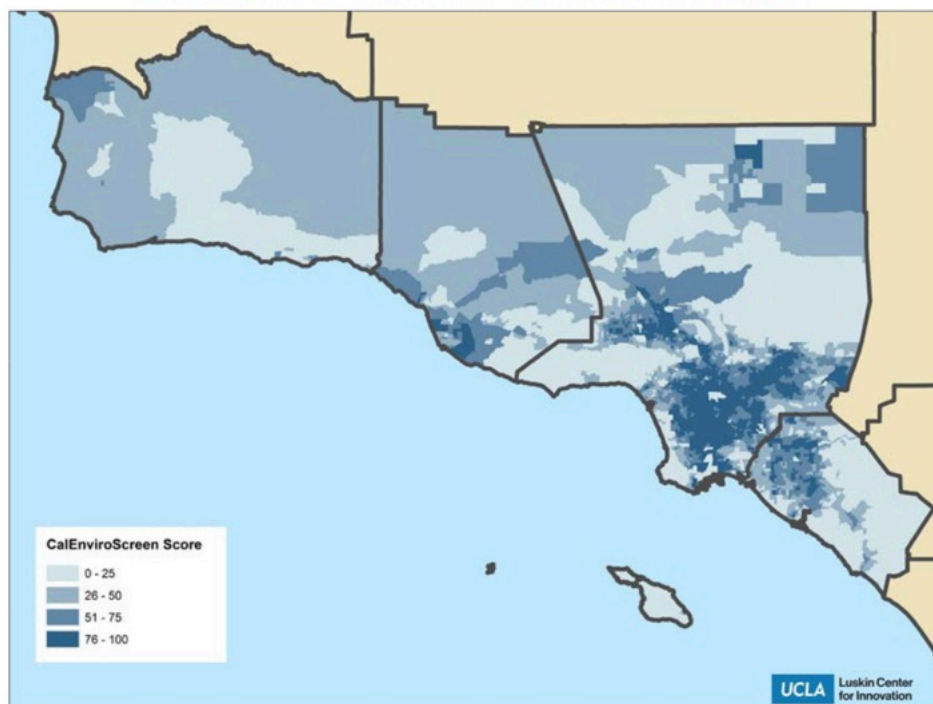
I reviewed the Southern California Regional Energy Needs Assessment (Trumbull & Deshazo, 2021) to determine the community elements that were missing that could potentially be integrated. I chose this study because it assesses energy needs in a large geographical area, and thus presents an immediate bias. The subject region of this needs report—four southern CA counties—represents a very large and diverse population.

How does this regional energy assessment fit within the aforementioned community needs assessment framework? We can start by assessing the first three steps assigned in the CDC CHNA:

Step 1: Define the community.

“Assessing geographic variation in critical indicators during this transformation for the energy sector can help to inform policymakers and community leaders on regional energy needs.” (Trumbull & Deshazo, 2021).

This report identifies the community by geography. The mention of adoption of clean energy technology alludes to socioeconomic elements as part of the defined community, for example, culture, policy, and available resources. The report additionally correlates regional geographic communities with “measures of community vulnerability, including CalEnviro Screen’s Disadvantaged Community (DAC) data, future high heat days, and median income” (Trumbull & Deshazo, 2021)—that is disadvantaged community data, climate data, and median income. Due to the scale of this needs assessment, in area as well as population, these measures can provide a high-level account of the energy community.



Source: Figure created by UCLA Luskin Center for Innovation (2021). Data from California Office of Environmental Health Hazard Assessment

Fig. 1: Assessment location area depicting CalEnviroScreen scores (Trumbull & Deshazo, 2021)

Therefore, the energy community described in this needs assessment is essentially the residential energy-consuming population of Los Angeles, Orange, Santa Barbara, and Ventura counties, based on geographic boundaries. The report examines the total population and assesses results per county in order to compare energy needs.

Step 2: Define the objective and scope of the assessment.

According to the report, the objective of this needs assessment is to analyze “regional differences in energy needs [and in doing so] identify geographic and vulnerability trends to enable policymakers to target priority areas for support in order to advance climate and equity goals.” To my understanding, the objective is therefore to assess energy consumption and highlight the vulnerabilities that are prevalent in each county; this would provide data to guide sound policymaking.

I believe this is a good area for greater community engagement. For example, the report shows a predictable inverse relationship between DAC score and energy consumption but does not describe an underlying cause of lower energy consumption. Is it economic—the cost of utilities? A lack of infrastructure (physical or social)? Grid reliability? Gas vs electric (study looked at electricity consumption)? This information, in my opinion, could be instrumental in prioritizing energy needs for a community.

Step 3: Collect and analyze data, identify community assets, and community engagement.

Electric consumption data was aggregated from both utility provider sources, when available, and an estimation technique based on population and determinants. Data was grouped by census tract. GIS data was collected from various public agencies (i.e., environmental, census, energy data).

This is an accurate way to collect data, in my opinion. However, although it explores the correlation between energy consumption, DAC (see Fig. 2), income, and climate, it does not explore these as root causes of energy needs, or rather the varying ways in which DAC, income, and climate impact community energy needs. Without additional factors, it would be challenging to parse out that data. Here is exactly where greater community engagement would provide the unique polyvocality to enrich this data. In Fig. 2, we can observe a small difference between the highest per kWh consumption for DAC score of 100 (highest disadvantaged community designation) and the lowest per capita kWh consumption for a DAC score of 0 (not disadvantaged). I hypothesize more extensive latent analysis of this data could reveal that net energy consumption in this data set is largely behavioral and only somewhat correlates with DAC score. What I find compelling is the correlation between DAC and variance in per capita energy usage (Fig. 2), the implication being that a low DAC score correlates with greater energy availability compared to low DAC sample.

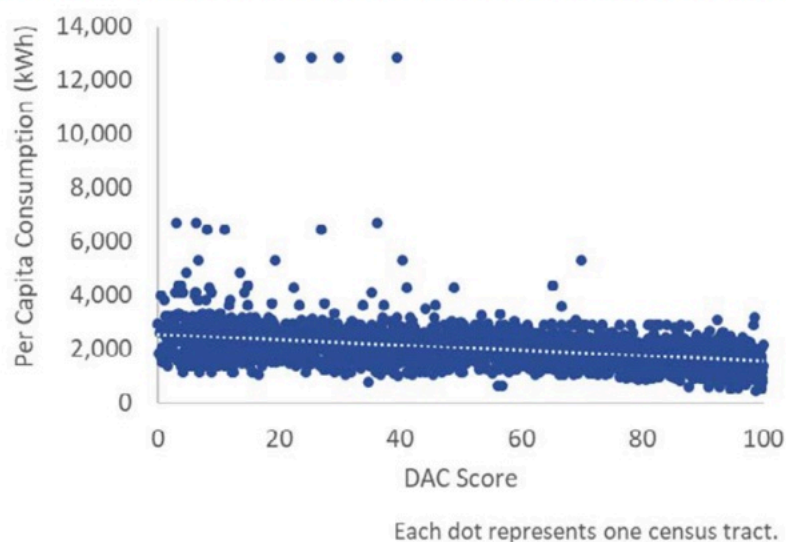


Fig. 2: Disadvantaged Community (DAC) score vs per capita energy consumption (Trumbull & Deshazo, 2021)

Consider the extent to which usage flexibility, even if not fully utilized, is an asset during extreme weather conditions, more likely extreme heat in Southern California, or other emergencies. In contrast to usage, I believe the visualization of these results is more telling of capacity. Consider too how this can be a product of access to reliable energy infrastructure, and of energy utility affordability, and of agency to effect specific energy improvements in communities.

Circling back to a working definition of energy poverty (Cong et al., 2022), this is a presentation of relative energy poverty, where all DAC score samples appear to have some degree of electricity access, the highest DAC score samples consume electricity, but there is clearly a discrepancy in available resources. Since DAC is a metric based on census tracts, this further highlights the issue of discrepant parameters between geographic and ethnographic community data. Although this would require a more detailed study of the data, I suspect elements of energy justice can be used to better analyze the reason for this instance of energy poverty.

Sharing or disseminating this information is also a critical part of the process. Making this data or results available to community stakeholders and collaborators promotes a transparent and inclusive process.

Data Collection

I was fortunate enough to interview an expert on the topic. Dr. Destenie Nock, who humbly describes herself as “an engineer whose work focuses on energy transitions and energy justice,” is a professor in Civil & Environmental Engineering and Engineering & Public Policy at Carnegie Mellon University (D. Nock,

personal communication, March 1, 2024). Her work focuses on critical energy systems modeling to address sustainability and energy justice.

Data biases are inevitable to some degree, especially in this relatively new space of discourse. I asked Dr. Nock (personal communication, March 1, 2024) about her experience with data biases in this field. “Data limitations and scarcity is a key challenge [...] to really look at energy poverty you need to get to the household level and look across multiple years. This can be difficult” (D. Nock, personal communication, March 1, 2024). Difficult, and resource intensive. As Dr. Nock points out, a large amount of data provides better resolution—in this case in terms of describing sustainability impacts of energy transitions. However, data collection and assessment efforts can only be as detailed and impactful as available resources allow. Systemic constraints on collecting sufficient data are a major source of bias introduced in energy data.

Importantly, Dr. Nock’s work in data collection revolves around creating a virtual model to better simulate and study energy poverty; it approaches energy justice from a quantitative lens. “Normally I start with what data is available. Then I look at if I can get as close to the individual as possible. My work is community informed research, but I do not engage with communities much. I am a data analyst, and a systems modeler. My work is informed by organizations that do work in communities, but I do not often see the response of people I hope to affect, because normally I work with community advocates and utility companies” (D. Nock, personal communication, March 1, 2024).

Next, I conducted a comparative interview with Ana Rico, who is in contrast a community ambassador working with the Community Environmental Council. Her work, like Dr. Nock’s, involves collecting community data; however, Ana focuses on community engagement and impact. During our discussion, Ana extrapolated on the process of community engagement as well as the many challenges she faces daily. We touched on geographic-based data, including census data, Ana responded that people constantly move and settle in ways that don’t align with geographic delineations. This makes it challenging to collect and interpret data that is framed by location. For example, she recalls her experience organizing translation services for outreach in various languages. Regarding data collection, Ana shares “the census is one place where you can look, justice 40 is another one, where they really go into the incorporated areas and they just kind of map it out. And then you have to dig a little bit more and find out what kind of languages they speak in that neighborhood then you're prepared. Right. And then you can start laying out the project and the plans for it. And then you have to start communicating with organizations, finding the right organization. Um yeah. It's work” (A. Rico, personal communication, March 1, 2024). However, she continues, “it's not just Spanish and English that I have to translate and interpret. [...] For one instance, Santa Barbara had a new language, Ñomndaa, it's hard to pronounce, but this language comes from Guerrero, Mexico and not a lot of people know how to speak that language right? It's a native language and so we looked, and we looked [for a translator]. It took months and months and by the time that we got to the actual people we wanted to talk to they had moved!” (A. Rico, personal communication, March 1, 2024).

While Dr. Nock relies on such geographic data for her work, Ana finds it to be unreliable. Information presented this way is convenient and gives a high-level efficient view of a project where location and geography are primary factors; however, Ana presents a compelling argument that granularity can sometimes contain critical information. For example, Ñomndaa, more commonly referred to as Amuzgo, has fewer than 60,000 registered speakers worldwide, of which at least 45% are monolingual (Schmal,

2023). This is based on migration estimates together with Mexican census data; however, the US census does not document this as a spoken language, even though there are Amuzgo-speaking populations. Therefore, there is no census data representation of Amuzgo speakers, which makes community assessment data collection challenging, and energy assessment data remiss.

Although Ana's primary challenge in that example was reconciling map data, census data, and ethnographic data to reach community members, the conversation pivoted as we began discussing how she feels about conducting assessments. I wanted to probe the framework in which her work operates. "By the time that you're done with this one phone call that your boss says [has to be] 15 minutes, it's already an hour, and if the person loves to talk that's 45 minutes extra [...] You can't just say *I want this from you*, but not ask how your day is or if you need other resources than what I'm sharing with you. Do you need food? Do you need assistance with your bills? I mean, that's getting to know the person, right? Sometimes they call me at night--at nighttime, and I'm about to go to bed. I can't ignore them [...] right? And [I am] not cutting them off" (A. Rico, personal communication, March 1, 2024).

While Ana is a veritable community champion, what she reveals in this discussion is a lack of resources for people that conduct community assessments, and for assessments themselves. As mentioned, she is typically given 15 minutes to conduct an interview, whereas it can easily take an hour or more to have a meaningful and personal and respectful conversation while collecting data. According to Ana this is imperative to building community trust—not only in the information collecting process, but also in communicating plans or goals to the community. Therefore, another important consideration for assessments is that they require resources beyond technical data collection and analysis. "Make sure that you have extra funding for the follow-up. So, the follow-up means once you're done with your project, maybe two or three months later, you come back and you have the same meeting as when you started" (A. Rico, personal communication, March 1, 2024). I think the follow-up meeting is a critical data point, not only to reflect results to the community, but also for a baseline comparison to understanding and document the impact of a project or changes in energy resources. In my opinion, this should be an integral part of a framework for community-focused energy assessments. As Ana points out, this requires additional resources and planning; in her experience many projects are hyper- focused on collecting data for project planning and don't put aside resources for post-project and future data collection.

How would you describe a society that has ideally achieved energy equity or justice?

"Everyone can afford to keep their homes to a safe and comfortable indoor temperature."

-Dr. Destenie Nock

“... we now use ‘community-orientation’ as our most fundamental criterion for categorizing [Renewable Energy] projects. Community-oriented RE facilities are primarily intended to serve the people near them. Utility-scale projects are not. For too long, this fundamental difference has been treated as a side issue while megawatt output per facility has been an unnecessarily confusing fixation nationwide” (County of San Bernardino, 2017).

“San Bernardino County has among the highest solar energy potential of anywhere in the United States, making it a prime location for solar energy facilities. Some of the mountain ridges in the county’s desert areas are highly suitable for wind energy facilities. San Bernardino County also has higher than average potential for bioenergy facilities compared to the rest of California” (NREL, 2008).

Both of these quotes found in the County of San Bernardino General Plan (2017) describe the county’s renewable energy development goals. The intent is to promote development of community-oriented renewable energy resources, accounting for the impacts of utility-scale development.

San Bernardino is the largest county in the United States by area. According to the County of San Bernardino’s indicators, 82% of its 20,100 square miles is vacant land; it’s no wonder the county prioritizes infrastructure development, as there is so much barren desert land.

Renewable energy resources are being constructed at a record pace, but the rapid development of renewable energy infrastructure capacity for electric generation, transmission, and storage introduces a host of social and environmental problems. It seems then that County of San Bernardino characterize the problem as related to the scale of development. Still, the focus on *how much?* implies maximizing development may be a priority over addressing specific community needs first.

For the next part of this analysis, I looked at cases that are not considered in the description of the county’s capacity for renewable energy development. While the County of San Bernardino’s report assumes the community needs added renewable energy capacity, it does little to address any concerns of existing grid reliability.

As an example, I’ve compared Yucca Valley, Palm Springs, and Victorville, CA. Palm Springs and Yucca Valley are very near each other—almost adjacent, geographically speaking, but are in different counties; this therefore excludes Palm Springs from the County of San Bernardino energy study. Meanwhile

Victorville and Yucca Valley are both in San Bernardino County, roughly 60 miles apart as the crow flies.

Palm Springs Population Pyramid 2024

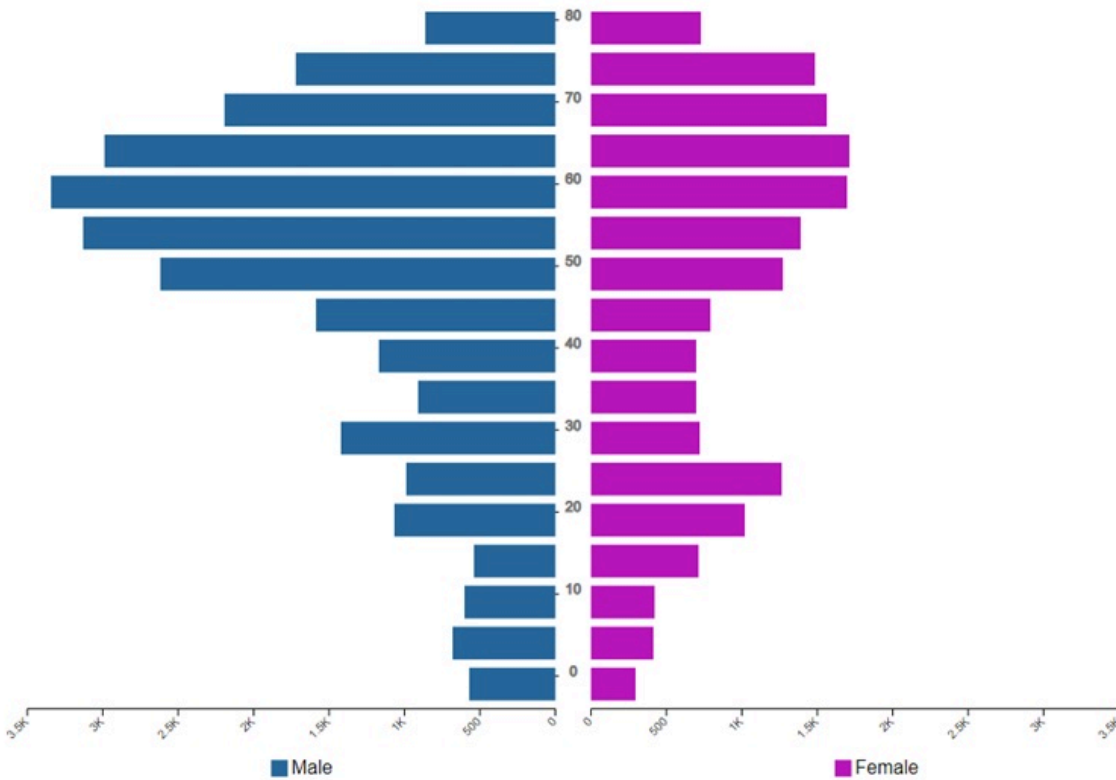


Fig. 3: (World Population Review, 2024)

Palm Springs' population of 46,000 tends to be relatively older, with a median age of 57.3 years old. The median annual salary is ~\$48k, and the city faces an overall poverty rate of 13.89%. On average it is expected the city's population will grow by 0.64 - 0.66% yearly.

Yucca Valley Population Pyramid 2024

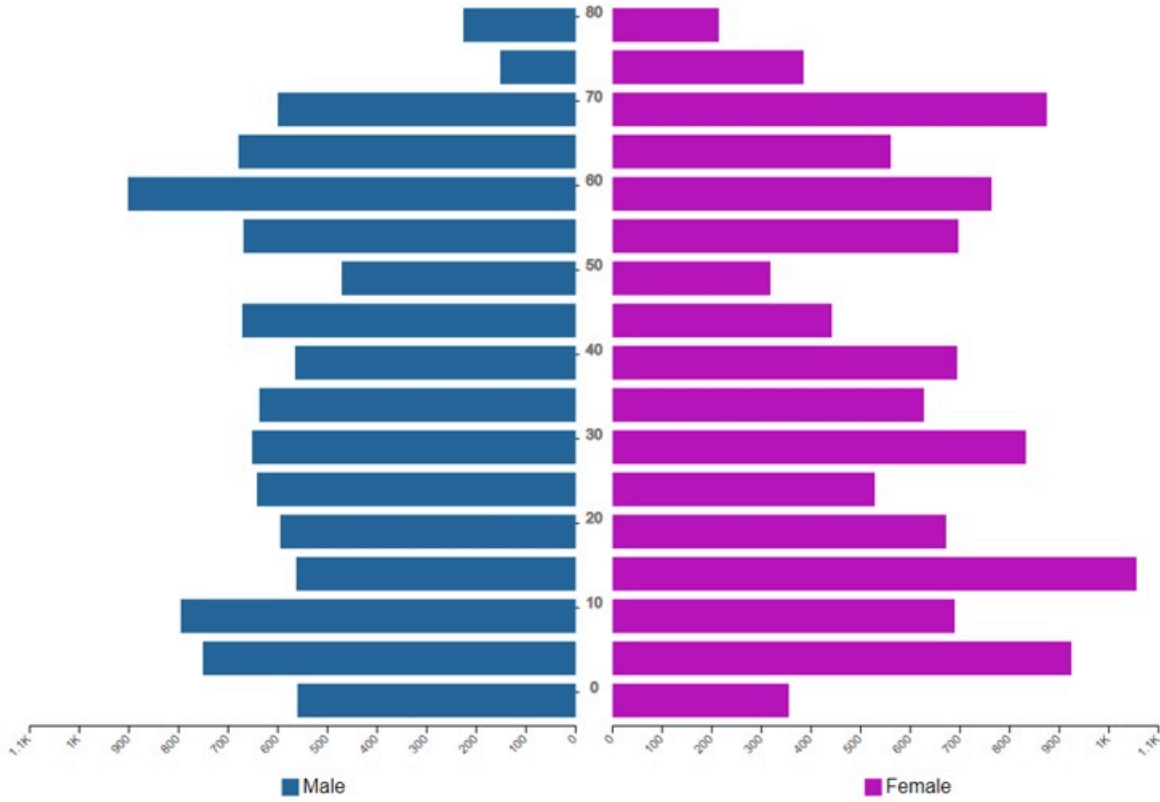


Fig. 4: (World Population Review, 2024)

Yucca Valley has a population of around 21,500, with a very mixed distribution of ages (Fig. 4). The median age is 39.9. The average salary is ~\$40k, with an overall poverty rate of 20.17%. On average, Yucca Valley's population is expected to shrink by roughly 0.21% yearly.

Victorville Population Pyramid 2024

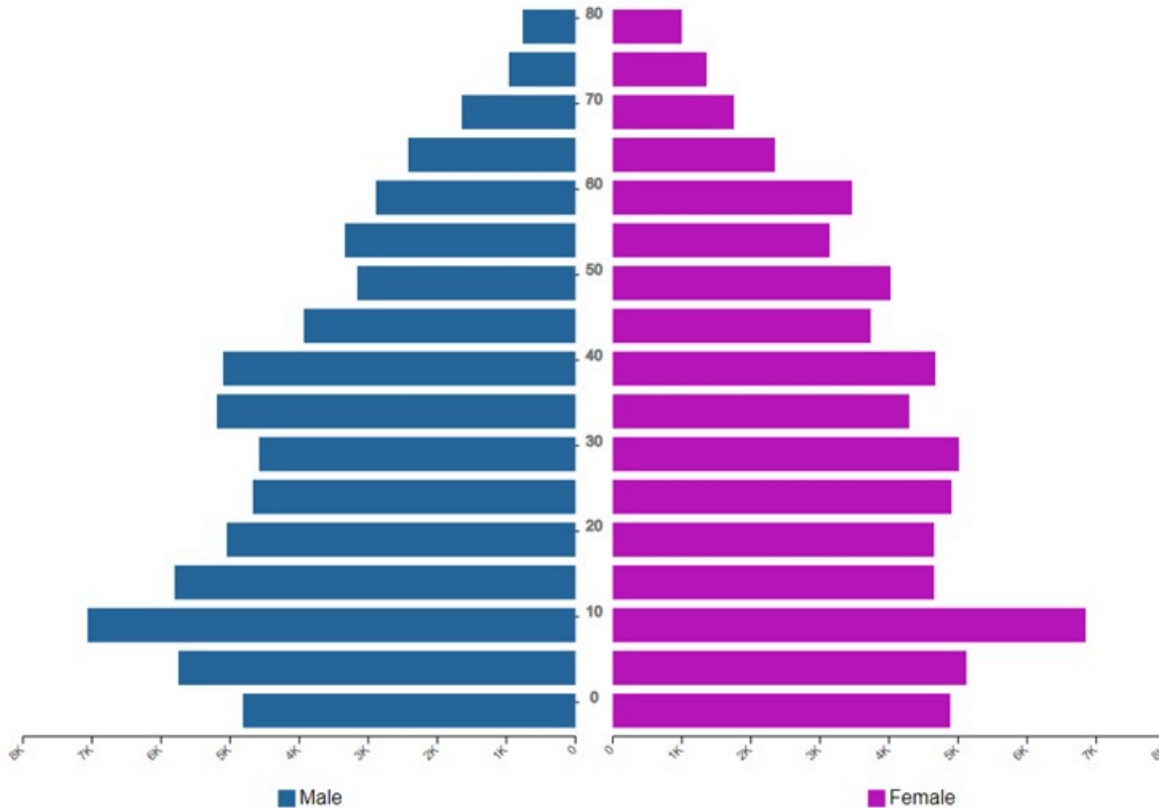


Fig. 5: (World Population Review, 2024)

Victorville has a population of around 139,800, with a young-leaning distribution of ages (Fig. 5). The median age is 31.8. The average salary is ~\$39k, with an overall poverty rate of 20.17%. On average, Victorville's population is expected to grow by roughly 0.93% yearly.

To assess whether there were prevalent issues related to grid reliability, I analyzed Southern California Edison (SCE) (2023) reliability data by energy district (Fig. 6). Together with quantitative census data, some interesting latent analysis opportunities became evident.

I immediately identify large variation in outage trends for different locations. Having identified these variables, I can now frame this investigation as a sociological interpretation of this otherwise quantitative data, acknowledging that the motivation for this SCE data is a quantitative assessment of outages to prioritize areas where outages were due to equipment failure rather than public safety power shutoffs or planned outages (i.e. brownouts and system upgrades). My primary focus for this outage data set is primarily looking at alternative metrics for those communities which may reveal root causes for a richer analysis of energy system priorities. To better compare overlooked community information relevant to

energy assessments, I decided comparing two was most logical; I deliberately omitted Victorville for primary analysis, choosing instead Yucca Valley and Palm Springs since they have similar demographic data but more disparate energy resource conditions.

I only want to discuss one result for the assessment of Victorville’s outage data. In Fig. 6, We can observe a correlation between Victorville’s population growth and the number of outages reported by SCE due to power safety shut-offs, maintenance/repairs, and upgrades, etc. (i.e., grid reliability). Since 2019, Victorville has had a boom of nearly 20% population growth. Given projected steady population growth (County of San Bernardino, 2017), grid reliability should be a strong consideration in planning energy projects. Further ethnographic analysis could support or refute the need for grid reliability but would certainly provide better data as to where energy poverty arises and where it hits hardest.

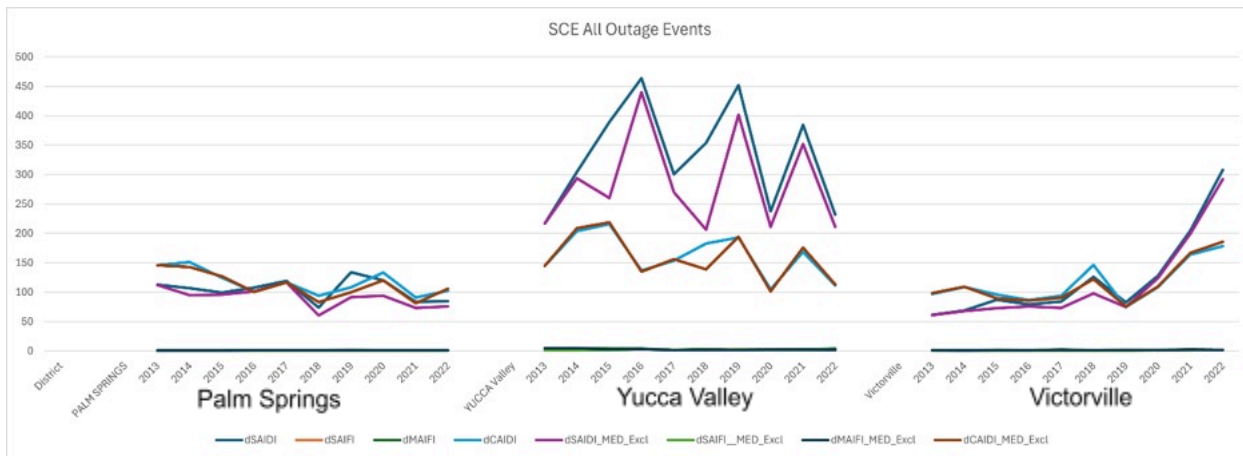


Fig. 6: "..._MED_Excl" data points exclude equipment outages, upgrades, and installations (i.e., service-related, or safety-related outage only). Note the drastic gap between outage and "..._MED_Excl" outage trends, indicating that a large number of outages were equipment related. Created from data from (SCE, 2023) reliability report data.

Yucca Valley

Yucca Valley has historically seen high frequency of electricity outage events relative to other analyzed cities. This implies a need to improve grid infrastructure, as outages are not necessarily related to population growth/decline such as posited for Victorville. Again, this suggests that building new renewable energy infrastructure might not be the community’s top priority before reliable grid access. Fig. 4 shows relatively little variation in population separated by age; this is an unusual distribution; however, given the relatively small population, this data is easily skewed. Nonetheless, there is a relatively older population distribution compared to most cities. In effect, there is a larger population that is especially vulnerable to environmental hazards associated with a changing climate.

In Yucca Valley this amounts to extreme heat, freezing temperatures, flooding, fires, and occasional poor air quality due to smoke or sandstorms. Also, Yucca Valley has disproportionately higher equipment-related outages than neighboring cities. “[Outage] events can also create vulnerabilities for Yucca Valley community members. The vast majority of homes and business do not have backup power supplies, so a loss of electricity can cause a loss of refrigeration for food and medical supplies, limit cooking, cause loss of heating or cooling [...] lighting, and limited or no access to the internet or other information systems. Many businesses are forced to close during [an outage], causing economic hardships and depriving community members of important services such as grocery stores, gas stations, and banks/ATMs” (Town of Yucca Valley, 2022).

This assessment reflects fairly common topics of inquiry found in vulnerability assessments; however, due to the context, the main purpose of this report is to analyze the state of the town and the goals for future development. Therefore, I believe, the data presented has an intimate flavor and is rooted in community interests. Vulnerability assessments do appear within energy assessments, and include the climatic, economic, and demographic geographic data, however the nature of these is quantitative, and they don’t normally consider community history and dynamics. Fig. 7 below shows a snippet of a vulnerability assessment chart found in the Yucca Valley general plan vulnerability assessment (2022) includes many categories of social and environmental community features—the full assessment results list many more indicators. Importantly, the goal for this assessment is “to increase community resilience and help lower vulnerability scores, particularly for populations and assets that received a score of V4 or V5” (Town of Yucca Valley, 2022). As one can observe in Fig. 7, the town has its work set out, as most of the population data reflects V4 or V5 (except for renters—an inexplicable benefit of renting in Yucca Valley). Based on community health and vulnerability considerations, there is a more pressing need for improving grid reliability than for expanding energy generating resources.

POPULATIONS AND ASSETS	AIR QUALITY	DROUGHT	EXTREME HEAT & WARM NIGHTS	FLOODING	HUMAN HEALTH HAZARDS	LANDSLIDES	SEVERE WEATHER	WILDFIRE
Low-income households	V4	V5	V5	V4	V4	V3	V3	V4
Outdoor workers	V5	V5	V5	V3	V5	V2	V4	V5
Overcrowded households	V3		V5	V3	V4	V4	V2	V3
Persons experiencing homelessness	V5		V5	V5	V5	V4	V5	V5
Persons living on single-access roads	V1		V1	V3		V4	V3	V4
Persons with chronic illnesses	V5		V5	V4	V4	V4	V5	V5
Persons with disabilities	V3		V5	V4	V3	V4	V4	V5
Persons without access to lifelines	V3		V5	V5	V3	V4	V4	V5
Renters	V3	V4	V3	V3	V2	V3	V4	V3
Seniors (65+)	V4		V5	V4	V4	V4	V3	V5
Seniors living alone	V5		V5	V5	V5	V5	V4	V5
Undocumented persons	V4		V5	V4	V5	V4	V5	V4
Airports			V3	V4			V2	V3
Biking and hiking trails			V1	V2		V4	V2	V4
Bridges			V3	V4		V3	V4	V3

Fig. 7: Snippet of results for Town of Yucca Valley vulnerability assessment report (Town of Yucca Valley, 2022)

Palm Springs

Palm Springs has maintained a relatively low level of outage events. With a lower population and larger area than Victorville (thus a lower population density), higher average income and lower poverty rate, which also impacts available funding for public projects, or community development. Palm Springs lies in Riverside County and is included in Riverside County's Western Coachella Valley Area Plan (2021), which covers community demographics and economic and land-use projects. Some specific zones are called out as having a high capacity for energy resource development due to physical features or climate. However, this is an assessment of available resources, and economic opportunity, and not an assessment of community needs or priorities.

It was not surprising that SCE's (2023) outage data showed Palm Springs experiences fewer outage events; from a high level, this probably implies greater grid reliability. However, another element that differentiates it from Yucca Valley is population density. Although Palm Springs technically has a lower population density, much of it is uninhabited desert, and the majority of the population resides in smaller, central subdivisions of Palm Springs. This is not the case in Yucca Valley, which is much more dispersed. The maximum estimated population density in Yucca Valley is estimated to have around 3800 per square mile within subdivision groups, whereas in Palm Springs the maximum is estimated to have 5700 within

neighborhoods (Statistical Atlas, 2018)—quite a large difference, supposing the measured sample areas are similar in size. See Figs. 8 & 9. Therefore, I posit we are observing two very different energy systems at play; technically and practically, it is more efficient to build electric utilities grouped in a smaller area. This reduces the scale of required transmission infrastructure needed per capita, and as a result reduces the maintenance requirements and risks of malfunction.

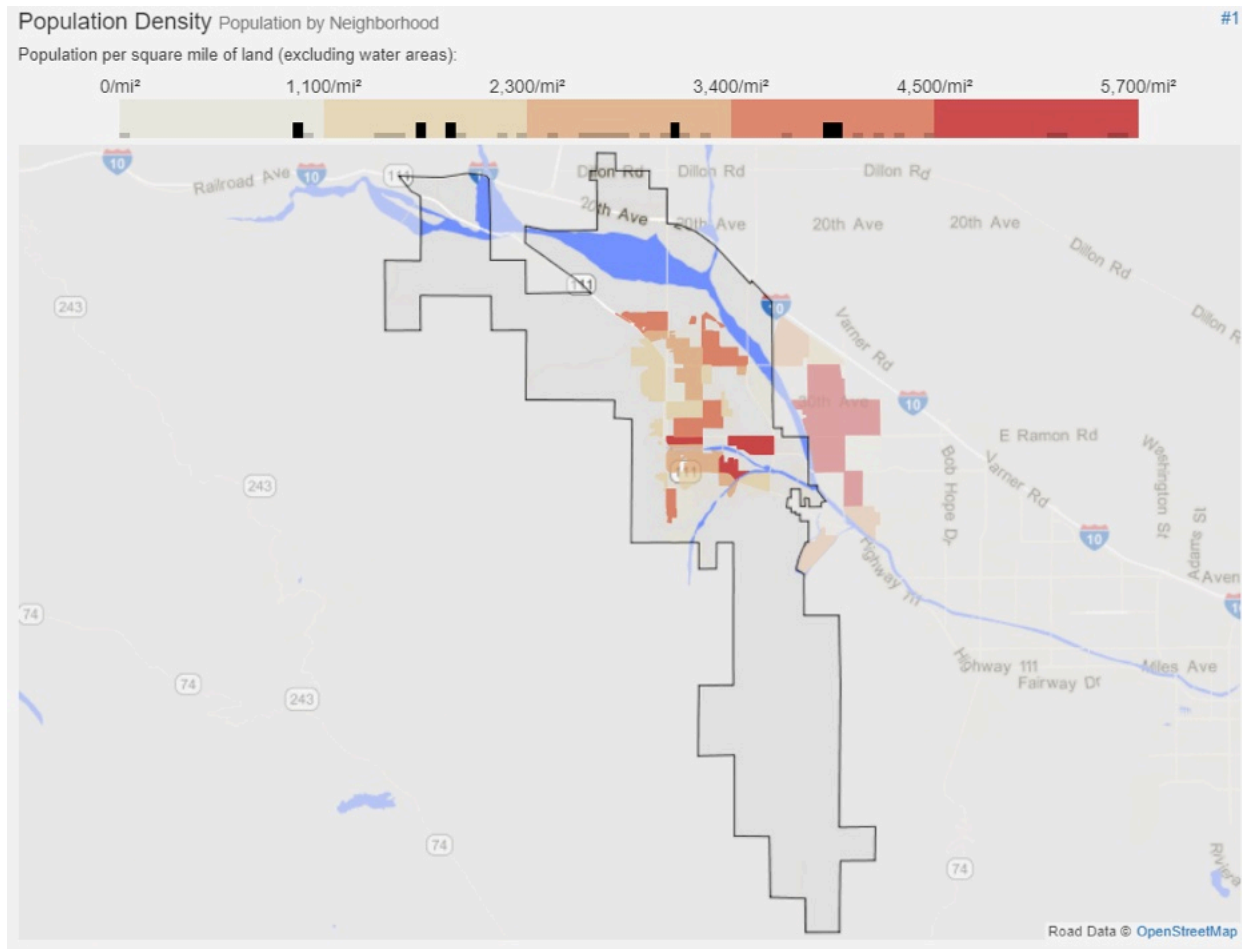


Fig. 8: Population density of Palm Springs by neighborhood (Statistical Atlas, 2018)

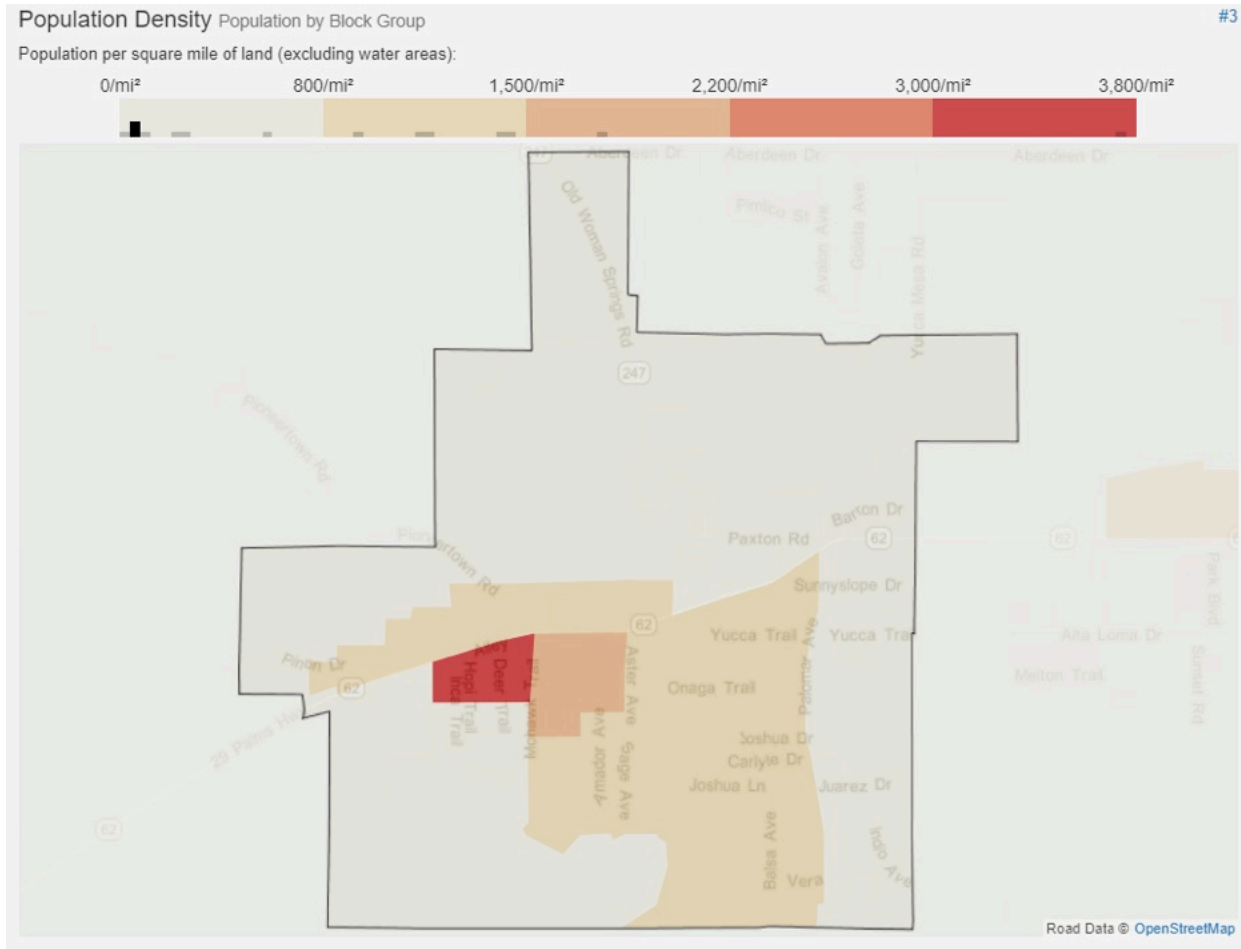


Fig. 9: Population density of Yucca Valley by block group (Statistical Atlas, 2018)

In stark contrast, Yucca Valley is more dispersed (most of it), dotted with old homesteads that sit on several acres of land; this requires an extensive transmission infrastructure to provide grid access to remote residents.

Although I was not able to locate this data, it would be interesting to compare outage data for different areas within these cities in order to develop a better social frame to understand where and why the outages occur, and how that could impact specific areas.

Conclusion

To pave the way for an equitable, just, and sustainable transition to clean energy resources, we must focus on the communities those resources impact. I broadly define community as not just a society but the locality it inhabits as well. In essence, community is the entire ecosystem with which the respective society engages. On the other hand, some regard community as specifically depicting interpersonal relationships.

For example, Chavis and Lee (2015) describe community as “not a place, a building, or an organization; nor is it an exchange of information over the Internet. Community is both a feeling and a set of relationships among people. People form and maintain communities to meet common needs.” Ultimately, I believe it is all of these things; community can be made up of any sort of social, demographic, ideological, geographical slice of society; arguably, these attributes are just some by which we can classify community. Not only because it is simpler that way, but it also gives belonging to members of the community. That gives it the underlying connotation that is lacking in literal and rhetorical sources. Community implies sharing and/or togetherness. Census and health surveys, and other official community data collection methods of all sorts define different forms of community based on an intersectionality of demographics, geography, income, climate, etc. Or sometimes, it can simply define a population with shared traits. For example, Dr. Nock defined community succinctly as “a group of people who share similar beliefs and cultural values” (D. Nock, personal communication, March 1, 2024) while Ana Rico described it as “all of it, everyone is included” (A. Rico, personal communication, March 1, 2024).

There are many lenses by which we can view community. I believe ethnographic community data can be integrated in energy assessments to produce a more accurate, polyvocal analysis of how and why communities experience energy poverty, and of energy needs in general. All the various ways to describe Energy form a collective definition that reflects its value, and our energy needs today. This definition is a necessary first step to identify energy poverty and its impact at various scales.

In the context of my project, both interviewees worked in different dimensions of the energy-sociology space. Speaking to both was in itself a form of ethnographic data collection, and after my discussions I believe that we would benefit from greater participation and collaboration from experts in data collection to advocate for ethical and equitable assessments, and report on gaps in data collection resources.

In the studies of Victorville (concisely), Yucca Valley, and Palm Springs outage data, comparing data from different types of assessments (e.g. the city and county general plans, environmental assessments, census, and public health data, etc.) was instrumental in determining additional questions needed for an assessment to capture a richer narrative of local energy systems and communities. In this case, further latent content analysis begged the question: what social and ethnographic community indicators differentiate the performance of energy infrastructure in neighboring communities with similar geographic characteristics? I aimed to show through this analysis that social indicators relate to accessibility of reliable infrastructure. They can reveal other root causes of energy poverty, ones that may be invisible in standard energy assessment data.

Overall, my research and analysis showed the potential for applying ethnographic data collection methodology in the assessment of energy needs. The goal is to improve energy assessments to promote just transitions and energy justice by giving communities greater accessibility, affordability, and agency of energy resources. Doing so will give communities a better framework and more power to address energy poverty.

Summary

In short, energy poverty, in many forms, is a widespread and pervasive global problem. It is closely interwoven with complex societal systems and is therefore difficult to identify. Even though there is

abundant research and data about energy resources, there remains a lack of thorough community data collection methods in regard to energy resource management. Energy assessments rely on quantitative data to produce technical and measurable results. Overlooking ethnographic data limits an energy assessment's capacity to capture and represent community energy needs. Including this data in analysis does not need to be an onerous task. No need to reinvent the wheel: there are various ethnographic community needs assessment models which already engage in this sort of data collection. I believe we can borrow from these models, or directly use data from existing such datasets, even when assessments are done for different purposes. We find that energy assessments fall short of incorporating this sort of qualitative data, which could provide a framework for community-driven energy resource management.

There are countless combinations of ethnographic factors that can influence a community's unique energy needs; and many of those elements are already captured in other forms of community assessments. In keeping with the theme of meshing the technologic and ethnographic, an ethnographic framing of energy assessments could help identify root causes of energy poverty and help communities overcome access, affordability, and agency challenges.

Afterword

At the onset of MESH, we were asked to reflect on our place in a liminal space of learning, and to continue to do so throughout the program. At this point, the end of the program, I believe there is no other side to the liminal space—we can hit the ejector seat button at any time, but there is no end to knowledge, it continues on. It is up to us to choose when to exit the liminal space having made progress sufficient for oneself. Given more time this and other MESH topics can hypothetically be researched ad infinitum; I had to hack down entire sections of this report and cut short my research as a matter of wrapping things up and calling it *good enough*. I have also been working on a painting (among other frivolous distractions) alongside my MESH capstone project. This painting is planned as a gift, so it has a deadline as well. Analogously, the finality of a painting is subjective, and this one perpetually feels *not there yet*; nonetheless, I will soon have to call it done: cure, varnish, and a sigh of closure. As my project came into focus, so did my painting—what started as an experiment in warm/cold contrast took on a meaning and unique symbolism that I had not anticipated; I won't say what it means to me, but I invite your own interpretation.



By the way I don't know how this picture will look in various digital formats, I welcome you to visit more of my art on my Instagram handle [@ehrmannshai](#)

-Shai

Bibliography

- Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, 2(2), 8–14. Scencedirect. <https://doi.org/10.1016/j.npls.2016.01.001>
- Birol, F. (2007). Energy Economics: A Place for Energy Poverty in the Agenda? *The Energy Journal*, 28(3), 1–6. <http://www.jstor.org/stable/41323106>
- California Energy Commission. (2024a). *Energy Maps of California*. California Energy Commission. <https://www.energy.ca.gov/data-reports/energy-maps-california>
- California Energy Commission. (2024b). *Funding Resources*. California Energy Commission. <https://www.energy.ca.gov/funding-opportunities/funding-resources>
- Cambridge Dictionary. (2024). *Community*. <https://dictionary.cambridge.org/us/dictionary/english/community>
- Centers for Disease Control and Prevention. (2013). Community Needs Assessment. In *Centers for Disease Control and Prevention*. https://www.cdc.gov/globalhealth/healthprotection/fetp/training_modules/15/community-needs_pw_final_9252013.pdf
- Chavis, D. M., & Lee, K. (2015). *What Is Community Anyway?* Ssir.org; SSIR. https://ssir.org/articles/entry/what_is_community_anyway
- Che, X., Jiang, M., & Fan, C. (2021). Multidimensional Assessment and Alleviation of Global Energy Poverty Aligned With UN SDG 7. *Frontiers in Energy Research*, 9. <https://doi.org/10.3389/fenrg.2021.777244>
- City-data. (2024). *Victorville, California (CA 92392) profile: population, maps, real estate, averages, homes, statistics, relocation, travel, jobs, hospitals, schools, crime, moving, houses, news, sex offenders*. Www.city-Data.com. <https://www.city-data.com/city/Victorville-California.html>
- Collins. (2024). *Community*. <https://www.collinsdictionary.com/us/dictionary/english/community>
- Cong, S., Nock, D., Qiu, Y. L., & Xing, B. (2022). Unveiling hidden energy poverty using the energy equity gap. *Nature Communications*, 13(1), 2456. <https://doi.org/10.1038/s41467-022-30146-5>
- County of Riverside. (2021). Western Coachella Valley Area Plan. In <https://planning.rctlma.org/sites/g/files/aldnop416/files/migrated/Portals-14-genplan-GPA-2022-Compiled-WCVAP-4-2022-rev.pdf>.
- County of San Bernardino. (2017). *Count of San Bernardino General Plan - Renewable Energy and Conservation Element*. <https://www.sbcounty.gov/uploads/LUS/Renewable/RECElementFINALADOPTEDVersion8817WEB.pdf>

- Dictionary.com. (2024). Community. In *Dictionary.com*. <https://www.dictionary.com/browse/community>
- Ferrall-Wolf, I., Annelise Gill-Wiehl, & Kammen, D. M. (2023). A bibliometric review of energy justice literature. *Frontiers in Sustainable Energy Policy*, 2. <https://doi.org/10.3389/fsuep.2023.1175736>
- Fit and Healthy Vermonters. (n.d.). *Community Assessment Tool Kit: Nutrition and Physical Activity Fit and Healthy Vermonters Community Assessment Tool Kit: Nutrition and Physical Activity*. https://vnrc.org/wp-content/uploads/2019/12/Fit_and_Healthy_Vermonters_Community_Assessment_Toolkit.pdf
- Gaines, L., & Mintz, M. (1994). *Energy Implications of Glass-Container Recycling*. US Department of Energy. <https://www.nrel.gov/docs/legosti/old/5703.pdf>
- Institute on the Environment. (2023). *Mini Grants & DEIJ Grants*. University of Minnesota. <https://environment.umn.edu/fellows-grants/grants/>
- Karekezi, S., Mcdade, S., Boardman, B., Kimani, J., & Lustig, N. (2012). *Energy, Poverty, and Development Convening Lead Authors (CLA) Lead Authors (LA) Review Editor*. https://previous.iiasa.ac.at/web/home/research/Flagship-Projects/Global-Energy-Assessment/GEA_Chapter2_development_lowres.pdf
- Lee, J., & Byrne, J. (2019). Expanding the Conceptual and Analytical Basis of Energy Justice: Beyond the Three-Tenet Framework. *Frontiers in Energy Research*, 7. <https://doi.org/10.3389/fenrg.2019.00099>
- Li, D., Bae, J. H., & Rishi, M. (2022). Sustainable Development and SDG-7 in Sub-Saharan Africa: Balancing Energy Access, Economic Growth, and Carbon Emissions. *The European Journal of Development Research*. <https://doi.org/10.1057/s41287-021-00502-0>
- Long, T., & Johnson, M. (2000). Rigour, Reliability and Validity in Qualitative Research. *Clinical Effectiveness in Nursing*, 4(1), 30–37. <https://doi.org/10.1054/cein.2000.0106>
- MacQueen, K. M., McLellan, E., Metzger, D. S., Kegeles, S., Strauss, R. P., Scotti, R., Blanchard, L., & Trotter, R. T. (2001). What is community? An evidence-based definition for participatory public health. *American Journal of Public Health*, 91(12), 1929–1938. <https://doi.org/10.2105/ajph.91.12.1929>
- MIT D-Lab. (2017). *Energy Assessment Toolkit Training & Supporting Documents*. MIT. <https://d-lab.mit.edu/research/energy/energy-needs-assessment-toolkit/training-supporting-documents>
- Olofsson, V. (2023). Energy Justice and Territory: Present and Futures of Wind Energy in Brazil. *International Journal of Engineering, Social Justice, and Peace*, 10(1), 27–49. <https://doi.org/10.24908/ijesjp.v10i1.16050>

- Perez-Sindin, X. S., Lee, J., & Nielsen, T. (2022). Exploring the spatial characteristics of energy injustice: A comparison of the power generation landscapes in Spain, Denmark, and South Korea. *Energy Research & Social Science*, 91, 102682. <https://doi.org/10.1016/j.erss.2022.102682>
- Qian, Y., Xu, Z., Gou, X., & Škare, M. (2022). A survey on energy justice: a critical review of the literature. *Economic Research-Ekonomska Istraživanja*, 1–30. <https://doi.org/10.1080/1331677x.2022.2155860>
- Roddis, P., Roelich, K., Tran, K., carver, S., Dallimer, M., & Ziv, G. (2020). What shapes community acceptance of large-scale solar farms? A case study of the UK's first "nationally significant" solar farm. *Solar Energy*, 209, 235–244. <https://doi.org/10.1016/j.solener.2020.08.065>
- Ryan, S. E., Hebdon, C., & Dafoe, J. (2014). Energy research and the contributions of the social sciences: A contemporary examination. *Energy Research & Social Science*, 3, 186–197. <https://doi.org/10.1016/j.erss.2014.07.012>
- SCE. (2023). Annual Electric Reliability Report For Year 2022. In *SCE Reliability Reports and Public Meeting*. https://www.sce.com/sites/default/files/custom-files/PDF_Files/2022_Annual_Electric_Reliability_Report.pdf
- Schmal, J. (2023). *Monolingualism in Mexico (2010)*. Indigenous Mexico. <https://www.indigenoustmexico.org/articles/monolingualism-in-mexico-2010>
- Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science*, 1, 1–29. <https://doi.org/10.1016/j.erss.2014.02.003>
- Statistical Atlas. (2018). *The Demographic Statistical Atlas of the United States*. Statisticalatlas.com. <https://statisticalatlas.com/place/California/Palm-Springs/Population#data-map/neighborhood/population-density>
- Town of Yucca Valley. (2022). *Appendix C: Vulnerability*. General Plan Update. <https://www.yucca-valley.org/our-town/departments/community-development/planning/general-plan-update>
- Trumbull, K., & Deshazo, J. (2021). *Southern California Regional Energy Needs Assessment*. <https://innovation.luskin.ucla.edu/wp-content/uploads/2021/07/Southern-California-Regional-Energy-Needs-Assessment.pdf>
- U.S. Department of Energy. (2022). *Alternative Fuels Data Center: Maps and Data*. Afdc.energy.gov. <https://afdc.energy.gov/data>
- United States Environmental Protection Agency. (2018). *How we use water*. US EPA. <https://www.epa.gov/watersense/how-we-use-water>

van der Valk, O. M. C., & De Vos, B. I. (2016). Family ties, preconceived images and trust: How local community defines market collaboration in the Dutch fish chain. *Marine Policy*, 71, 175–183. <https://doi.org/10.1016/j.marpol.2016.05.019>

World Population Review. (2024). *Cities*. Worldpopulationreview.com. <https://worldpopulationreview.com/us-cities/>

Justice Unleashed: Transforming the Tijuana River Watershed through Socio-Environmental Empowerment

Marleigh Mitchum

Shiley-Marcos School of Engineering

MESH 540: Capstone Project Course

Willy Oppenheim, Ph.D

April, 14, 2024

Justice Unleashed: Transforming the Tijuana River Watershed through Socio-Environmental Empowerment

The Tijuana River flows through the United States and Mexico, encompassing broad social and environmental challenges stemming from trash, sewage, and sediment pollution due to inadequate infrastructure. Addressing these issues is a complex task due to jurisdictional boundaries; while efforts have been made on both sides of the border, they have not been sufficient. Subsequently, the Tijuana River continues to suffer from heavy pollution, contaminating the water quality and directly impacting social and environmental health. This paper aims to raise awareness of the social and environmental inequities within the watershed by examining existing research. This paper pursues socio-environmental empowerment for the Tijuana River Watershed by applying socio-environmental justice principles, exploring sustainable initiatives, and researching local organizations making a positive difference. The findings ultimately illustrate how socio-environmental justice principles can play a role in shaping equitable and sustainable solutions that address socio-environmental injustices in the Tijuana River Watershed while empowering marginalized communities and fostering collaboration.

Literature Review

Background Context

The Tijuana River watershed spans 1,750 square miles, with three-quarters in Mexico and the remainder in the United States ([San Diego Regional Water Quality Control Board, 2023](#)). The watershed traverses Mexico's deserts and mountains, ultimately flowing into the Pacific Ocean and forming the Tijuana River Estuary, designated as a US National Estuarine Research Reserve ([TRNERR, 2024](#)).

Unfortunately, the watershed is subject to pollution due to inadequate trash and sewage infrastructure, primarily stemming from rapid urbanization. Rapid urbanization placed tremendous strain on Tijuana's sewage infrastructure, causing significant challenges for communities on both sides of the California-Mexico border ([San Diego Regional Water Quality Control Board, 2023](#)). Simmons ([2022](#)) points out the key factors that contributed to this population surge, leading to the emergence of impoverished communities lacking essential infrastructure like water, electricity, and waste management systems:

1. During the Prohibition Era in the 1920s, internal migration increased as laborers streamed in for alcohol distribution and consumption.
2. The Maquiladora Program, initiated in the 1960s, attracted foreign manufacturers and investors to Mexico's border cities, leveraging duty-free import laws and low-cost labor.
3. World War II's demands for agricultural labor led to the Bracero program, drawing millions of workers to US farms, concurrently increasing Tijuana's population substantially.
4. The termination of the Bracero Program in 1965 spurred Mexico's Border Industrialization Program, encouraging foreign investments in border regions.

Today, in the most impacted areas, dirt roads have become so eroded that they are impassable by automobiles ([Simmons, 2022](#)). Subsequently, housing in these areas lacks access to proper trash collection

services, accumulating trash along the hillsides, canyons, and ravines. Eventually, runoff originating from the steep hillsides of Tijuana carries the sediment and trash from the urban areas downstream, crossing the border into California and making its way into the Tijuana River Estuary, ultimately exacerbating environmental challenges (EPA, 2022).

Additionally, the Tijuana River valley in the United States faces flood risks, endangering rural housing, agriculture, and equestrian activities in the vicinity (Albrecht, 2019). During intense storms, the river is prone to flooding, exposing contaminants like sewage waste, urban refuse, and illegally dumped pollutants, causing the water quality to become hazardous and contaminated with chemicals, bacteria, and heavy metals (Albrecht, 2019). This pollution poses public health risks to communities on both sides of the border (Calderón-Villarreal et al., 2022).

According to the San Diego Regional Water Quality Control Board, industrial facilities lacking adequate environmental protection regulations contribute significantly to this pollution through improper wastewater management practices, making them significant contributors to the problem. These factories often operate without facing legal consequences, continuously discharging pollutants into the Tijuana River without enforcement or accountability (Calderón-Villarreal et al., 2022). Additionally, "free-trade" agreements between the US and Mexico contribute to rapid urban growth in Tijuana, restrict Mexican environmental regulation enforcement, and lead to sewage system and infrastructure underinvestment (Calderón-Villarreal et al., 2022). Consequently, local communities have long sought government intervention to manage their waste correctly. However, neither the US nor Mexican authorities have committed to effective, sustainable solutions.

Water Quality

High quality water is more than the dream of the conservationists, more than a political slogan; high quality water, in the correct quantity at the right place at the right time, is essential to health, recreation, and economic growth. — Edmund S. Muskie

Many studies have highlighted significant health risks associated with contaminated water. In a study conducted during the summer of 2019, water quality tests were carried out in densely populated areas, where sampling was taken from seven different sites along the canal from June to August (Calderón-Villarreal et al., 2022). The study focused on measuring levels of fecal indicator bacteria and chemical compounds typically found in wastewater. The findings revealed alarming levels of sewage contamination, with *E. coli* levels surpassing Mexican legal limits by four orders of magnitude (40,000 times), resembling untreated sewage levels (Calderón-Villarreal et al., 2022). This was notably worse than previous reports from the Mexican Federal Government in 2019, with coliform levels two orders of magnitude higher than measurements recorded between 1995 and 1997 (Wakida and Rivels, 1997, as cited in Calderón-Villarreal et al., 2022). The study concluded that the ingestion of riverside tube water (Iloraderos) and direct contact with river or storm drain water pose acute health risks to residents (Calderón-Villarreal et al., 2022).

Additionally, the study highlighted how access to clean drinking water was notably difficult for individuals living near the canal. Many locals had to rely on public restrooms and nearby businesses for water and sanitation services (Calderón-Villarreal et al., 2022). This infringes upon the fundamental human right to safe and clean water, as recognized by the United Nations, for drinking, hygiene, cooking, and other essential purposes. The United Nations emphasizes the importance of providing financial support, capacity

building, and technology transfer to ensure that all countries, especially developing ones, can offer safe, clean, accessible, and affordable drinking water and sanitation (UN, 2022). General Comment No. 15 from the Committee of Economic, Social, and Cultural Rights underscores that access to water is essential for human dignity and is fundamental for realizing other human rights (UN, 2022). Moreover, the World Health Organization recommends a daily water supply of 50 to 100 liters per person, free from chemical substances, radiological hazards, and microorganisms, to be considered safe (EPA, 2022). Additionally, water should be physically reachable and economically feasible.

One local, Max, shared his experience with Calderón-Villarreal et al.'s study (2022) after being deported from the United States, highlighting the struggles of accessing basic amenities:

When they'll let me in, I wash my clothes at the gas station when I go into the restroom. Sometimes they'll let me do it because I clean the restroom for them. That's how I pay to use the bathroom, I have to clean it. But at least I get to wash my stuff. Plus, I can sometimes fill up a bucket with water from the tap and bring it back here with me.

Firsthand accounts like Max's shed light on the specific challenges faced by locals, aiding in finding practical solutions that target the specific challenges; this perspective encourages innovative solutions tailored to the specific needs of the community and addresses factors contributing to environmental injustice, as detailed in Calderón-Villarreal et al., (2022).

It is evident that the lack of access to sanitation and clean drinking water directly impacts the surrounding communities of the Tijuana River and results in vulnerability and socio-environmental injustice. The locals' health and quality of life are significantly affected by this situation. The lack of adequate structural support to manage this crisis stems from cross-border governmental inaction or ineffective remedial measures (Calderón-Villarreal et al., 2022). Improving infrastructure stands out as a viable solution. Several remedial actions are necessary, as recommended by Calderón-Villarreal et al. (2022):

1. Elimination of tax relief programs for transnational corporations.
2. Strengthening of environmental enforcement mechanisms, including potential US sanctions on parent corporations.
3. Binational cooperation on comprehensive planning for private and public waste management.
4. Increased funding for environmental protection and public health monitoring of water quality.

Furthermore, achieving environmental and health justice requires trans-sectoral interventions involving legislative and community sectors. These interventions can ensure public access to safe drinking water, food, shelter, and healthcare (Calderón-Villarreal et al., 2022). Enhanced monitoring of various aspects of the issues and the associated threats will be crucial in developing practical solutions ([Scripps Institution of Oceanography](#)).

Methodology

The methodology of this paper integrates various research elements to examine complex social and environmental issues while maintaining ethical considerations through a social and environmental justice lens. The literature review explores existing research on social, environmental, and economic contexts concerning inequities in the Tijuana River Watershed region. The literature review primarily relies upon the research article written by Calderón-Villarreal et al. (2022), *Deported, homeless, and into the canal*:

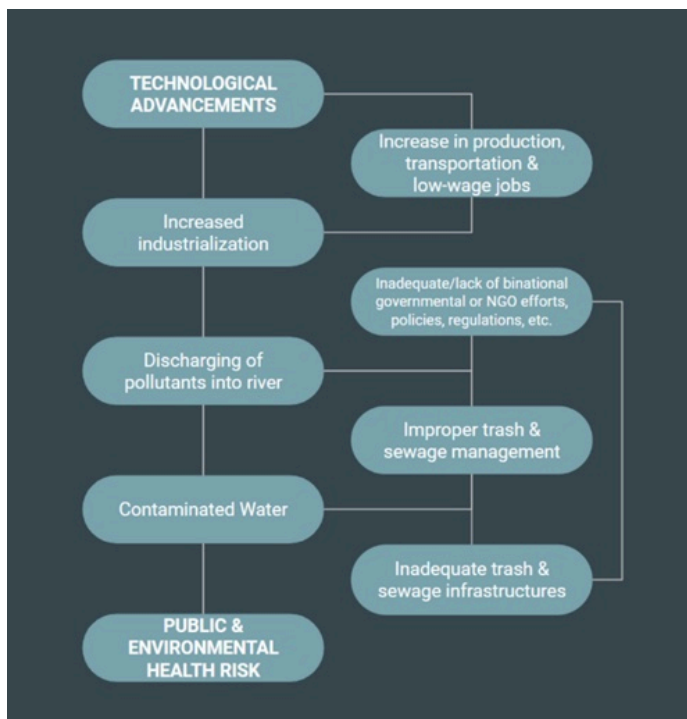
Environmental structural violence in the binational Tijuana River, to analyze the social, environmental, and economic inequities in the Tijuana River through a socio-environmental justice lens. The results and discussion section analyzes the application of socio-environmental justice principles and includes examples of organizations that effectively utilize socio-environmental justice principles. The book written by Walker (2012), *Environmental justice: Concepts, evidence and politics*, is primarily relied upon to illustrate principles of distributive justice, procedural justice, and justice as recognition, where their application to socio-environmental empowerment in the Tijuana River region is explored. In the section of the results and discussion that analyzes the feminist method, *In a Greener Voice: Feminist Theory and Environmental Justice*, written by Verchick (1996), by Verchick (1996), is primarily relied upon to illustrate the components of the feminist method, where its application to inequities surrounding the Tijuana River are explored. The methodology involves a multidimensional approach consisting of literature reviews, community-based research, and socio-environmental ethical considerations. The methodology involves examining social, environmental, and economic inequities within the Tijuana River region, where socio-environmental empowerment is pursued through the analysis and application of socio-environmental principles, as well as how governmental and non-governmental organizations can play a role in tackling inequities. Lastly, epistemological stances significantly influenced the nature and approach of this paper, recognizing that multiple perspectives and experiences shape socio-environmental issues. This perspective allowed for an exploration of diverse viewpoints, including those of marginalized communities, experts in the field, and stakeholder influences within socio-environmental injustices. Epistemological stances were used to analyze social, environmental, and economic contexts within the Tijuana River region. This lens allowed for a deep examination of the root causes of socio-environmental injustices, uncovering systemic inequalities, power imbalances, and ethical dilemmas in current approaches to environmental management and social justice. These epistemological stances guided the paper towards a comprehensive understanding of socio-environmental issues, encouraging critical reflection and the exploration of alternative perspectives and solutions through a socio-environmental justice lens.

Results and Discussion

A "risk society" refers to a society vulnerable to environmental hazards from agricultural and industrial activities. Communities along the Tijuana River exemplify this, facing pollution due to inadequate waste and sewage systems, impacting marginalized groups disproportionately and linking environmental inequality to public health. Using the concept of the "treadmill of production," I created a chart detailing factors contributing to these "risk societies" along the Tijuana River. It highlights the role of technology in production growth, transportation enhancement, economic expansion, and the environmental consequences due to deficient waste management systems.

Figure 1

Tijuana River Watershed, Treadmill of Production



Distributive Justice

Distributive justice refers to the equitable allocation of environmental impacts across land, water, air, and food, taking into account dimensions of vulnerability, need, and responsibility (Walker, 2012). As outlined by Walker (2012): *vulnerability* highlights how collective environmental burdens can affect individuals differently based on their physiological, economic, social, and cultural contexts, for instance, older individuals may be more susceptible to extreme temperatures, economically disadvantaged populations may lack resources to recover from environmental crises, immigrants might struggle with understanding environmental risks, and children can be particularly vulnerable to various types of pollution; *need* emphasizes the necessity for access to resources depending on specific circumstances, such as water, energy, and protection; Lastly, *responsibility* involves the unequal distribution of pollution burdens, where those responsible for pollution often impose consequences on nearby communities, creating disparities in environmental impact.

In the Tijuana River Watershed context, distributive justice encourages us to consider how environmental impacts, such as pollution and resource distribution, are distributed across different communities and groups. Through the lens of distributive justice, equitable and socially just solutions for the marginalized communities within the Tijuana River Watershed can include:

1. **Redistributing Environmental Benefits:** Ensuring that clean air, water, and land are accessible to all communities, regardless of socio-economic status. This might involve implementing policies to reduce pollution sources and improve environmental quality in underserved areas.
2. **Equitable Resource Allocation:** Fair distribution of necessary resources, opportunities, benefits, infrastructures, trash, and waste management facilities to promote environmental equity and reduce environmental burdens on disadvantaged communities.
3. **Community Engagement and Participation:** Involving affected communities in decision-making processes related to environmental policies, projects, and initiatives. This empowers communities to advocate for their rights and ensures their voices are heard when shaping sustainable interventions.
4. **Environmental Justice Advocacy:** Supporting advocacy efforts that address systemic injustices and promote policies prioritizing environmental justice, such as regulations to reduce pollution from industrial sources or infrastructure investments in underserved areas.
5. **Education and Awareness:** Promoting environmental education and awareness campaigns highlighting the link between social and environmental health and impacts. This fosters a sense of collective responsibility and encourages individuals and organizations to take action toward a more just and sustainable future.

In the context of the Tijuana River Watershed, equitable and socially just solutions under the lens of distributive justice through governmental and non-governmental organizations can include:

1. **Research and Data Collection:** Both sectors can invest in research and data collection efforts to understand environmental inequities, assess impacts on vulnerable populations, and identify effective interventions informed by distributive justice principles. Effective policies and regulations could be made based on the research findings.
2. **Policy Development and Regulations:** Governmental organizations can integrate distributive justice into policy development and regulation processes. This includes conducting equity assessments to identify and address environmental disparities, allocating resources based on need, and prioritizing environmental justice in decision-making frameworks.
3. **Community Engagement:** Both governmental and non-governmental organizations can engage with communities to ensure their voices are heard in environmental policy discussions. This involves conducting outreach, facilitating public forums, and incorporating community feedback into decision-making processes.
4. **Collaborative Partnerships:** Governments and NGOs can collaborate on projects that promote distributive justice to improve access to clean water and address environmental health disparities.
5. **Advocacy and Lobbying:** NGOs can engage in advocacy and lobbying efforts to influence governmental policies and decision-making processes, advocating for equitable and sustainable solutions that prioritize environmental justice and community well-being.

By applying distributive justice, we can identify disparities in environmental quality, resource access, and exposure to environmental hazards. The application of distributive justice could aid in creating a more socially and environmentally just Tijuana River Watershed region, where all communities have equal access to a healthy and sustainable environment. Furthermore, by aligning governmental and nongovernmental efforts with distributive justice principles, stakeholders can work collaboratively to address socio-environmental injustices and promote positive change for communities impacted by environmental disparities.

Procedural Justice

Procedural justice focuses on power redistribution, allowing affected communities to participate in decision-making processes (Walker, 2012). It entails respecting their input, ensuring meaningful involvement, providing access to information and resources, and integrating them into community-based environmental research initiatives (Walker, 2012). Procedural justice implies that those affected by environmental policies should have input in decision-making processes. Mere consultation is insufficient; impacted groups must have meaningful input into policies affecting their health and well-being (Walker, 2012). Currently, power is disproportionately held by governmental agencies, corporations, and stakeholders, leading to the exclusion of impacted groups in decision-making processes that could affect them. Redistributing power is crucial for achieving procedural justice.

In the Tijuana River Watershed context, procedural justice can advocate for governance structures that empower affected communities, environmental organizations, and governmental agencies to collaborate effectively. Procedural justice fosters transparency, accountability, and fairness by ensuring stakeholders have a voice in environmental policies, regulations, and interventions. This approach reduces the likelihood of decision-making processes being dominated by powerful entities at the expense of marginalized communities. Furthermore, procedural justice emphasizes the importance of access to information, resources, and opportunities. This enables communities to engage in data collection, environmental monitoring, and policy implementation, ultimately empowering them to contribute actively to solutions that directly impact their well-being. This can also involve establishing participatory platforms like community forums, stakeholder meetings, and collaborative workshops. These platforms can facilitate dialogue, knowledge sharing, and consensus building, leading to more informed and inclusive decision-making processes. Additionally, procedural justice would encourage incorporating diverse perspectives, local knowledge, and experiences into environmental planning and management. This can ensure that interventions are responsive to the specific needs and priorities of the different community groups.

In the context of the Tijuana River Watershed, equitable and socially just solutions under the lens of procedural justice through governmental and non-governmental organizations can include:

1. **Transparency and Accountability:** Procedural justice promotes transparency and accountability in governance. By openly sharing information, disclosing decision-making processes, and ensuring that decisions are made based on fair and objective criteria, trust is built among stakeholders. This trust is crucial for implementing policies and interventions that benefit all parties involved.
2. **Inclusive Decision-Making:** Procedural justice emphasizes the importance of inclusive decision-making processes. By involving diverse stakeholders, including affected communities, environmental experts, policymakers, and NGOs, in discussions and planning, policies can better reflect the specific needs of the community members. This inclusivity leads to more effective solutions that target specific topics.
3. **Community Empowerment:** Procedural justice empowers communities by giving them a voice in shaping policies and interventions that directly impact their lives. Through participatory processes, communities can contribute local knowledge, expertise, and perspectives, leading to solutions that are contextually relevant and sustainable in the long term.
4. **Adaptive and Responsive Policies:** Procedural justice encourages adaptive and responsive policies that can involve community-based feedback, evaluation, and continuous improvement. This flexibility allows policies and interventions to be adjusted based on changing socio-environmental

conditions, emerging challenges, and evolving community needs, ensuring their relevance and effectiveness over time.

Applying the principles of procedural justice to governmental and nongovernmental organizations creates an environment for positive change, policy innovation, and sustainable interventions in addressing socio-environmental injustices. It fosters collaboration, empowers communities, promotes fairness, and strengthens the effectiveness of efforts aimed at achieving social and environmental justice.

Justice as Recognition

Justice as recognition focuses on acknowledging historical and ongoing environmental vulnerabilities experienced by various social groups (Walker, 2012). It addresses issues of oppression, discrimination, and racism, which result in unequal recognition of different social identities such as race, gender, ethnicity, and religion (Walker, 2012). Justice as Recognition emphasizes recognizing and prioritizing vulnerable groups with unique historical and present vulnerabilities to environmental harm (Walker, 2012).

Understanding how different concepts of racism have shaped social structures and environments over time is crucial in analyzing and addressing current environmental injustices faced by marginalized communities in the Tijuana River Watershed region (Walker, 2012). Examining historical contexts can help to understand the evolution of racism and its impact on contemporary environmental inequalities within the Tijuana River Watershed region.

Pulido (2000) sheds light on why communities of color are disproportionately affected by industrial practices and pollution compared to white communities, challenging the narrow view of racism as individual acts and highlighting its structural forms that perpetuate inequalities (Pulido, 2000). Pulido (2000) identifies three key issues: facility siting, intentionality, and an uncritical approach to scale, which contribute to a limited understanding of racism and its spatial dynamics within cities (Pulido, 2000). By introducing the concept of white privilege, Pulido (2000) expands our understanding of racism beyond individual acts to include discriminatory patterns in environmental regulation (Pulido, 2000). For instance, she discusses how industrial pollution is often away from white communities, showcasing the disconnect between intent and outcome in addressing racism (Pulido, 2000).

In the Tijuana River Watershed context, justice as recognition can prompt government and nongovernment organizations to address historical and systemic inequalities that contribute to socio-environmental injustices (Walker, 2012). This can include:

1. Recognizing and rectifying past injustices.
2. Advocating for equity in resource allocation and access.
3. Challenging discriminatory practices and policies.

For example, point 3, challenging discriminatory practices and policies, can aid in challenging police brutality that the marginalized groups of Tijuana experience. Upon involuntary return from the US through deportation, many individuals find themselves in the underclass or homeless category, facing social isolation, discrimination, stigma, and various social and environmental injustices (Calderón-Villarreal et al., 2022). These individuals often seek refuge along the Tijuana River Canal to evade police brutality. However,

during instances of police violence, residents are inadvertently exposed to the contaminated water of the Tijuana River, as the canal serves as a sanctuary from such incidents due to law enforcement's reluctance to approach or enter the water (Calderón-Villarreal, et al., 2022). By actively dismantling barriers and promoting inclusivity through the principles of justice as recognition, organizations can create a more just and equitable environment that supports positive change.

The Feminist Method

The feminist method, as introduced by Verchick (1996), can be a powerful tool in addressing social and environmental inequalities, offering three critical approaches, including unmasking, contextual reasoning, and consciousness-raising.

Unmasking involves questioning seemingly neutral environmental laws, policies, or decisions to uncover underlying social power dynamics (Verchick, 1996). By applying this approach to marginalized communities' injustices in Tijuana, we can reveal the root causes behind these issues and develop practical solutions that consider their experiences (Verchick, 1996).

Contextual reasoning involves understanding social and environmental problems within the real-life experiences of those most affected (Verchick, 1996). By embedding our understanding in the lived experiences of marginalized communities in Tijuana, we can better formulate policies and regulations that address their specific challenges and needs. Personal perceptions and historical narratives are crucial in enriching our understanding of these issues and acknowledging their impacts (Verchick, 1996).

Consciousness-raising involves sharing personal experiences to derive collective significance or meaning (Verchick, 1996). This process allows individuals and communities to share valuable information that can drive positive change and inform decision-making processes. Enabling communities to communicate their experiences with governments and stakeholders fosters opportunities for inclusive decision-making that incorporates their perspectives and realities (Verchick, 1996).

In the context of the Tijuana River Watershed, equitable and socially just solutions under the lens of the feminist method can include:

1. **Intersectional Analysis:** The feminist method encourages an intersectional analysis of social and environmental issues (Verchick, 1996). By considering how various factors like gender, race, class, and ethnicity intersect with environmental challenges, we gain a more comprehensive understanding of the injustices faced by different communities along the Tijuana River.
2. **Centering Marginalized Voices:** This perspective prioritizes centering the voices and experiences of marginalized groups, including women and other vulnerable populations (Verchick, 1996). By listening to and amplifying their perspectives, we can identify specific environmental injustices they face and tailor solutions that address their unique needs and concerns.
3. **Challenging Power Structures:** The feminist method challenges power structures perpetuating environmental injustices (Verchick, 1996). It calls for greater accountability from institutions and decision-makers, advocating for transparency, inclusivity, and meaningful participation of affected communities in environmental policy and decision-making processes.

In the context of the Tijuana River Watershed, equitable and socially just solutions under the lens of the feminist method through governmental and non-governmental organizations can include:

1. **Inclusive Policy Development:** The feminist method emphasizes inclusivity and amplifies marginalized voices (Verchick, 1996). By incorporating this approach into governmental and nongovernmental organizations, policies can consider all stakeholders' diverse needs and experiences, especially marginalized communities impacted by socio-environmental injustices.
2. **Advocacy for Gender and Environmental Justice:** This approach advocates for gender and environmental justice, highlighting the disproportionate impacts of environmental degradation on women and other marginalized groups. Governmental and nongovernmental organizations can use the feminist method to advocate for policies that promote environmental health equity, access to resources, and protection of vulnerable communities.
3. **Capacity Building and Education:** The feminist method promotes community capacity building and education (Verchick, 1996). Organizations can support initiatives that educate and empower individuals, especially women and youth, to advocate for their rights, participate in environmental decision-making, and implement sustainable practices at the grassroots level.

Application of the Feminist Method to the Women of the Tijuana Region

In 2014, Calderón-Villarreal et al. conducted a study capturing women's lived experiences in Tijuana. The feminist method can be used to delve into the social inequities faced by women in Tijuana and their correlation with broader social injustices.

The study illustrates the link between clinically significant depressive symptoms (CSDS) and social disparities. It highlights how CSDS, influenced by environmental, social, biological, genetic, and psychological factors, profoundly impacts individuals' well-being (Verchick, Robert. (1996). Specifically, the study underscores the social challenges that disproportionately affect women's health and quality of life (Calderón-Villarreal et al., 2014). It notes the higher prevalence of depression among women across diverse cultural and social contexts, attributing this inequity to power dynamics and societal norms (Calderón-Villarreal et al., 2014).

Using educational attainment, socioeconomic status (SES), and fertility as social stratifiers, the study reveals varying levels of vulnerability among women in Tijuana regarding CSDS (Calderón-Villarreal et al., 2014). The study's findings underscore the need for intersectional policies and interventions to address depressive symptoms and enhance the mental well-being of women in Tijuana (Calderón-Villarreal et al., 2014).

To address the challenges faced by women in Tijuana through *unmasking*, the existing laws, policies, and decisions can be questioned. This process reveals the underlying power dynamics perpetuating these injustices (Verchick, 1996). By acknowledging the specific experiences of the women in Tijuana, we can develop solutions that mitigate these issues effectively. Neglecting these experiences would hinder our ability to implement impactful strategies and prevent further social injustices (Verchick, 1996).

Through *contextual reasoning*, we can better understand how women in Tijuana are affected in their day-to-day lives and can craft policies and regulations that lead to positive change (Verchick, 1996). Data is crucial in this process, providing factual insights that drive meaningful action. Engaging with personal

perspectives enriches our understanding of these issues and their impact on women in Tijuana; sharing personal and historical narratives helps us acknowledge women's experiences and their effects.

The data collected from women sharing their real-life experiences aligns with *consciousness-raising*, offering valuable insights for driving positive change (Verchick, 1996). Facilitating information sharing between communities, governments, and stakeholders creates opportunities for decision-making that considers the experiences and impacts of communities.

Overall, the feminist method can be a valuable tool to address socio-environmental injustices affecting marginalized communities in the region.

TRNERR - An Organization that Embodies Socio-Environmental Justice Principles

TNERR embodies the principles of distributive justice, procedural justice, justice as recognition, and the feminist method through its multifaceted approach to environmental conservation and community engagement. The Tijuana River National Estuarine Research Reserve (TRNERR) is a part of the National Estuarine Research Reserve System ([NERRS](#)). TRNERR is dedicated to managing, preserving, and protecting the Tijuana River Estuary through scientific research, educational initiatives, restoration projects, and stewardship practices (TNERR, 2024). The organization focuses on habitat restoration and conservation, endangered species management, and managing sediment, solid waste, and wastewater challenges (TNERR, 2024).

Regarding *distributive justice*, TNERR aims to allocate environmental benefits and resources equitably, ensuring that conservation efforts benefit both the natural ecosystem and the communities reliant on it. This is evident in the work currently being conducted through the ResiDUOS Project, which is supported by the National Oceanic and Atmospheric Administration Marine Debris Program (NOAA MDP) through the United States-Mexico-Canada-Agreement Implementation Act ([USMCA](#)) ([NOAA MDP, 2024](#)). As detailed on [TRNERR's website](#), the ResiDUOS Project comprises a 5-pillar approach, aiming to improve social-ecological resilience in the U.S-Mexico border region through marine pollution prevention:

1. Scale up the circular economy for solid waste through reuse and income generation at pilot sites.
2. Establish and implement a cross-border Marine Debris Leadership Academy.
3. Improve binational flood emergency response and resilience.
4. Provide an exemplary model of land-based marine debris capture and characterization.
5. Protect and enhance beach, dune, high-marsh, and riverine environments. (TRNERR, 2024)

Furthermore, *procedural justice* is evident in TRNERR's collaborative approach, which involves stakeholders and local communities in decision-making processes. This is reflected in the Marine Debris Leadership Academy (MDLA) of the ResiDUOS Project, which includes members from Mexico and the United States, consisting of local and federal governments, community organizations, academia, and nonprofits (NOAA MDP, 2024). This is further detailed on the NOAA MDPs website:

The MDLA used multiple learning methods to expand participant knowledge, sharing practical knowledge, involving participants in field experiences, and creating art. Participants learned practical knowledge, how to address technical issues, and practiced relationship building strategies by

engaging in training on multicultural leadership and conflict resolution. The MDLA also incorporated experiential learning in the field, allowing participants to visit trash hotspots in both countries, explore the upper watershed, and speak with officials that were engaged with solid waste management. (NOAA MDP, 2024)

By fostering partnerships and engaging with diverse voices, TNERR ensures that environmental actions are transparent, inclusive, and responsive to community needs and concerns.

Additionally, *Justice as recognition* is illustrated through TNERR's acknowledgment of the estuary's critical status and its role in advancing environmental justice initiatives. By recognizing and prioritizing the environmental vulnerabilities and concerns of the Tijuana River Estuary, TNERR demonstrates a commitment to addressing historical and ongoing injustices in the region.

Lastly, TNERR's integration of *the feminist method* involves listening to and incorporating community feedback into their conservation and restoration projects. On the [Divided Together](#) podcast, TNERR involves community members with direct knowledge and experience of matters concerning the San Diego/Tijuana border region. The podcast includes indigenous stories and traditional land management methods, nature-based solutions addressing local community issues in the Tijuana River Valley, scientific research endeavors, historical events, and the intricate history of the San Diego/Tijuana border area (TNERR, 2024). This inclusive approach ensures that diverse perspectives and experiences are heard and considered, ultimately aiding in exploring more effective and sustainable interventions.

In conclusion, TNERR's comprehensive and collaborative approach underscores its role as a leader in habitat conservation, restoration, and pollution prevention, ultimately guided by socio-environmental justice and equity principles. TNERR is a prime example of an organization that embodies principles of distributive justice, procedural justice, justice as recognition, and the feminist method.

Upcycling - A Sustainable Attempt to Tackle Trash Pollution

The repercussions of plastic extend to the Tijuana River Watershed; its prevalent use in single-use packaging often leads to disposal issues, especially in areas needing proper waste management infrastructure. As a result, substantial portions of plastic end up in landfills or polluting natural habitats, highlighting the urgent need for sustainable solutions (Caldera et al., 2022).

Upcycling is a fundamental aspect of sustainable production and consumption within a circular economy, involving repurposing, reusing, repairing, and upgrading waste materials. This practice is gaining traction and necessitates a shift in consumer and producer mindsets, where waste is considered a valuable resource. Commonly upcycled materials include plastic, glass, metal, E-waste, cardboard, clothing, textiles, and wood. Techniques employed in upcycling focus on preserving these materials' durability, functional performance, and unique characteristics while also considering aesthetic appeal.

Upcycling encounters various barriers and enablers at different levels. This includes macro, meso, and micro, as Caldera S. et al. (2022) outlined: *macro-barriers* encompass economic, structural, regulatory, and legal challenges, such as insufficient policies, funding limitations, regulatory hurdles, lack of incentives, political influence, and limited access to non-standard materials; *meso-barriers* involve institutional and community-related issues, such as restricted financial resources, reluctance to accept waste as a viable raw

material, limited consumer awareness, and the absence of standardized practices; lastly, *micro-barriers* pertain to specific manufacturing challenges individual enterprises face, including limited knowledge, resources, marketing capabilities, transparency issues, and concerns regarding contamination and pricing constraints.

On the other hand, various enablers present opportunities for waste upcycling, as outlined by Caldera et al. (2022): *macro-enablers* encompass strategies like resource allocation and mobilization, official endorsements, educational initiatives, and promoting circular economy principles; *meso-enablers* foster community support, raise awareness, encourage engagement, advocate for reuse over recycling, and streamline processes to reduce costs, time, and effort; lastly, *micro-enablers* focus on cultural shifts in perception, emphasizing product uniqueness, supporting experimentation, continuous improvement, and optimizing material processes to enhance upcycling practices.

Furthermore, upcycling waste offers a range of opportunities across social, environmental, and economic dimensions as outlined by Caldera et al. (2022): socially, it fosters employment opportunities, promotes sustainable leadership, encourages collaboration among stakeholders, and contributes to socioeconomic revitalization; environmentally, it contributes to achieving sustainable development objectives, reduces environmental impacts and resource extraction, and fosters innovation; and economically, it drives changes in consumer behavior, fuels entrepreneurial endeavors, and boosts profitability through unique offerings.

Marginalized communities within the Tijuana River region can leverage upcycling techniques, utilizing self-taught skills to create innovative designs. For example, the nonprofit organization [Waste for Life](#) collaborates with marginalized groups to develop solutions addressing environmental waste challenges and poverty. By partnering with waste pickers in Buenos Aires, Waste for Life transforms collected waste into valuable products, establishing a production system that fosters self-reliance and economic stability, all while advancing socio-environmental equity ([WFL, 2024](#)). This exemplifies how organizations can integrate upcycling practices to achieve circular production methods and meet Sustainable Development Goals. Such initiatives contribute to reduced resource extraction, enhanced resource efficiency, lower emissions, and overall benefits for society, the environment, and the economy, ultimately advancing socio-environmental justice principles.

Waste for Life could play a significant role in addressing the waste issue in Tijuana. By collaborating with local communities and stakeholders, Waste for Life could implement several strategies to tackle the waste problem effectively:

1. Waste for Life could initiate community-based waste collection and sorting programs. This could involve training and employing residents, including marginalized groups, to collect and sort waste materials. By doing so, Waste for Life addresses the waste issue, creates employment opportunities, and fosters community involvement in waste management.
2. Waste for Life could establish upcycling workshops and training centers in Tijuana. These centers would provide education and resources for residents to learn upcycling techniques and transform waste materials into valuable products. By promoting upcycling skills, Waste for Life empowers individuals to contribute to waste reduction efforts while generating income through sustainable practices.

- Waste for Life could collaborate with local businesses and government agencies to promote sustainable waste management practices. This could involve advocating for policies incentivizing waste reduction, recycling, and upcycling initiatives. By partnering with stakeholders, Waste for Life amplifies its impact and creates a more comprehensive approach to addressing the waste issue in Tijuana.

Waste for Life's efforts in Tijuana would involve community engagement, skill development, policy advocacy, and collaboration with various stakeholders. Waste for Life can contribute significantly to mitigating the waste problem through these initiatives while promoting social, economic, and environmental benefits for the local community.

Governmental Organizations - *Current Strategies to Combat the Pollution*

The United States Environmental Protection Agency (EPA) plays a significant role in addressing cross-border pollution issues in the Tijuana River Watershed. The EPA is involved in the US Environmental Protection Plan, which sets out objectives to enhance the water quality of the Tijuana River upon its entry into California (EPA, 2022). The projects outlined on the [US EPA's Sustainable Water Infrastructure webpage](#) (2024) aim to promote infrastructure solutions to address transboundary flow pollution, including the following:

- The [State and Local Stakeholder Engagement](#) fosters transparency in decision making and aids identification of infrastructure solutions broadly supported by the public (EPA, 2024).
- The [Technical Evaluation of Infrastructure Solutions](#) supports decision making through analysis of feasible projects with the potential to address transboundary flows in the Tijuana River thoroughly and the Pacific Ocean (EPA, 2024). The figure below illustrates the current infrastructure locations, forming the basis for identifying the initial ten projects and the regions impacted by transboundary flows.

Figure 2

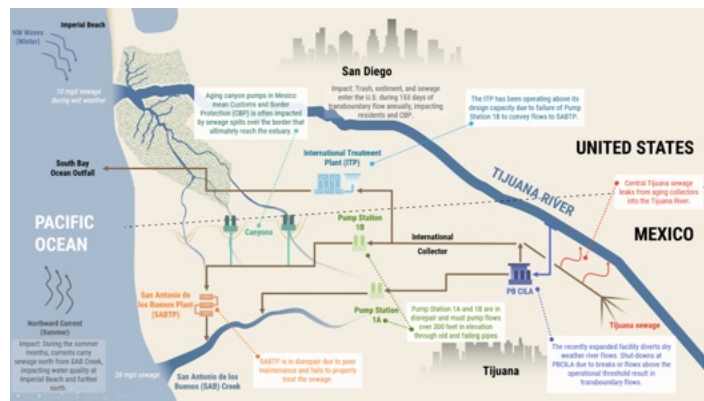
Current Infrastructure locations (EPA, 2024)



- The [National Environmental Policy Act \(NEPA\)](#) Implementation ensures that potential US-side infrastructure solutions comply with NEPA requirements (EPA, 2024).
- The Binational Engagement ensures that the EPA is coordinating with Mexico to advance a solution that addresses the transboundary wastewater flows (EPA, 2024). The two binational agreements signed by the U.S. and Mexico can be viewed in the [Summary of Agreements](#) (pdf). (EPA, 2024)

Figure 3

Tijuana Wastewater and River Flow Schematic (EPA, 2024)



Furthermore, the International Boundary and Water Commission, established by the US and Mexico, plays a crucial role in managing transboundary water flow and disputes. The Commission's proposed infrastructure projects, backed by significant budgets from both governments, aim to reduce transboundary wastewater flow and untreated discharges into the Pacific Ocean (EPA, 2022). The agreement details San Diego and Tijuana sanitation initiatives, funded by \$330 million from the U.S. government and \$144 million from Mexico (EPA, 2022). These projects aim for completion by 2027, targeting a 50% cut in transboundary wastewater flow days in the Tijuana River and an 80% decrease in untreated wastewater discharged into the Pacific Ocean, 10 kilometers south of the border (EPA, 2022).

Additionally, the South Bay International Wastewater Treatment Plant (SBIWTP) in the United States is slated to double capacity as part of these efforts (EPA, 2022). Plans include constructing a new treatment facility in San Antonio de los Baños, Mexico (EPA, 2022). These combined projects aim to increase the treatment capacity by 43 million gallons per day for Mexican sewage, thereby mitigating sewage discharges into the Pacific Ocean and the Tijuana River (EPA, 2022). Further measures involve restoring and enhancing pump stations and sewer lines in Tijuana to reduce sewage spills (EPA, 2022).

These infrastructure initiatives align with socio-environmental justice principles by addressing environmental inequalities and promoting equitable access to clean water and a healthy environment for communities in the Tijuana River watershed. By reducing water pollution and improving infrastructure, these projects create a healthier environment for all residents, particularly those disproportionately impacted by environmental hazards. However, there is a need for comprehensive planning and consideration of local community impacts to ensure effective and equitable outcomes. These governmental organizations can potentially collaborate to foster positive change for social and environmental justice through community involvement and surveys. This collaboration could involve conducting community-based needs assessments within Tijuana and surrounding areas to determine the priorities and concerns of local communities regarding water quality, pollution management, and environmental protection. By engaging with communities directly, these organizations can gain valuable insights into residents' challenges and tailor their policies, projects, and regulations to address these specific needs. This inclusive approach can lead to more effective and sustainable strategies for improving water quality, reducing pollution, and promoting environmental justice in the region.

Organizations - Exemplifying Socio-Environmental Justice Principles through Sustainable Stewardship

Organizations can play a pivotal role in managing environmental issues within the Tijuana River Watershed:

Alter Terra, a non-profit organization dedicated to coastal and marine conservation, has researched solid waste movement extensively in the Tijuana River for over a decade (Romo, 2019). Through meticulous mapping of dump sites across the Tijuana watershed, Alter Terra strategically places transmitters to track trash, providing crucial insights into the lifecycle of waste in the river (Romo, 2019). Utilizing this data, Alter Terra deploys trash booms, large-scale strainers designed to intercept and halt trash migration downstream. These barriers have proven highly effective in capturing trash of various sizes, contributing significantly to pollution reduction efforts and generating employment opportunities.

Similarly, WILDCOAST, another conservation organization, employs a barrier system to prevent plastic from advancing downstream in the Tijuana River while gathering valuable data on pollution trends. A dedicated capture system, installed in Los Laureles Canyon, Tijuana, serves as a focal point for pollution interception (Clean Currents Coalition, 2022). By deploying barriers strategically and repurposing collected waste whenever feasible, WILDCOAST actively contributes to cleaning efforts and environmental sustainability. WILDCOAST ultimately addresses environmental justice by benefiting the local environment and public health by removing waste, empowering female community leaders, and improving access to outdoor spaces.

Wild Coast embodies attributes of socio-environmental justice through community engagement; their ‘behavior-change communications and outreach strategy’ consists of three essential components:

1. Community forums in impacted areas within the City of Tijuana to better understand views and attitudes towards plastic pollution in their neighborhoods and communities.
2. Awareness campaigns tailored to the lessons learned in the community forums that leverage the data gathered from the plastic capture system to target the most common plastic types.
3. Calls for action directed at communities, governments, and private industries through meetings with key stakeholders, media outreach, and partnerships with local artists, leaders, and sports teams. (Clean Currents Coalition, 2022)

Wild Coast’s project results embody attributes of socio-environmental justice through engagement with education, outreach campaigns, lessening public health threats, recreation opportunities, and more, as listed on their website:

1. Improving the health of the local underserved community of 75,000 inhabitants;
2. Increasing outdoor recreation opportunities for underserved communities on both sides of the border by reducing the volume of debris clogging open space areas and by building two parks in Los Laureles, one with a small soccer field;
3. Creating three permanent full-time jobs and 18 independent contractor positions as community debris collectors;
4. Changing behavior towards plastics through education and outreach campaigns that encourage reduction, reuse, and recycling;

5. Lessening public health threats associated with accumulated plastic waste and other debris in estuarine and marine habitats in the Tijuana-San Diego County border region. (Clean Currents Coalition, 2022)

Furthermore, the [Southern California Coastal Water Research Project \(SCCWRP\)](#) operates as a Research and Development Agency focused on advancing science to enhance the management of aquatic systems in Southern California and beyond (SCCWRP, 2024). Their work involves developing innovative strategies, tools, and technologies that effectively protect and enhance ecological health in Southern California's coastal ocean and watersheds. As part of a comprehensive watershed approach for assessing pollution sources, the Southern California Coastal Water Research Program collaborates with other boundary-spanning organizations to conduct a thorough watershed-scale pollution source assessment. With its expertise in water-quality management, the Southern California Coastal Water Research Project could potentially collaborate with other organizations to conduct comprehensive pollution source assessments at the watershed scale. This data-driven approach can identify critical sources of pollution and inform targeted mitigation strategies.

Lastly, the [Climate Science Alliance organization \(CSA\)](#) manages a Climate Change and Baja California Peninsula Work Group, acknowledging the deep interconnectedness between Alta California and Baja California (CSA, 2024). This workgroup develops solutions to address climate change impacts within the cross-border region through an ecosystem-based approach. Their objective includes fostering collaboration to strengthen research, community, and ecosystem ties. The Climate Science Alliance's focus on climate change and ecosystem-based solutions aligns well with the cross-border challenges faced by the Tijuana River Watershed. It could develop resilience strategies that benefit human communities and the environment by fostering connectivity between researchers, communities, and ecosystems.

Overall, collaboration and data sharing between these organizations can significantly enhance pollution prevention initiatives. These organizations can collaborate by leveraging their research, conservation, advocacy, and community engagement strengths. By prioritizing community involvement and conducting surveys to understand local perspectives, they can develop holistic and sustainable approaches to address social and environmental injustices in the Tijuana River Watershed.

Summary

For many of us, water simply flows from a faucet, and we think little about it beyond this point of contact. We have lost a sense of respect for the wild river, for the complex workings of a wetland, for the intricate web of life that water supports. — Sandra Postel

In summary, this paper pursues the realm of socio-environmental empowerment within the Tijuana River Watershed, utilizing socio-environmental justice principles, sustainable initiatives, and the influence of local governmental and non-governmental organizations. The findings underscore the potential of these principles in crafting equitable and sustainable solutions, ultimately addressing socio-environmental injustices while empowering marginalized communities and fostering collaborative efforts.

References

- Albrecht, D. E. (2019). Addressing climate change at the community level in the United States. (P. R. Lachapelle, Ed.). CRC Press.
<https://www.routledge.com/Addressing-Climate-Change-at-the-Community-Level-in-the-United-States/Lachapelle-Albrecht/p/book/9780815380924>
- Boi clean currents. Clean Currents Coalition. (2022).
<https://cleancurrentscoalition.org/coalition-projects/tijuana-river-mexico/>
- Caldera, S., Jayasinghe, R., Desha, C., Dawes, L., Ferguson, S., (2022). Evaluating barriers, enablers and opportunities for closing the loop through ‘waste upcycling’: A systematic literature review, *J. sustain. dev. energy water environ. syst.*, 10(1), 1080367, 2022, DOI:
<https://doi.org/10.13044/j.sdewes.d8.0367>
- Calderón-Villarreal, A., Mujica OJ, Bojorquez I. (2014). Social inequalities and prevalence of depressive symptoms: a cross-sectional study of women in a Mexican border city, 2014. *Rev Panam Salud Publica.* 2020;44:e9. <https://doi.org/10.26633/RPSP.2020.9>
<https://iris.paho.org/bitstream/handle/10665.2/51832/v44e92020.pdf?sequence=1&isAllowed=y>
- Calderón-Villarreal, A., Terry, B., Friedman, J., González-Olachea, S. A., Chavez, A., Díaz López, M., Pacheco Bufanda, L., Martinez, C., Medina Ponce, S. E., Cázares-Adame, R., Rochin Bochm, P. F., Kayser, G., Strathdee, S. A., Muñoz Meléndez, G., Holmes, S. M., Bojorquez, I., Los Huertos, M., & Bourgois, P. (2022). Deported, homeless, and into the canal: Environmental structural violence in the binational Tijuana River. *Social Science & Medicine (1982)*, 305, 115044. <https://doi.org.sandiego.idm.oclc.org/10.1016/j.socscimed.2022.115044>
- Climate Science Alliance. (2024). <https://www.climatealliance.org/>
- Environmental Protection Agency. (2022). U.S. And Mexico agree to invest \$474M to address Tijuana River sewage problem.
<https://www.epa.gov/newsreleases/us-and-mexico-agree-invest-474m-address-tijuana-river-sewage-problem>
- Environmental Protection Agency. (2024). Quotations About the Environment.
<https://www.epa.gov/history/quotations-about-environment>
- Environmental Protection Agency. (2024). Statement of Intent and Minute 328 (PDF).
<https://www.epa.gov/system/files/documents/2022-10/Summary%20of%20Agreements.pdf>

- Environmental Protection Agency. (2024). Tijuana River Watershed Technical Evaluation of Infrastructure Solutions.
<https://www.epa.gov/sustainable-water-infrastructure/tijuana-river-watershed-technical-evaluation-infrastructure>
- Environmental Protection Agency. (2024). Tijuana River Watershed Stakeholder Engagement. Accessed April 14, 2024.
<https://www.epa.gov/sustainable-water-infrastructure/tijuana-river-watershed-stakeholder-engagement>
- Environmental Protection Agency. (2024). USMCA Tijuana River Watershed And Adjacent Coastal Transboundary Wastewater Flows.
<https://www.epa.gov/sustainable-water-infrastructure/usmca-tijuana-river-watershed>
- H.R.5430 - 116th Congress (2019-2020): United States-Mexico-Canada Agreement Implementation Act. (2020, January 29).
<https://www.congress.gov/bill/116th-congress/house-bill/5430>
- National Estuarine Research Reserves. (2024). <https://coast.noaa.gov/nerrs/>
- National Oceanic and Atmospheric Administration Marine Debris Program. (2024). The Marine Debris Leadership Academy: Spanning Boundaries to Tackle Marine Debris in the Tijuana River Watershed.
<https://blog.marinedebris.noaa.gov/marine-debris-leadership-academy>
- Pulido, L. (2000). Rethinking environmental racism: White privilege and urban development in southern California. In *The People, Place, and Space Reader* (pp. 334-339).
<https://atrium.lib.uoguelph.ca/server/api/core/bitstreams/1b49f34d-fa27-48e3-a4fe-39b37bde5145/content>
- Resolution A/RES/64/292. United Nations General Assembly. (2010). General Comment No. 15. The right to water. UN Committee on Economic, Social and Cultural Rights, November 2002 https://www.un.org/waterforlifedecade/human_right_to_water.shtml
- Romo, O. (2019, June 22). ALTER TERRA: Using Trash to Clean Up Trash. *Earth Island Journal*, 34(2), 16.
<https://www.earthisland.org/journal/index.php/magazine/entry/using-trash-to-clean-up-trash/>
- San Diego Regional Water Quality Control Board. (2020). Sewage Pollution within the Tijuana River Watershed.
https://www.waterboards.ca.gov/sandiego/water_issues/programs/tijuana_river_valley_strategy/sewage_issue.html

- Scripps Institution of Oceanography. (2024). Tijuana River Vally Cross-Border Research and Future Vision. <https://scripps.ucsd.edu/crossborderpollution>
- Simmons, A. Tijuana River Valley Pollution: How the Environmental Protection Agency Expects to End a Ninety-Year Environmental and Public Health Crisis, 33 Vill. Evtl.L.J. 113 (2022). <https://digitalcommons.law.villanova.edu/elj/vol33/iss1/5>
- Southern California Coastal Water Research Project. (2024). <https://www.sccwrp.org/>
- Tijuana River National Estuarine Research Reserve. TRNERR. (2022). <https://trnerr.org/>
- TRNRR. *Divided Together* podcast. (2024). <https://trnerr.org/library/divided-together-podcast/>
- Verchick, Robert. (1996). In a Greener Voice: Feminist Theory and Environmental Justice. *Harvard women's law journal*. Vol. 19; 23 - 88; 66 p. https://www.researchgate.net/publication/290993657_In_a_Greener_Voice_Feminist_Theory_and_Environmental_Justice_19_Harvard_Women's_Law_Journal_23_1996
- Walker, G. (2012). Environmental justice: Concepts, evidence and politics. *Taylor & Francis Group*. <https://ebookcentral.proquest.com/lib/sandiego/reader.action?docID=958746>
- Waste for Life. <https://www.wasteforlife.org/>



Source: Growing Gardens, [2014](#)

Reimagining Agriculture: Integrating Indigenous Knowledge and Human Experience for Socio-Ecological Transformation

Lauren Closs

USD MESH | Capstone Project

ABSTRACT

Examining the disconnect between technological progress and human well-being, with a focus on the agricultural sector, this study emphasizes the imperative of integrating Indigenous knowledge and human experience into research frameworks. Through an analysis of hegemonic and colonialist structures in modern agriculture, the paper advocates for a systems-based approach rooted in agroecology to foster socio-ecological transformation. Furthermore, it argues for a relational transformation in agriculture, emphasizing the importance of healing the relationship between farmers and their land. Colorado emerges as a potential model for this transition, given its history of adaptability and leadership in regenerative agriculture. By highlighting examples of community healing through urban agricultural initiatives in Boulder County, the paper underscores the potential for agriculture to serve as a catalyst for broader systemic change. Ultimately, it calls for a reimagining of agriculture as a nexus of environmental and socio-economic systems, grounded in shared knowledge and stewardship, to navigate the complexities of our interconnected world.

INTRODUCTION

We exist during a time where information is accessible at the touch of our fingertips, but yet so many of us are unaware of the nature of the challenges humanity is faced with. Scientists have more than enough evidence to prove that a radical shift is needed to avoid catastrophic climatic breakdown, so why do we find

ourselves in a state of prolonged inaction? Perhaps a radical shift in our research methodologies is needed; so I ask, what does it mean to produce meaningful and impactful research within a post-truth era? I believe the answer lies within presenting research findings through the lens of human experience and Indigenous knowledge.

The 20th century was defined as a period in time in which humanity made tremendous progress in technological advancements. Efficiency and profitability were (and still are) the primary motive for progress. However, the pursuit of capital has blinded us from what truly feeds our soul, our relationships we build with others and our relationship to nature. I cannot think of an industry where this concept is more evident than agriculture. As industrially intensive farming practices have become the face of modern agriculture, we have witnessed a deterioration among farming landscapes, rural communities, and human health. Continuing to follow the “traditional” model will only lead us to destroy the very resources our society requires to sustain itself. Farmers are at the forefront of our societal connection to the ecological systems that sustain us; however, as farming has become increasingly industrialized, that connection has eroded.

In order to have a more holistic understanding of the systems that operate within the context of agriculture, we must first understand the historical narratives that have defined agricultural development. I will begin by assessing the role of hegemonic and colonialist structures of power in modern agriculture, and the social and ecological ramifications of such a system. By implementing a systems-based approach to agriculture that is built on the foundation of Indigenous knowledge, we can begin to heal our soil and our relationship to farmland, while dismantling hegemonic power structures. The term agroecology provides us with the structural foundation for how to cultivate regenerative, locally-adaptive agricultural systems that act against forces of hegemony. Throughout this paper I will demonstrate the socio-ecological transformation that is actualized through implementing principles of agroecology and interconnectedness, and provide examples of how this is possible in an urban environment.

I believe that in addition to the physical transformation, our agricultural system is in desperate need of a spiritual transformation. So I ask, “How can we look for ways to heal our minds, bodies, and communities through healing our agroecosystems?” I build the argument that healing our agrarian systems begins with healing the relationship between farmers and their lands; through gaining a deeper awareness of ecosystem services, farmers can position their operations to work in harmony with and strengthen existing biological synergies to sustain their operations. By recognizing our interconnectedness to the world around us, we can begin to reframe our relationship with agriculture to be one of stewardship.

I believe Colorado is uniquely situated to be a model of this transition. Its mountainous region characterized by its extreme weather have meant farmers in this state have always had to put adaptability at the forefront of their farming efforts. But beyond that, Coloradan farmers have routinely been at the forefront of the regenerative agriculture/agroecology movement. Their connection to place, and healthy living make Colorado the perfect place to begin to understand how we can change our relationship to agriculture. Boulder county has repeatedly gained national recognition for their eco-conscious lifestyle, and is exemplary of how local agricultural production can support and flourish within urban communities. To expand on the principle of healing our relationship to land, I use several examples of how urban agricultural spaces, as well as other land projects in Boulder have contributed immensely to community healing, and how other communities can apply these same principles to heal their land and communities from the disconnection that was forged through industrialized agriculture.

It is my hope that this paper will serve as a reminder that we are all parts of much larger complex systems, and how we interact with those systems will determine much of our reality. We have the power to create entirely new systems built upon the foundation of shared knowledge, circularity, and hope; and what better place to start than agriculture - the intersection of our environmental and socio-economic systems.

LITERATURE REVIEW

History of Agricultural Development in Colorado and the United States

Our words are powerful, the ways in which we frame issues, and how we come to understand them, ultimately determines how we try to solve them. Much of the existing research frames our ecological, agrarian, and climatic crises in terms of economics and quantitative analytics. This approach to research follows a linear, or cause and effect, understanding of our interconnected crises, and has radically simplified the larger natural and anthropocentric systems of which they are formed. In order to identify the root of the problem we must understand the historical narrative that drove the development of a more industrialized approach to agriculture, and identify the relational impacts of that transition so we know where to start. Through incorporating analysis of historical context, studies have begun to recognize the influence of colonialism, anthropocentrism, and hegemonic power structures embedded in our global food system. There is a famous quote that reads: “Those who do not learn from history are doomed to repeat it.” I think there is much to be learned by understanding how and why our food systems are the way they are, in order to ensure that the systems we build to take its place are rooted in social and environmental justice.

Considering we live in a globalized world that exists largely as a result of colonialist expansion, it becomes necessary for us to understand how colonization and war have been important political influences on food systems ([Hueston, 2012](#)). Many activists and scholars have begun to bring attention to the inherent colonialist structure of modern western science, and the impact it has had on policy interventions within the agriculture industry. Current politics favor the perspective of “experts” in their designated fields, and give little, if any, attention to local and Indigenous knowledge systems that have developed over generations. Author and activist Vandana Shiva also demonstrates this idea in her book [Monocultures of the Mind](#), stating that “emerging from a dominating and colonizing culture, modern knowledge systems are themselves colonizing.” It would thus be foolish for us to attempt to reconstruct our food systems using the same colonizing knowledge systems that have led us to our present circumstances.

What we require is a profound shift in our understanding of humanity’s place in the world. Historical literature has taught us that humanity exists outside of or apart from nature; it has taught us that we can endlessly exploit our natural resources and label it as progress and development; it has taught us that profit and efficiency are what we should be striving toward. As agriculture began to adopt more of a profit-seeking narrative, food came to be seen as a commodity, and when food is seen as a commodity rather than a commons, food systems are then designed around where they can make the most money rather than valuing nutrition, connection or sustaining the land’s productive capacity. It is humanity's obsession with efficiency and profit that has led to the development of increasingly consolidated markets and industrialized methods of production.

Much of the current literature that analyzes the consequences of industrialized agriculture fails to recognize the disconnection between farmers and their land. When research solely focuses on quantitative analytics, it fails to consider how that change impacts us relationally. When we replace human labor with industrialized

equipment, we are radically simplifying what it means to be a farmer. Farmers then no longer require a deep awareness of the larger systems of which they are a part of, and can no longer use their fine-grained knowledge of the land to find subtler ways of producing food, and their fine-grained knowledge of the market to find better ways of selling it (Monbiot, 2023). While many farmers lack specialized education, their knowledge has been curated through their lived experiences and wisdom that has been passed down through generations. It is this deep understanding of place that enables farmers to create resilient, locally-adapted food systems, yet this has precisely been what has been left out of the discussion.

Much of the current literature available that has highlighted the widening disconnect between man and nature, fails to address how that same principle is seen in agriculture. Perhaps through healing the relationships between farmers and their lands, we can not only heal the soil, but also restore connection to ourselves and our communities. The existing research that investigates the implications of disconnection - from culture, society, and nature - often fails to recognize the true interconnectedness of these different dimensions, in that, the actions we impose upon nature we ultimately impose upon ourselves. To better understand this philosophy, we must look to sources of Indigenous knowledge and wisdom to guide our understanding, for many of their cultural teachings exemplify this same principle. We must bring into question the entire western narrative of humanity's identity of existing outside/separate from nature. Indigenous scholars have long been arguing that what is needed is a fundamental shift in the way we see and engage with the world.

Additionally, to have a more complete understanding of past research that has been conducted on agricultural systems, it becomes necessary to identify the role of state-funded research, and more specifically, what kinds of research has been funded in the past. Unfortunately in order to pursue research studies, scientists need money, lots of money. State and federal funding have often been the source of research funds for many studies produced across a multitude of scientific disciplines. The problem here is that there is heavy influence from industry intertwined in politics, and to protect the interests of agribusiness, federal funds have tended to be allotted toward research that was directed at improving the efficiency of farming, which catered almost exclusively to large operations, and by offering unflinching support for industry, agri-state scientists and officials failed to safeguard the farmers and the lands that were essential to their original mission (Weeks, 2016). Most of the research that has been conducted in this regard is conducted by highly specialized disciplines that frame the agrarian crisis in terms of their specific discipline, and largely fail to equate the problem in a more interdisciplinary and systematic approach.

The scope of my research is primarily concerned with Colorado, but the historical trends and developments are closely mirrored in those of the United States as a whole. However, I believe Colorado is uniquely positioned to be at the forefront of the regenerative agriculture movement, for the state has long had to adapt to unforgiving climatic conditions. Brutal and unpredictable winter and summer weather, coupled with drought that has persisted over decades, has forced Coloradan farmers and officials to become increasingly innovative in their adaptive solutions. Colorado is also one of the top agricultural states in the US, bringing in more than \$45 billion into the state's economy (Kelly, 2024), thus providing incentive to ensure the industry's long-term sustainability. However, despite Colorado being an agricultural state, there is little research that describes how it can be used as a model for resilience.

Agroecology

Current literature within the field of agroecology is wide ranging, which can be attributed to the multifaceted nature of the term itself. As a field of study that crosses traditional disciplinary boundaries, agroecology is rooted in not only changing how we manage agricultural production, but also changing the relationship between farmers and the communities they serve. It is becoming more common for researchers to bring into question the role of social structure in transforming our food systems, and recognizing the injustices that are bred through our current methods of agricultural production. Some of the most popular areas of research within this field of research relate to principles of circularity, resilience, and responsible governance. At the core of these three principles is recognizing that the productivity of our agroecosystems is ultimately going to be determined by its self-sustaining capacity. This then requires research to be structured in a way that seeks to understand the ecological models our agricultural systems operate within, in order to obtain a more holistic understanding of the impact agricultural practices have on overall ecosystem health. It also requires a shift in perspective where farmers (and researchers) do not view themselves as an external observer, but recognizes his (and all of humanity's) inseparability from the systems that govern the natural world. This way of viewing and being in the world is at the heart of Indigenous culture.

While the term agroecology has recently gained popularity among scholars, it has also faced criticism for a lack of consistency with how it has been studied. However, I argue that this lack of consistency is actually a good thing; because of its key principles of localized adaptive systems, diversity and context-specific knowledge, the kinds of research that is being conducted and the methodologies used need to look very different. It becomes easy to understand why a term like agroecology has faced much criticism in this regard, for it does not fit within the traditional western scientific model. Western science is consumed with this idea of silver bullet solutions that produce uniform results; however, in the field of agriculture, attempting to create a one size fits all solution involves radically simplifying nature. The natural systems within which our agricultural systems operate are extremely complex and vary tremendously in terms of locality. It is unrealistic to assume that what works in one area will produce the same results under completely different climatic conditions. That is why I believe that research within the field of agroecology should instead be focused on how its defining principles have been applied and adapted to various local contexts. It seems to me that the lack of consistency in terms of research is precisely what agroecology is all about. Agroecology provides a set of structural guidelines but not a step-by-step tutorial; it is up to the community how to best structure their systems to best fit their needs.

Another important area of research in agroecology has been the incorporation of Indigenous knowledge and practices. For many Indigenous communities, adopting agroecological production practices is inseparable from the work of valuing and reviving traditional knowledge and practices (Sampson et al., 2021). Indigenous peoples have lived in harmony with natural systems for generations, and have developed a deep understanding and connection with their lands that lie far beyond western conceptualizations; for this reason, Indigenous knowledge systems have largely been ignored by western science.

Soil Health

One of the most commonly studied metrics relating to agroecosystem health is the health of the soil. The majority of the scientific literature that exists as it relates to soil health is largely focused on tracking and analyzing how nutrients are cycled through agroecosystems, the diversity of soil microbes, and the role fungal species play in maintaining soil health. Studies highlight the importance of understanding how these are related to and reinforce one another to gain a more holistic understanding of soil health. Researchers are beginning to recognize the systemic nature of our soil networks, and are beginning to expand their visions to

adopt a more systems-based approach to research. While soil itself has been studied for thousands of years, science is only beginning to piece together the inner workings of this complex system, so if we were to base our entire transition toward more sustainable food systems on the backings of this incomplete and insufficient knowledge, we would fall short.

A common critique of research conducted within the fields of both soil biology and ecology is the usage of academic vocabulary that is largely incomprehensible to anyone who is not a specialist within that field of study. Studies have long centered the voices and perspectives of specialized experts, and have created a vertical assembly of knowledge, where expert knowledge has gained higher levels of prestige over other forms of knowledge. This structure of knowledge has greatly led to the devaluing of local knowledge systems that over generations have developed a more intimate understanding of the ecological systems they reside in. Not to mention, by centering research in expert terminology, it prohibits a significant portion of farmers from contributing to its scientific literature, considering less than a quarter of American farmers hold a degree of higher education ([Ortiz, 2015](#)). It is then our role as researchers to uplift and center the perspectives and experiences that farmers hold, and work to combine the deep but narrow knowledge that farmers hold with the broad but shallow expert knowledge in a meaningful way that makes research comprehensible for everyone.

Traditional research methods that are ultimately rooted in the scientific method require strict adherence to protocols in order to produce replicable sets of data. While that information is useful in terms of reporting and tracking progress in one area, it does little in terms of overall systems change. A significant portion of that research is conducted within the framework of laboratory research. While laboratory findings help us understand the biology and chemistry of soil composition, it does not provide a holistic view of the health of the overall agroecosystem. However, many of the trends that are reflected through numerical data do not always translate the same way on the land. In laboratory research, variables must be controllable and not subject to change or external influence. This approach becomes problematic in areas of research that apply to complex systems, especially those of the natural world, which are subjected to the circumstances of their environment; therefore it makes little sense to analyze complex systems such as agroecosystems strictly through laboratory research. However, by developing more of an interdisciplinary approach of partnering soil science with Indigenous knowledge, diverse knowledge systems can ultimately be used as a tool in understanding the relationship not only between agriculture and the natural environment, but also ourselves and the natural world.

Considering agriculture acts as a direct link between society and the natural systems it operates within, research should be concerned with the loss of connection between humans and their environment. Many authors claim that a spiritual reawakening is needed to transform our relationship with agriculture where its landscape is not viewed as a commodity, but as something more sacred. Studies often attribute a component of this spiritual connection to Indigenous practice, which has in turn led to the romanization of Indigenous culture. Research should instead be aimed at understanding ways in which we can support Indigenous movements in recognizing the validity of their knowledge and practices rooted outside the boundaries of western science.

METHODOLOGY

One framework that has gained increased attention in recent research is the ecosystem services framework which reveals the dependency of our human well-being on ecosystem structures and processes by

highlighting their economic and social benefits for beneficiaries ([Matzdorf & Meyer, 2014](#)). Expanding on this framework, the aim of my research is to examine the potential ecosystem services offered through urban agricultural spaces as a way to heal multiple societal relationships. Considering agriculture is our society's direct link to the ecological systems in which we rely upon and live within, I find it necessary to understand not only how we can change the physical practices involved in agriculture, but also the social and emotional components as well. Much of the data that currently exists regarding regenerative agriculture focuses primarily on the ecological components, and fails to address how we can adapt our practices to simultaneously heal relationships within the soil, and within our communities.

While the current frameworks of research are both important and necessary, it fails to acknowledge the deeper connections many farmers have with their lands, and the almost spiritual component of obtaining a more intimate understanding of the ecological systems they operate within. I have orchestrated a series of interviews with farmers along the front range currently practicing various principles of agroecology and regenerative agriculture, to gain a better understanding of how they have developed and modified their practices to sustain their livelihoods amidst the rapidly changing and unforgiving environment of Colorado, and to better understand the role that connection plays in that development. Through the information gathered in my interviews, I showcase the deeper meaning within urban agricultural spaces, and demonstrate the essential role of connection to land and community in framing a sustainable transition.

The interviewees were asked a series of questions regarding their background, community empowerment, and structures of hegemonic power. Following a semi-structured approach, the questions asked were meant to act as guiding questions to allow for a deeper dialogue to take place, and to participate in the co-creation of knowledge. Once the series of interviews was complete, I revisited the audio recordings and notes taken during the process to identify common narratives and perspectives that were shared amongst interviewees, which aided in shaping and supporting the arguments made throughout this report.

The scope of my research also incorporates principles of deep ecology to reconceptualize the meaning that is held within urban agricultural spaces. The term deep ecology was first used in a publication by the University of Ohio entitled: *The Shallow and the Deep, Long-Range Ecology Movement. A Summary*, where author Arne Naess addresses the shallow efforts of modern ecological movements, and suggests a deeper perspective that is inclusive of principles of diversity, complexity, autonomy, decentralization, symbiosis, egalitarianism, and classlessness. Deep ecology provides a new set of paradigms and practices that help us to see the interconnections, not only in energy flows, but in food chains, hydrological cycles, and even, ultimately, the interconnections between our values and our environmental problems, between our ideologies, technologies and their environmental consequences. Between our human relationships and their effect on our relationship to Nature ([Dengson, 1986](#)).

Much of the alternative narratives I explore in this paper can be attributed to Indigenous value systems, and build off of decolonial theories that incorporate perspectives of how the concept of healing through connection to place can be applied to healing the land from historical uses, and redesigning agricultural spaces, especially within urban environments. By incorporating Indigenous knowledge systems into framing our agricultural transition, we can begin to unravel the colonial and hegemonic structures of power that have governed western society since its beginning. This involves a radical shift of the way western society relates to land and agricultural production, and changing this narrative requires we heal the disconnection both between the land and our communities. To frame what this healing might look like, later in this paper discusses several unique and creative ways communities in Boulder, CO have used this principle to heal

communities and land from previous devastation. I then explain how these examples provide an opportunity for future discussions around community healing, whether that be from extreme weather events or past historical injustices, to include the perspective of healing through connection to land and place. Exploring healing from a decolonizing perspective provides insight into the essential understanding where learning and healing coexist along this journey ([Field, 2022](#)). This same principle can also be useful in designing urban agricultural spaces that strive to build connection on various fronts. Using techniques such as counter-mapping, I demonstrate how we can construct meaningful narratives that embody human relationships to place, and what that looks like for urban agriculture.

To integrate an epistemological approach, ie. one that emphasizes the aims of interpretive research to study ‘participants’ ideas, attitudes, motives and intentions, and the way they interpret the social world ([James & Busher, 2009](#)) to understanding the application of principles of agroecology, I began to volunteer with a regenerative farm in my local community: Growing Gardens, located in Boulder County. The knowledge and experience obtained through this experience has given me valuable insight into the role that community involvement plays in creating more sustainable food systems. During my time spent there, I took extensive field notes capturing and interpreting that experience. Once complete, I revisited my field note entries to identify overlapping themes of overlapping themes in conversation, as well as the spatial and relational observations made. By combining farmers’ lived experiences with an analysis of past scientific research, it is my hope to create multipurpose research aimed at linking our ecological problems associated with modern day agriculture practices to problems mirrored in the social structure of our society. In doing so, I plan to emphasize the importance of ecological, emotional, and spiritual wellbeing; and showcase its essentiality in reframing our current narrative of what it means to be a farmer.

RESULTS AND DISCUSSION

The adoption of more industrialized approaches to farming practices has led to a noticeable disconnection between farmers and their land. The promise of new technology and silver bullet solutions has led farmers to abandon more localized knowledge systems and practices to favor what I consider “artificial efficiency” (ie. systems of efficiency that radically simplify and attempt to control natural systems, systems that produce high yields, but are inefficient in maintaining ecosystem functionality, providing nutrient-dense food items, enhancing food security, and ensuring long-term sustainability). To understand the context for why this relational shift has occurred, it is necessary to recognize the influence of hegemonic power structures in agricultural development, and how the increasingly industrialized methods of production have led to a deterioration of soil health, and farmers’ relationships to their land.

As a society that has become obsessed with technological advancements to replace what can be seen as the suffering of intense labor, we have begun to look for meaning in more abstract ways, through virtual realities that ignore the current state of our one true reality. Much like how the expansion of industrialized agriculture has crumbled the structure of rural-agricultural communities, it has dismantled the complex systems within our soils by attempting to simplify the complexities of nature. It seems that the more a society sees itself as cerebral, with clever technological and material innovations, the more its bonds with, and recognition of, the significance of natural processes and ecosystems recede ([Flora, 2010](#)). The consequences of this disconnection being: farmers have increasingly lost touch with a deeper understanding of local ecological systems, local food economies have become increasingly insufficient and become reliant on external producers to meet their needs, and consumers have become increasingly disconnected from where their food comes from. Our current industrialized system puts a relative handicap on those whose assets include

traditional knowledge of the local idiosyncrasies of soil and climate, and whose energies are absorbed by the labors of husbandry rather than manipulating the rural-urban nexus (Pearse, 2015). The majority of research that has been conducted thus far has been shallow in assessing the role of connection (McFadden, 2019). By continuing to rely on the western scientific methodologies, which is largely responsible for the crisis we currently face, we will ultimately fail to create sustainable change. In order to change the system, we have to change our relationship to it.

We must recognize that the illusion of local abundance and cheap imported food provided by supermarkets is unsustainable, and we must work to reconnect consumers with local farmers. COVID-19 illustrated the weaknesses of industrial-productivist agriculture as the economic fallout resulted in a swift disruption of food production, processing, distribution and consumption (Gordon et al., 2021). This was ultimately a wakeup call for many Americans as to how dependent we are on imported food items, and how vulnerable our globalized food system really is. As extreme climatic events and pandemics are expected to become increasingly more common in our collective future, we need to start looking for ways to redesign our food systems so future events don't cause such a dramatic disruption. Part of advancing food sovereignty alternatives based on indigeneity and/or agroecology is to plant the seeds of resilient, land-based, communal alternatives (Figuroa-Helland et al., 2018). These systems are predicated on the holistic and collective understanding of individual ecosystems that balances trade-offs between food and production and foundational ecosystem functions (Winter et al., 2020).

Upon further reviewing my fieldnotes and interview responses, one theme stood out to me very clearly: *connection*. Every farmer I spoke with described some aspect of connection as being why they pursued a career in regenerative agriculture. The most common responses involved: connecting with where their food comes from, and connecting others to where their food comes from. These findings are consistent across multiple other studies that show the relational values of community well-being, eco-stewardship, and connections with nature have been shown to influence farmers' commitments to regenerative agriculture (Frankel-Goldwater, 2024). Here I see connection and healing relationships as mutually inclusive of one another. It is the relationship between themselves and food they are wanting to heal.

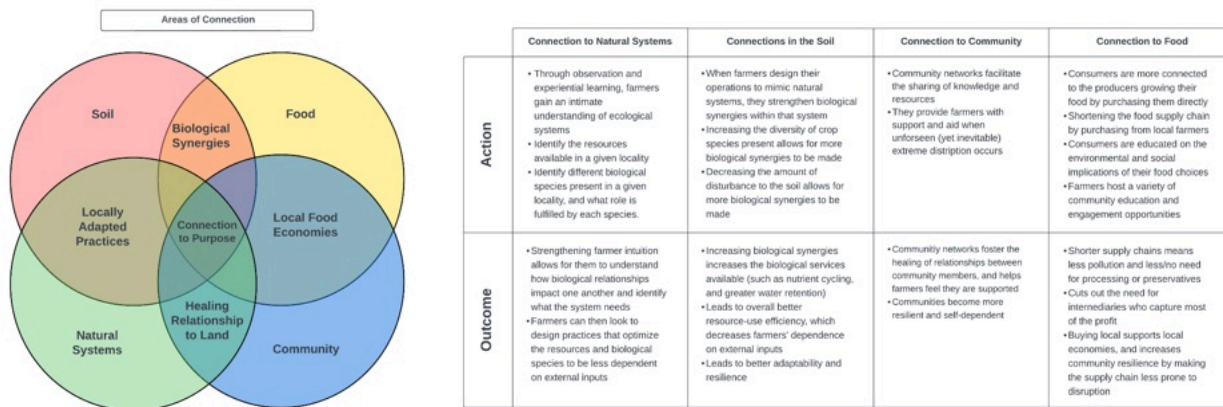


Figure 1 Areas of Connection

Healing Connection to Land

Redesigning our food systems should first be concerned with changing how it is produced. Farmers should be seen not only as producers of food commodities but as stewards of agroecosystems, and uphold the

responsibility of ensuring the lands' self-sustaining capacity. This simply cannot be achieved through technocratic idealisms that drastically undermine the complexity of natural ecosystems, and impose a false sense of control and dominance over these systems. Positioning farmers in a role of dominance diminishes their capacity to learn from the natural systems they manage. There is a great deal of difference between learning "from" nature and learning "about" nature. When we learn "about" nature she becomes an object of study, leading to exploitation of her. [...] But when we learn "from" nature we establish a close relationship with her ([Kumar, 2016](#)). It is important [for farmers] to engage in restoration with development of a personal relationship with the land and its living things (Kimmer, 2020). In doing so, farmers will develop a greater awareness of the ecological functions that are essential to the lands' long-term sustainability, and the relationship they form with the land will ultimately drive long-term commitment.

The inclusion of healing is common throughout many Indigenous teachings, and how the act of healing the planet is deeply intertwined with healing our relationship to land. "Restoring land without restoring relationship is an empty exercise. It is relationship that will endure and relationship that will sustain the restored land. Therefore, reconnecting people and the landscape is as essential as reestablishing proper hydrology or cleaning up contaminants. It is medicine for the earth" (Kimmer, 2020). So we must then ask ourselves: what does that healing look like? Is the kind of healing that is being alluded to even possible within the modern frameworks of western society where humans and nature are seen as separate entities? Colonization has influenced the detachment of traditional connections and relationships with humans, plants, animals, and the land. The deep connections include both learning and healing from and with the land. The process of decolonizing healing involves reconnecting and engaging with the land to situate healing and learning ([Field, 2021](#)).

Indigenous authors have often alluded to the necessary healing that must take place in order to free our minds from colonial influence, and how that healing is mirrored through healing our relationship to land. Enacting this kind of change involves experiential approaches to learning and healing build upon strengths of Indigenous ways of knowing and being in relation with the land (Greenwood et al., 2018). This same principle applies to redefining land in terms of agriculture that would honor land as a relation, not merely as a piece of capital (Carlisle, 2022). In order to heal relationship to land, we must steer away from the narrative of viewing land as commodity, and re-orient our understanding of place by acknowledging the emotional impact or history of a given place; that is how we begin to heal.

Counter-mapping can be used as a tool in depicting relationship to place, or what many Indigenous scholars refer to as "the story of the land". Few of us have thought to ask what truths a map may be concealing, or have paused to consider that maps do not tell us where we are from or who we are ([Steinauer-Scudder, 2018](#)). The idea of counter-mapping is to define the relationship between place and experience; it can be used to illustrate the emotions tied to a past event, but can also be used to describe the kinds of emotional experiences one can expect to have at a given location, or to depict how land (or relationship to land) has changed over time. I believe this approach can be incredibly useful in designing urban agriculture, for there are fewer opportunities to engage with nature in an urban setting.

The state of Colorado has long been recognized for its beautiful landscapes and a local culture rooted in connection to nature; all across the front range there is evidence of the deeper connection people experience with the land. I began to question in what ways has this connection to land been used as a resource to aid community and individual healing? How can healing through connection to land be applied to agriculture, and how can we use principles of connection to redesign our food systems to be more resilient and

sustainable? In the subsections following, I provide a series of examples as to how Boulder communities have used this principle of connection to land to heal from devastating events, and its implications for our global future. The Rocky Mountain Botanic Gardens and the Fort Chambers/Poor Farm Management Plan are both exemplary of the Indigenous notion of healing through connection to place and community.

Rocky Mountain Botanic Gardens

The Rocky Mountain Botanic Gardens serve as an educational garden that displays a variety of Colorado native plant species woven throughout an immersive trail that encourages visitors to experience a deeper sense of connection to the natural landscape around them. This place also represents how community members used this space as a way to heal from a devastating 500-1,000 year flood that wiped out the community of homes that once stood in its place. In September of 2013 the town of Lyons was hit with more than a years worth of precipitation in less than a week, which caused catastrophic flooding, totaling over 4 billion dollars in damages, taking the lives of 9 community members, and wiping out more than 50 mobile homes that resided along the South Saint Vrain Creek. Of the 50 mobile homes that were destroyed not a single one was replaced; considering the two mobile home parks were the only source of affordable housing in the county, virtually none of those residents were able to return to Lyons following the flood, and were forced to relocate elsewhere. Several years later, when the site was finally cleared, community members and volunteers began to create a space where the public could learn about and enjoy the beauty of the natural world. It is obvious as one walks through the garden the trauma that was inflicted there, and the connection the community has to this place, as there are countless encounters with artistic memoirs and pieces left by community members, that all reflect their connection to this land. Upon conducting further research into the history of the development of the garden space, it became obvious that the garden represented a space of healing- that supported the community through their flood recovery efforts.



Individuals have contributed by adding pieces of jewelry, along with other artistic creations. All kinds of natural objects became tools for creative expression. At the center of the garden lies a large structure that makes out the shape of a heart, and is made of intertwined branches and other pieces of debris. The structure

represents our interconnectedness to the natural world around us, and demonstrates an awareness through art and cultural initiatives can further reveal the vital, ecological importance of sustaining ecological functions (Ball et al., 2017). This garden is exemplary of the transformative healing that is actualized through connection to a given place, and demonstrates the resilience shown by the community of Lyons, CO. As extreme climatic events such as this one are expected to occur in increasing frequency and intensity, we must look for examples where communities have come together to grieve, heal and rebuild so other communities may do the same.

Fort Chambers/Poor Farm Management Plan

In her book *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* author Robin Kimmer writes that the truth of our relationship with the soil is written more clearly on the land than in any book; she then goes on to explain how humanity will be unable to heal its relationship with land until we hear its stories. This notion of “hearing the stories of the land” involves acknowledging its history to then invite space for collective healing to take place. Counties across the United States have begun to work in collaboration with Indigenous leaders to create such healing spaces. Currently, the city of Boulder is working with Arapaho and Cheyenne Tribal Representatives to create the Fort Chambers/Poor Management Farm Concept Plan, a collaborative stewardship plan for a unique city open space site with important historical, ecological and agricultural features and a direct connection to the Sand Creek Massacre.

Throughout this project, the city has collaborated with Arapaho and Cheyenne Tribal Representatives to:

- Learn the Cheyenne and Arapaho Tribes, the Northern Arapaho Tribe and the Northern Cheyenne Tribe's desired long-term relationship with the land.
- Understand how best to interpret the land's history and its connection to the Sand Creek Massacre and accurately describe Boulder residents' role in the massacre.
- Identify opportunities to incorporate the intergenerational trauma that the Arapaho and Cheyenne Nations have endured from both the colonization of Indigenous lands in the Boulder Valley and the Sand Creek Massacre into Boulder history (Knapp, 2024).

The aim of the project is to heal the land from past land uses through ecological restoration, and to hold space for individual and collective healing through including educational elements and indigenous art. The project site, Fort Chambers, is the location of the deadliest day in Colorado's history: The Sand Creek Massacre where over 200 native americans (mostly women, children and elderly) were betrayed and brutally murdered by the United States military. The plan for the project included area descriptions for agricultural production, forested wetlands conservation area, as well as a number of educational points along the proposed healing trail. In recognition of the history of Fort Chambers, the purpose of the proposed farm would be to act as a healing place for all: community members, visitors, wildlife and natural ecosystems. The Poor Farm Management Plan demonstrates a path for healing historical injustices by acknowledging the emotional relation to place. However, this same approach can be applied to healing our connection to land through regenerative agriculture and agroecology.

Find out more [here](#).

Healing Connections within the Soil Through Agroecology

When I first embarked on my research journey into understanding agroecosystem health, I was drawn toward quantifiable studies that often involved soil composition, nutrient densities, water solubility, and mycology studies. While this research is immensely important for understanding how our natural systems function, it does very little to situate a systemic response that addresses the root problems associated with our food systems. Additionally, while talking with several farmers within my community, I repeatedly found that much of soil science was largely incomprehensible to the majority of farmers, and/or did not translate to what they were experiencing on their farm. One interviewee mentioned how some of their most productive fields would score lower on soil tests (primarily in terms of nutrient availability and organic matter



composition). What this demonstrates is that the full picture of soil health encompasses more than its biological and chemical composition, thus establishing a clear need for an intuitive awareness of the functioning of the agroecosystem as a whole. During the interviews, several of the farmers I spoke with explained that it was not so much the understanding of specialized soil science that made their farming operations successful, and that it was largely their intuition and experiential knowledge that guided their decision making. They explained that through their deeper understanding of biological systems and processes, that they were able to design agricultural systems that mimic and/or enhance ecosystem functions.

Figure 2 *Systems of Agroecology*

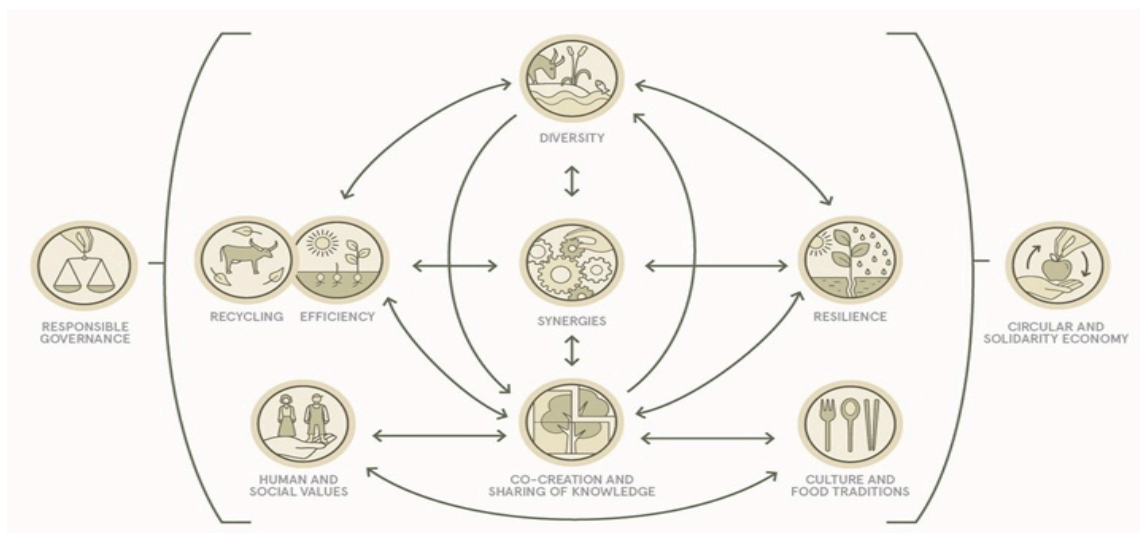
If we want to design food systems through biomimicry, farmers should look to mirror principles of biodiversity and circularity.

Agroecology provides a framework for understanding how this can be achieved. In her book *Agroecology & Regenerative Agriculture: Sustainable Solutions for Hunger, Poverty, and Climate Change*, author Vandana Shiva lays out a series of agroecological principles to guide farmers in the design of agroecosystems as the following:

- Enhancing the recycling of biomass, optimizing nutrient availability, and balancing nutrient flow
- Securing favorable soil conditions for plant growth by managing organic matter and enhancing soil biotic activity
- Minimizing losses due to flows of solar radiation, air, and water through microclimate management, water harvesting, and soil management through increased soil cover
- Species and genetic diversification of the agroecosystem
- Increasing the beneficial biological interactions and synergism among agrobiodiversity components that result in the promotion of key ecological processes and services

Developing these kinds of systems ultimately is rooted in biodiversity. As diversity increases, so do opportunities for co-existence and beneficial interactions between species that can enhance agroecosystem sustainability (Shiva, 2022). Preserving greater levels of biodiversity both above and below ground can be achieved through less disturbance to the soil, ie. tillage. When farmers reduce their amount of tillage, the underground root networks are able to build stronger, more resilient connections.

Several of the farmers I spoke with also emphasized the importance of local contextual knowledge (another key principle of agroecology), which ultimately helped them modify their practices to be better adapted to certain climatic conditions. Colorado has always been a particularly challenging environment for agricultural production. One of the farmers explained one of the challenges with farming in Colorado is the intense year-round sun exposure with very little precipitation. When they would leave their fields fallow during the winter season, the harsh levels of sun exposure would cause immense amounts of soil erosion to occur. When the farm began to implement cover cropping during the winter, they saw a massive reduction in soil erosion. Keeping roots in the ground is the important principle here; when there is constantly something growing, you are constantly feeding the microbial network via root systems, which is ultimately what holds the soil together. This in turn allows the soil to retain larger quantities of water, leaving it less susceptible to erosion and drought. Understanding this principle is paramount considering in the US alone, soil on cropland is eroding 10 times faster than it can be replenished (Cosier, 2019). The key here is systems thinking: by recognizing agriculture as a part of larger natural ecosystems, we begin to understand the role of other organisms, and can use these natural synergies to better support, and ultimately sustain, agricultural production.



Principles of Agroecology. Source: FAO (2017)

Figure 3

Healing Connections within Community Networks

Another prominent theme present in my interviews involved the support of community networks. Community networks facilitate support for farmers by the sharing of knowledge and resources, providing collaborative space for problem solving, as well as connecting farmers more directly with consumers. One of the farmers interviewed for this study shared a meaningful example of how their community network showed immense support by providing them with plant seedlings following an unusually late hail storm in July of 2023 that virtually wiped out their entire harvest. They also mentioned that the majority of the equipment and resources they used on the farm were donated to them from other local farmers, and that many of the practices and techniques they used were shared with them from neighboring farmers, or were collectively constructed.

Creating community networks also entails redesigning local food systems following principles of agroecology and biomimicry design, and should be focused on building and strengthening local circular economies. Strengthening local food economies means shortening the supply chain, eliminating waste, and connecting producers and consumers as much as possible. This stands especially true for urban environments, which have become increasingly distanced from agricultural production and the problems associated with organic waste. Just as every city is unique by design, local food systems should also be unique to place. The design of the system should aim to rebuild the broken system, its ecological cycles and the broken links between the city and the countryside, which means creating food-smart citizens who know what they are eating and where their food comes from (Shiva, 2022). Each one of us needs to become ‘an ecological citizen’, that is, someone who ‘understands that the social problems we face are interconnected and must be met through transformative personal change and creative collective action in their home community’ (Scatolini, 2022).

Restoration of agroecosystems is an ongoing cyclic process that requires intergenerational stewardship. There is a quote I grew up with that says: “it takes far longer to heal something than to break something”; thus the healing of our agroecosystems will require an ongoing transfer of knowledge onto new generations to keep the cycle of regeneration alive. The problem we face here is that fewer and fewer people are pursuing careers in agriculture, and when there is nobody to pass the knowledge onto, the intimate understanding of that particular land is then lost. With a large percentage of American farmland on track for being retired with no lineage to pass on to, farmland is going to continue to be bought up by large corporations expanding their production unless more people become interested in pursuing even small-scale regenerative agriculture. We desperately need to find more ways of getting young people involved with growing food. Several local farms in Boulder have begun to address this issue by hosting a variety of engagement opportunities for young, elderly, and disabled community members.



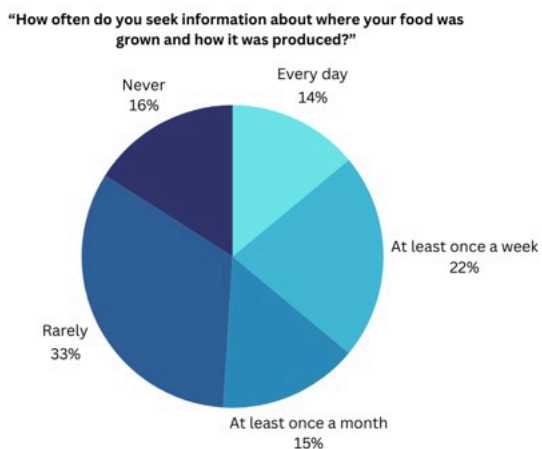
This is where the healing of relationships comes into play. By creating spaces for multi-generational use, we create space for new dialogue to occur. This dialogue in turn creates a stronger foundation of community, and contributes to the co-production of and relationship-based exchange of knowledge (Nelson et al., 2023). Collaborative dialogues establish clear and observable goals which work towards creating a self-identity based in culture, individual strengths, and community resources to address present and future concerns (Field, 2021). It is these relationships that are at the heart of sustaining circular local economies, where value is given to the trustworthy relationships that develop between

consumer and producer. One of the most important and impactful changes we can begin to make is by directly supporting local farmers. Research has highlighted the increasing consumer demand for local food options, and farmers are beginning to develop more creative ways to directly connect with consumers. This

doesn't just have to be through farmers markets or CSA programs. Several farms in Boulder have begun to implement a variety of community engagement programs and educational opportunities for members to connect with food, animals, and nature. Such innovative approaches can improve the connection of people to soil by boosting the soil knowledge of land users and increasing the understanding of the consequences of food choices ([Ball et al., 2017](#)).

Healing Connections Between Consumers and Food

As trends of urbanization are projected to continue into the future, we must continue to look for creative new ways of bridging the disconnection between natural and urban environments. A recent study suggests that fifty-four per cent of the global population is estimated to live disconnected from the natural environment ([Pino et al., 2022](#)). The conveniences of a "modern" country insulate people; even the most basic needs of water, food, and energy are delivered from a supply chain so long and convoluted that consumers do not associate them with the natural world ([Flora, 2010](#)). The most recent Food Literacy and Engagement Poll conducted by Michigan State University further demonstrated this disconnection with their results showing



that 49% of respondents never or rarely seek information about where their food was grown or how it was produced ([MSU, 2022](#)). Sheril Kirshenbaum, co-director of the survey provided commentary regarding this disconnection stating: "as a nation, we celebrate our long history of farming and food production, yet so many of us have not been paying attention to how agricultural practices and emerging technologies sustain us" ([Michigan State University, 2021](#)). Human society as a whole needs to become more aware of its connection to the soil and realise the the dependence on soil for food, biomass and the functions it provides to maintain the biosphere ([FAO and ITPS, 2015](#)).

Figure 4 Consumer Disconnection. Source: [MSU, 2022](#)

Urban agriculture holds the promise of being a space where community members can reconnect with both nature and food. Communities can use this principle of relationship to

place to meaningfully design urban agricultural spaces to serve a dual purpose: to heal the ecology of the land, and to heal community relationships; this is the idea at the heart of agroecology. So the question is then, how do we integrate people and food systems into the ecological systems of a locality? The key is to offer people something the current system doesn't: the tools and the power to build a better life for themselves. Doing so restores dignified work by fostering communities that control what they produce (Klein, 2014).

Broader Applications to MESH Program

All of the farmers that were interviewed recognized in some way the implications of the growing threat of climatic breakdown, and see regenerative agriculture and agroecology as a way we can both lower and reverse the ecological impact of industrial agriculture, which thus far has been linked sustainability issues including the loss of biodiversity, agrochemical contamination and sedimentation in waterways, pesticide poisoning of non-target organisms, and emissions of greenhouse gasses and pollutants ([Power, 2010](#)).

Human manipulation and alteration of ecosystems for the purpose of establishing agricultural production has turned agroecosystems into highly simplified systems, to the point that they are structurally and functionally very different from natural ecosystems (Nicholls, 2017). This misalignment of practices has in turn resulted in a highly inefficient system of food production that requires far greater amounts of energy to produce than it gives, generates immense amounts of waste, and degrades the biological relationships that keep the system running. Redesigning our food systems to be more regenerative and thus self-sustaining, would dramatically reduce the need for costly and environmentally damaging external inputs.

Additionally, creating more localized food systems addresses broader social injustices brought on by hegemonic power structures such as market and land consolidation, which has led to grossly unjust economic and political inequalities. Consolidation has placed key decisions about our nation's food system in the hands of a few large companies, giving them outsized influence to lobby policymakers, direct food and industry research, and influence media coverage. These corporations also have enormous power to make decisions about what food is produced, how, where and by whom, and who gets to eat it (Howard, 2021). This in turn has led to dramatic inequalities in food distribution, debt entrapment, and has made communities increasingly reliant on externalities. Local networks create an opportunity for small producers to connect directly with the people who eat their food, butting out the intermediaries who otherwise capture most of the money. [...] A local food economy is more likely to keep people on the land, favor small-scale and diverse production, and generate employment than a transnational one (Monbiot, 2023).

SUMMARY

This project is aimed at demonstrating how the path toward making a more resilient and sustainable food system must be built on reestablishing connection - connection between farmers and their communities, connection between consumers and where/how their food is produced, and connections between farmers and their land. This study examines the role of industrialization and colonialism as the driving forces that forged the various disconnections throughout our global food systems. To demonstrate how this connection can be restored, this study examines how the community of Boulder has integrated the notion of healing relationship to land into their public spaces, as seen with The Rocky Mountain Botanic Gardens and the Fort Chambers/Poor Management Farm. To further understand what it means to heal relationships to land we can look to indigenous knowledge to guide an understanding of a different way of being with the land, and understanding agroecosystems. Using this knowledge we can begin to build place-based practices that have been mindfully developed over generations thanks to those dedicated to living a life in harmony with the natural world. To further enhance the development of these systems we can look to incorporate agroecological principles into their design. Systems of agroecology require the farmer to have a keen understanding of the biological relationships within a given ecosystem, and look for ways to support and mimic aspects of that system. In doing so, farmers are able to optimize the biological synergies which enhance multiple ecological functions. By reestablishing connection to land, within the soil, and throughout our communities, we can begin to create resilient and sustainable food systems; at the end of the day it all comes back to connection.

References

- Ball, B. C., Hargreaves, P. R., & Watson, C. A. (2017). A framework of connections between soil and people can help improve sustainability of the food system and soil functions. *Ambio*, 47(3), 269–283. <https://doi.org/10.1007/s13280-017-0965-z>
- Carlisle, L., Wakida, P., & Salvador, R. J. (2022). *Healing grounds: Climate, Justice, and the deep roots of regenerative farming*. Island Press.
- Cosier, S. (2019, May 30). The world needs topsoil to grow 95% of its food – but it’s rapidly disappearing. *The Guardian*. <https://www.theguardian.com/us-news/2019/may/30/topsoil-farming-agriculture-food-toxic-america>
- Dengson, A. (Ed.). (1986). *The trumpeter: Voices from the Canadian ecophilosophy network*, ed. Alan Dr. Rengsten [review]. *The Canadian Field-Naturalist*, 3(4), 1–4. <https://doi.org/10.5962/p.355691>
- FAO. (2017). *The 10 Elements of Agroecology: Guiding the transition to sustainable food and agricultural systems*. Rome. Available from: <https://www.fao.org/3/i9037en/i9037en.pdf>
- FAO and ITPS. 2015. *Status of the World’s Soil Resources (SWSR)—Technical Summary*. Rome: Food and Agriculture Organization of the United Nations and Intergovernmental Panel on Soils. Available from: <https://www.fao.org/documents/card/en?details=i5126e>
- Field, M. (2022). *Decolonizing Healing Through Indigenous Ways of Knowing*. In: Wallace, M.F.G., Bazzul, J., Higgins, M., Tolbert, S. (eds) *Reimagining Science Education in the Anthropocene*. Palgrave Studies in Education and the Environment. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-79622-8_8
- Figueroa-Helland, L., Thomas, C., & Aguilera, A. P. (2018). Decolonizing Food Systems: Food Sovereignty, Indigenous Revitalization, and Agroecology as Counter-Hegemonic Movements. *Perspectives on Global Development and Technology*, 17(1-2), 173-201. <https://doi.org/10.1163/15691497-12341473>
- Flora, G. (2010). *Remapping Relationships: Humans in Nature*. In *The Post Carbon Reader: Managing the 21st Century’s Sustainability Crises*. essay, Watershed Media.

Frankel-Goldwater, L., Wojtynia, N., & Dueñas-Ocampo, S. (2024). Healthy people, Soils, and ecosystems: Uncovering primary drivers in the adoption of regenerative agriculture by US farmers and ranchers. *Frontiers in Sustainable Food Systems*, 7. <https://doi.org/10.3389/fsufs.2023.1070518>

Gordon, E., Davila, F. & Riedy, C. Transforming landscapes and mindscapes through regenerative agriculture. *Agric Hum Values* 39, 809–826 (2022). <https://doi.org/10.1007/s10460-021-10276-0>

Growing Gardens. (2014, September). <https://growinggardens.org/>

Howard, P. H., & Hendrickson, M. (2021, February 17). Op-ed: Monopolies in the food system make food more expensive and less accessible. *Civil Eats*. <https://civileats.com/2021/02/17/op-ed-monopolies-in-the-food-system-make-food-more-expensive-and-less-accessible/>

Hueston W, McLeod (2012). A. OVERVIEW OF THE GLOBAL FOOD SYSTEM: CHANGES OVER TIME/SPACE AND LESSONS FOR FUTURE FOOD SAFETY. In: Institute of Medicine (US). *Improving Food Safety Through a One Health Approach: Workshop Summary*. Washington (DC): National Academies Press (US); A5. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK114491/>

James, N., & Busher, H. (2009). Epistemological Dimensions in Qualitative Research: the Construction of Knowledge Online. In *Online interviewing* (pp. 5–18). essay, SAGE.

Kelly, A. (2024, March 19). A snapshot of Colorado Agriculture. A Snapshot of Colorado Agriculture | Colorado General Assembly. <https://leg.colorado.gov/publications/snapshot-colorado-agriculture>

Kimmer, R. W. (2020). *Braiding Sweetgrass*. Milkweed Editions.

Klein, N. (2014). *This changes everything: Capitalism vs. the climate*. Simon & Schuster.

Kumar, S. (2019). Three Dimensions of Hindu Ecology: Soil, Soul and Society. In *The Silene Association*. essay. Retrieved from <https://www.silene.org/wp-content/uploads/2019/05/Satish-Kumar.pdf>.

Matzdorf, B., & Meyer, C. (2014). The relevance of the Ecosystem Services Framework for developed countries' environmental policies: A comparative case study of the US and EU. *Land Use Policy*, 38, 509–521. <https://doi.org/10.1016/j.landusepol.2013.12.011>

McFadden, S. (2019). *Deep Agroecology: Farms, food, and our future*. Light and Sound Press.

Michigan State University. (2021, April 23). New poll reveals public disconnect on food and climate change. *Phys.org*. <https://phys.org/news/2021-04-poll-reveals-disconnect-food-climate.html>

Monbiot, G. (2023). *Regenesis: Feeding the world without devouring the planet*. Penguin Canada.

MSU Food Literacy and engagement poll: Wave IV. MSU Food Literacy and Engagement Poll: Wave IV. (2019, February 14). <https://www.canr.msu.edu/news/msu-food-literacy-and-engagement-poll-wave-iv>

Naess, A. (1973). The shallow and the deep, long-range ecology movement. A summary* . *Inquiry*, 16(1–4), 95–100. <https://doi.org/10.1080/00201747308601682>

Nelson, E., Hargreaves, S., & Muldoon, D. (2023). Farmer knowledge as formal knowledge: A case study of farmer-led research in Ontario, Canada. *Journal of Agriculture, Food Systems, and Community Development*, 1–24. <https://doi.org/10.5304/jafscd.2023.124.010>

Nicholls, C. I., Altieri, M. A., & Vazquez, L. (2017). Agroecological Principles for the Conversion of Farming Systems. In A. Wezel (Ed.), *Agroecological practices for sustainable agriculture principles, applications, and making the transition* (pp. 1–18). essay, World Scientific.

Ortiz, E. (2015, August 24). New generation of young farmers increasingly college educated, but indebted | Sacramento Bee. *The Sacramento Bee*. <https://www.sacbee.com/news/business/article31912833.html>

Pearse, A., & Utting, P. (2015). Seeds of Plenty, Seeds of Want: Social and Economic Implications of the Green Revolution. In *Revisiting Sustainable Development* (Vol. 3, pp. 139–158). essay, UNRISD.

Pino, V., McBratney, A., O'Brien, E., Singh, K., & Pozza, L. (2022). Citizen Science & Soil Connectivity: Where are we? *Soil Security*, 9. <https://doi.org/10.1016/j.soisec.2022.100073>

Power, A. G. (2010). Ecosystem Services and agriculture: Tradeoffs and Synergies. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 2959–2971. <https://doi.org/10.1098/rstb.2010.0143>

Sampson D, Cely-Santos M, Gemmill-Herren B, Babin N, Bernhart A, Bezner Kerr R, Blesh J, Bowness E, Feldman M, Gonçalves AL, James D, Kerksen T, Klassen S, Wezel A and Wittman H (2021) Food Sovereignty and Rights-Based Approaches Strengthen Food Security and Nutrition Across the Globe: A Systematic Review. *Front. Sustain. Food Syst.* 5:686492. doi: 10.3389/fsufs.2021.686492

Scatolini, S. S. S. (2022). From spiritual ecology to balanced spiritual ecosystems. *HTS Teologiese Studies / Theological Studies*, 78(2). <https://doi.org/10.4102/hts.v78i2.7202>

Shiva, Vandana (1993) *Monocultures of the Mind Trumpeter*: 10, 4. <http://www.icaap.org/iuicode?6.10.4.11>

Shiva, V. (2022). *Agroecology & Regenerative Agriculture: Sustainable Solutions for hunger, poverty, and climate change*. Synergetic Press.

Steinauer-Scudder, C. (2018, February 8). Counter mapping. *Emergence Magazine*.
<https://emergencemagazine.org/feature/counter-mapping/>

Weeks, M. A., Sutter, P., & Andrews, T. (2016). (dissertation). *Industrializing a landscape: Northern Colorado and the making of agriculture in the twentieth century*.

Winter, K. B., N. K. Lincoln, F. Berkes, R. A. Alegado, N. Kurashima, K. L. Frank, P. Pascua, Y. M. Rii, F. Reppun, I. S. S. Knapp, W. C. McClatchey, T. Ticktin, C. Smith, E. C. Franklin, K. Oleson, M. R. Price, M. A. McManus, M. J. Donahue, K. S. Rodgers, B. W. Bowen, C. E. Nelson, B. Thomas, J.-A. Leong, E. M. P. Madin, M. A. J. Rivera, K. A. Falinski, L. L. Bremer, J. L. Deenik, S. M. Gon III, B. Neilson, R. Okano, A. Olegario, B. Nyberg, A. H. Kawelo, K. Kotubetey, J. K. Kukea-Shultz, and R. J. Toonen. 2020. Ecomimicry in Indigenous resource management: optimizing ecosystem services to achieve resource abundance, with examples from Hawai'i. *Ecology and Society* 25(2):26. <https://doi.org/10.5751/ES-11539-250226>

MESH Magazine

Capstone Project

Master of Science in Engineering, Sustainability and Health



Article

Filling in Gaps: Prioritizing Top Three Environmental Burdens to Public Health and Understanding The Factors Behind Categorizing Specific Populations as Vulnerable

Pelton, Kelsey
University of San Diego
kpelton@sandiego.edu

April 14, 2024 - Final Capstone Paper

ABSTRACT

Much of literature uses the term ‘vulnerable population’ to group individuals with increased susceptibility to health problems and health disparities. There’s a major gap in literature that breaks down the term vulnerable population into the sub-populations that are categorized into the term, especially when using the term in relation to environmental stressors. In this study, I fill a gap in literature by contributing to a better understanding of what classifies certain populations as vulnerable, breaking down their own unique reasons for vulnerability to three major environmental stressors of health concern, air pollution, water pollution (drinking water) and climate change. This study examines and uncovers the behavioral, developmental, biological, social, economic and political factors of vulnerability that children, elderly, people with pre-existing health conditions, low income and minority communities face from those environmental burdens. This study also fills a gap in literature in regards to why these populations are most at risk in the first place, and how we’ve gotten to this point, uncovering complex history. Gaps are filled, and solutions are proposed in terms of policy development, building resilience and awareness and prioritizing the voices of those most marginalized and underserved.

Keywords: Environmental burden, environmental stressors, public health, health risks, vulnerable populations, disproportionate burdens, air pollution, air quality, water pollution, drinking water, water quality, climate change, children, elderly, pre-existing health conditions, low income, minority populations

TABLE OF CONTENTS

Introduction.....	pg 3
Literature Review.....	pg 4
General Trends.....	pg 4
Climate Change - (<i>Trends & Gaps</i>).....	pg 5
Air Pollution - (<i>Trends & Gaps</i>).....	pg 6
Water Quality - (<i>Trends & Gaps</i>).....	pg 7
Environmental Injustices and Their Relation to Public Health - (<i>Trends & Gaps</i>).....	pg 8
Summarizing Gaps in Literature and How my Research Will Address Them.....	pg 9
Methodology.....	pg 9
Multifaceted Approaches.....	pg 9
Interviews Shaping the Study and Practical Work in the Field.....	pg 10
Research, Scientific Findings, Studies, Datasets, Hands-On Work.....	pg 10
Theoretical Framings.....	pg 11
Research Questions.....	pg 11
Epistemology and Various Ways of Knowing or Believing in a Topic.....	pg 12
Epistemological Approach to Climate Change.....	pg 12
Epistemological Approach to Air and Water Quality.....	pg 13
Results and Discussion.....	pg 14
Populations Within the Term ‘Vulnerable Populations’ Results of the Scientific Health, Social and Economic Factors of Vulnerability.....	pg 14
Children.....	pg 14
Elderly People.....	pg 15
Persons With Pre-Existing Health Conditions.....	pg 15
Minority and Low Income Populations.....	pg 16
Health Risks from Air Pollution, Water Pollution and Climate Change.....	pg 16
Water.....	pg 17
Climate Change.....	pg 17
Environmental Justice and Public Health.....	pg 17
Why it Matters.....	pg 17
Environmental Injustices and How We Got Here - A ‘Forgotten History’.....	pg 18

Redlining in the United States.....pg 18

Solutions / Making Change to Develop Positive History and Filling in Gaps.....pg 20

 Building Resilience and Awareness.....pg 20

 Listening, Collaborating, Developing the Conversation, Creating Priorities.....pg 21

 Advocating for Improved or New Policies.....pg 22

 Filling in Gaps of Existing Policies for Air Pollution.....pg 22

In Conclusion.....pg 22

INTRODUCTION

The intersection between the environment and its threats to public health is an increasing concern in the world. The current presence and projected trajectory of increased development, urbanization, industrialization, globalization, intensification of agriculture, and increasing energy use, has and will continue to result in air, land, and water pollution, deforestation, biodiversity loss and a changing climate. As a result, it causes a threatening relationship between the environment and public health, with vulnerable populations most at risk of developing chronic health conditions. On a global scale, almost the entire global population (99%) breathes air that exceeds World Health Organization air quality limits, and threatens their health ([World Health Organization, 2022](#)) and 1 in 3 people globally do not have access to safe drinking water ([World Health Organization, 2019](#)). In the United States, data from the last calendar year, 2023, finds that after decades of progress on cleaning up sources of air pollution, 119.6 million people still live in places with failing grades for unhealthy levels of ozone or particle pollution ([American Lung Association, 2023](#)) and nearly half of the tap water in the United States is contaminated with forever chemicals PFAS. It's safe to say that there is no safe public health without good planetary health, and environmental burdens are not distributed equally, disproportionately impacting certain communities more than others, with certain populations being at a higher risk of developing chronic and sometimes life threatening health conditions.

Much of literature and reports focus on one environmental stressor at a time, without disregarding the importance of this literature, there's a gap in literature that collectively in one report focuses on three of the most critical factors to protecting human health. When referring to protecting public health it's vital to bear in mind that in order to survive all humans must breathe air, drink water and live in a non-threatening climate and therefore there needs to be more literature that encompasses into one piece, the severity of air pollution, water pollution and climate change as three main environmental stressors that should be a top priority when referring to public health. In addition, many studies and reports have been completed to determine which populations are most at risk of developing health conditions from exposure to these environmental burdens, these populations are referred to as 'vulnerable populations'. The problem is, there's a major gap in comprehensive reports that break down details regarding each of the specific population categories that are classified within the term 'vulnerable populations'. That is why for the purpose of this study I fill a gap in literature by developing a report that encompasses all of these critical factors into one study. Therefore, for the purpose of this study I focus on air pollution, water pollution (drinking water) and climate change. I also contribute to a better understanding of the degrees to which five population categories are all classified under the term 'vulnerable populations' and what classifies them as vulnerable. These populations are, children, elderly people, people with pre-existing medical conditions, and minority and low income populations.

The significant importance and uniqueness behind this study is that it does not limit the study to one specific population while also not having it be too broad. By breaking down 'vulnerable populations' into **each** population that is classified under the term vulnerable population it provides a study that encompasses the behavioral, biological and scientific health factors specific to each population categorized as vulnerable, into one report, filling a gap in literature. It's critical to shed light on why each of these populations are vulnerable for their own unique reasons, but at the same bring attention to why they're all classified under the term 'vulnerable population'. As an example, a child is vulnerable to environmental stressors for different biological reasons than an elderly person is but they're both categorized under the broad term of 'vulnerable population'.

In addition, there's a major gap in literature in regards to why these populations are most at risk in the first place. The second purpose of this paper is to fill in those gaps by uncovering complex history and proposing solutions to create positive history moving forward, because there is no safe public health without good planetary health.

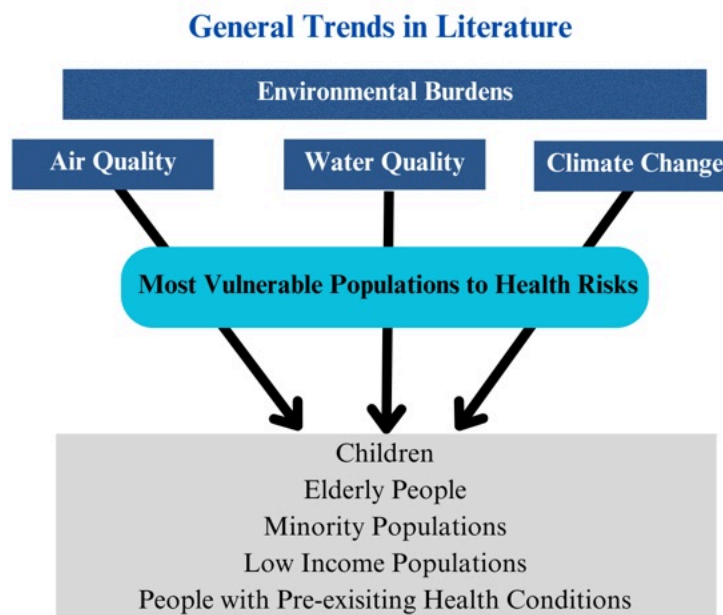
LITERATURE REVIEW

General Trends

An in depth literature review was an essential part of this study, it provides context, builds a framework, generates research questions and methodologies. The literature review done for the purpose of this study is also aimed at identifying dominant trends and gaps in literature. Identifying trends in literature is a critical part of this study in order to avoid a duplicative study, to provide background information, and to develop a general understanding of the issue and the current knowledge that exists in the field. On the contrary, finding gaps in literature is an essential part of this study because by doing so one is able to determine where there's a lack of knowledge in the field to shape where answers and solutions need to be developed, and to advance knowledge where gaps exist. Finally, diving deeply into both sides of the story when it comes to the potential of contradicting opinions is vital. Biases can naturally exist, which is why it's important to consider diverse viewpoints in order to avoid bias traps and to avoid only seeking information that confirms my potential preconceptions. In research it's critical to recognize multiple valid interpretations.

The topic at hand is very complex and multifaceted. The goal is to maintain scientific integrity, ensure transparency, develop a deeper understanding of why this issue exists and how we got here, determine gaps in understanding, be open-minded and encourage solutions, innovation and improve decision making.

Figure 1: Trends in Literature of the Most Vulnerable Populations to Environmental Stressors



As shown in Figure 1, a dominant trend in literature is that all categorized under the term vulnerable populations; children, minority and low income populations, elderly people, and people with pre-existing medical conditions are the most vulnerable to health risks from air quality, water quality and climate change. There's a huge benefit in examining what literature focuses on and what it lacks in regards to those specific burdens.

Climate Change

A general understanding when examining the correlation between climate change and its effects on people's health is that it both directly and indirectly impacts health and is strongly mediated by environmental, social and public health determinants ([World Health Organization, 2023](#)). Health is key to our well-being, happiness, and general quality of life. It is also important for economic progress and productivity. A person's health may depend on many factors, such as their income, race, gender, age, existing medical conditions or genetics, occupation, and where they live. Personal choices and social support structures also play a role in a person's health. Much of the trends in literature show that climate change affects people's health in many ways. As an example, as the climate changes, more people may be exposed to extreme weather like heat, floods, droughts, storms, and wildfires. These events can cause illness, injury, and even death. Climate change can also lead to more diseases spread by insects and ticks, and it can affect the quality of air, water, and food, including through the spread of harmful bacteria or viruses. In addition, hazards related to climate change can stress people's mental health ([US EPA, 2022](#)).

Much of the gaps in understanding on the topic of climate change affecting human health stems from information from climate deniers who state that the changing climate is not affecting human health. According to an article on the thinking error that makes people susceptible to climate change denial, there's the all-or-nothing problem in which "Climate change deniers simplify the spectrum of possible scientific consensus into two categories: 100% agreement or no consensus at all. If it's not one, it's the other" ([Shapiro, 2023](#)). Much of it also comes down to politics, economic interests or refusal to accept the evidence. As an example, the fossil fuel industry has been funding campaigns full of disinformation that creates doubt about climate change and its effects on the environment. A climate scientist and much of well backed up evidence and literature would say that the fossil fuel industry contributes significantly to global warming, natural disasters, public health and has the worst impacts on vulnerable populations, but the fossil fuel industry doesn't want people to believe that because their power, money and economic interest tend to have greater importance to their operations than the health of the most vulnerable populations. This brings up the importance of understanding why fossil fuel and other polluting industries locate themselves in underserved communities. In the results of this study, I uncover this complex issue, and how forgotten history has led to these disproportionate burdens.

Air Pollution

A general trend in literature and decades of research has shown that air pollutants such as ozone and particulate matter (PM) increase the amount and seriousness of lung and heart disease and other health problems. Anyone living in places with poor air quality and failing grades for unhealthy levels of ozone or particle pollution are at risk of harm to their health, but some groups of people are particularly more vulnerable to illness and death from the exposure than others. A dominant trend in research and literature shows that those most susceptible to air pollutants include children, elderly adults, individuals with pre-existing health conditions such as heart and lung disease. In addition, literature trends show that those in

lower socioeconomic neighborhoods are more vulnerable to air pollution due to proximity to industrial sources of air pollution, poor nutrition, stress, and other factors that can contribute to increased health impacts in these communities ([U.S. EPA, 2020](#)).

It's fair to assume that most people would agree that bad air quality results in health risks, even most climate deniers would most likely agree. We can blame air quality on a lot of reasons, manufacturing plants, pollution, or even natural disasters such as wildfires, and there's no denying that these natural disasters happen, the human eye is witnessing it ever increasingly. The scientific understanding of air pollution has advanced immeasurably. Scientists started developing air pollution monitoring devices over 80 years ago. Yet even with the advancement of technology and understanding on how to measure air pollution, disproportionate burdens are still occurring everyday and there's a lack of solutions being made as well as a lack of preventative measures.

By examining many sources on the causes of air pollution, I was able to gather a trend on the top causes of air pollution, which are; burning of fossil fuels, industrial emissions, household combustion devices, indoor air pollution (the use of toxic products called Volatile Organic Compounds 'VOCs'), vehicle emissions, wildfires, industrial facilities, by-product manufacturing and power generation, particularly coal-fueled power plants, and fumes from chemical production.

The gap in understanding comes from conflicting information and a political divide. As previously stated, major polluting facilities put out false information to protect their own interests and cause people to be conflicted on what the top factors of air pollution are. Fossil fuel companies, other major polluters, and their allies have spent hundreds of millions of dollars to spread false and misleading content on social media. One analysis found that 16 of the world's biggest polluters were responsible for placing more than 1,700 of these ads on Facebook in 2021 ([Turrentine, 2022](#)).

Another major gap in understanding comes from lack of monitoring everywhere. In the United States as an example, trends can be determined in areas where air pollution is monitored, however many U.S. counties actually don't have monitors—which means that many communities, especially rural ones, don't have official monitored information on their air quality. This gap in data stems across the globe due to air pollution not being monitored everywhere. A recent study shows that 6,000 cities in 117 countries are now monitoring air quality ([World Health Organization, 2022](#)). With there being 195 countries in the world and around 10,000 cities it shows that there's many areas that lack air quality data and therefore people living in these areas are unable to be aware of the health risks they're being exposed to. The same study also shows that those living in the areas where air quality is being monitored are still facing unhealthy levels of particulate matter and nitrogen dioxide, meaning that even where there's trends in data, significant action isn't being taken seriously.

Water Quality

Much of literature would agree that the impact of water pollution on human health has a significant threat. To find commonality in literature I examined a study that selected 85 relevant papers based on the keywords of water pollution, water quality, health, cancer and so on. Correlations between these papers concluded that water pollution is mainly concentrated in industrialization, agricultural activities, natural factors, insufficient water supply and sewage treatment facilities. Literature, science, research and public health reports show that unsafe water has severe implications for human health. Contaminated water and poor sanitation are

linked to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid and polio. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks ([World Health Organization, 2023](#)).

Much of literature indicates that lead, per- and polyfluoroalkyl substances known as PFAS, industrial pollution, and agricultural runoff are contaminating the drinking water for hundreds of millions of people—and many don't even know it. A recent study done in the United States indicates that testing revealed PFAS in 854 drinking water systems, directly impacting over 44 million individuals. This figure, however, only represents the tip of the iceberg. A study by the Environmental Working Group (EWG) in 2020 estimated over 200 million Americans might be consuming water with PFAS concentrations above 1 part per trillion (ppt). PFAS chemicals, utilized in various industrial and consumer products for their resistance to water, oil, and heat, do not break down in the environment or the human body. The ubiquity of PFAS raises concerns due to its association with several health issues. These include cancer, immune system suppression, and adverse effects on fetal development ([ECWQ, 2023](#)). Though some adverse effects from PFAS are known, there's a lack of understanding in literature in regards to the long term effects PFAS will have on people's health.

While much of literature examines the overall impact of drinking water on people's health, there's a lack of all-encompassing studies that focus specifically on the disparities behind access to clean and safe drinking water. Drinking water in the U.S is failing much of the vulnerable populations that are most at risk to developing health conditions, but literature often fails to encompass the experiences these marginalized populations face. The right to safe and clean drinking water should be a basic human right, but it's an issue of environmental inequality.

Environmental Injustices and Their Relation to Public Health

Much of literature can agree that environmental stressors are all around us, but are often found more in disadvantaged communities. Manufacturing plants, waste sites, and contaminated buildings are more likely to be in communities made up of low income residents or people of color. Historically this wasn't a major focus in literature, but more recently there has been a shift in focussing on the important matter of environmental justice, and how these overburdened communities have historically been ignored and faced with some of the biggest injustices when it comes to exposures of environmental contaminants. However, much of literature lacks attention on how and why underserved and vulnerable communities have been exposed to these environmental stressors in the first place, resulting in these areas becoming overly polluted and remaining as the place for polluting facilities to locate themselves. In the results section of this study I uncover a history of redlining and how America was segregated resulting in a spiral of low income and minority communities being more commonly located next to polluting facilities.

Much of literature can agree that systemic racism is a fundamental cause of these disproportionate exposures and associated health effects, yet a major issue is that skeptics still remain, due to refusal to accept the matter, political opinion, or unawareness, meaning there can be contradicting literature on the subject. As evidence, a poll, conducted nationally by Morning Consult, found that fewer than 4 in 10 white adults are aware that both Latino and Black communities face more pollution than the general population. In addition, 60% of respondents across the U.S. who identified as Black said they were very concerned about air pollution exposure in their community versus 32% of white adult respondents. Perceptions of environmental impacts varied along racial and ethnic lines as well. The study showed that 51% of Black

respondents and 48% of Latino respondents believe that environmental injustice is a major problem in the U.S., versus 33% of white adult respondents. Black and Latino respondents also reported high concern about climate change in their local community, with 52% of those who identify as Black and 50% of people who identify as Latino saying they are “very concerned” versus 38% of those who identify as white ([Environmental Defense Fund, 2020](#)).

Through extensive research on what populations bear the most disproportionate health burdens from environmental stressors and climate change a strong argument can be made that there is a complicated and ‘forgotten history’ behind the matter. Yet there’s more evidence than not that environmental injustices historically and still presently exist and the greatest health threats are amongst underserved populations.

Summarizing Gaps in Literature and How my Research Will Address Them

With a major dominant trend in literature being that children, elderly people, people with pre-existing medical conditions, minority and low income populations are the most vulnerable to health threats from air pollution, water pollution and climate change, this study is aimed at uncovering the behavioral, biological and scientific health reasons behind why each of these sub categories within the term vulnerable populations are classified as having increased susceptibility to those environmental stressors. In addition, this study is aimed at uncovering any social, political, historical and economic reasons that aren’t commonly discussed in literature in terms of how and why the United States has gotten this point. Furthermore, based on the gaps in literature in regards to air and water pollution, the goal for this study is to determine why low income and minority populations are more likely to live near polluting facilities and to uncover the complex history behind why environmental injustices exist. Finally, another key objective is to identify health disparities, social determinants of health and determine where and why there's a lack of protective measures on the most vulnerable people.

METHODOLOGY

Multifaceted Approaches

To define the scope and parameters of my study, the methodology I used takes a multifaceted approach to exemplify the myriad ways the environment affects public health and the underlying injustices. Figure 2 shows my methodology processes.

Figure 2: Capstone Methodology



Interviews Shaping the Study and Practical Work in the Field

Throughout obtaining my master's degree, in my studies and the course content I began seeing a major trend in the various environmental issues we studied, all of them came back to affecting human health in one or more aspects. This was the first step of inspiration for the topic of this capstone project. At the same time the capstone course began, I started a job at the U.S Environmental Protection Agency in the branch of Children's Health, Environmental Justice and Equity. I took this as the perfect opportunity to intertwine my practical work, utilize connections in the field and make observations to contribute to this study. The study began as focussing on primarily children's health and the associated risks from environmental burdens. One of the first steps I took was interviewing experts who have been in the field of children's health for many years. I first interviewed a Children's Health Coordinator from the U.S Environmental Protection Agency who has been in the field for over 20 years. One of the questions I asked was "what are the top environmental burdens that affect children's health in the region you work in?" The answer was drinking water, air quality and climate related disasters such as wildfires. I then interviewed a Pediatric Environmental Health Specialty Unit Doctor and Director at the Department of Health and Human Services, and got the same answer in regards to the top environmental stressors that affect children's health. As I began diving deeper into literature on the topic I was finding air quality, water quality and climate change to be dominant trends in what affects children's health. This helped me develop my first research question: why do those three factors have the greatest impact on children's health? As I started developing this study based on how air pollution, water pollution and climate change pose risks to children's health, I realized that a lot of literature already exists on risks to children's health from environmental burdens. That is what led me to expanding this study into all of the populations categorized under 'vulnerable populations'. I realized that in order to not limit this study it's important to examine more than one population that's categorized as vulnerable, and by doing so I could create a report that goes deeper into the five subcategories within the term vulnerable populations and fill a gap in literature. With my professional work life being primarily in

environmental justice and equity, I decided to continue to have this be a major part of the study. In my work I am able to continue to see where solutions need to be made, and what needs to be done to improve impacts in the field, which is intertwined into this study.

Research, Scientific Findings, Studies, Datasets, Hands-On Work

To maintain validity and reliability in this report, only credible sources were used in my research, this involved using search engines such as google scholar, examining peer reviewed articles, and platforms that contain academic papers, reports datasets and studies, as well as utilizing the university library to locate credible reports, studies and datasets. When collecting information from websites I ensured these were from official agencies such as government agencies, official organizations or institutions.

In addition, I integrated insights gleaned from my Master of Science in Engineering, Sustainability, and Health into this paper. Over the past two years I collected as much of the relevant information that obtains to this study from the course content and associated work and research into this study.

Finally, working directly in the field of Environmental Justice, Equity and Children's Health while developing this capstone project allowed for real-world application to strengthen the study. I was able to learn about real world problems that occur beyond my research. I mention environmental injustices many times throughout this study; through my work I can see first-hand that these injustices do occur. The work in this field opened up networking opportunities leading me to the interviews previously mentioned, which also shaped this study. Having meetings with other professionals in the field on a daily basis, especially those who have been working on environmental justice and health inequalities for many years allowed me to understand that these needs have been around for a long time, and are being worked on, but there's a long way to go. An essential part of the study is understanding what's being done, but also what needs to be done.

Theoretical Framings

The theoretical framework for this study consisted of first identifying a problem and creating a problem statement, then developing research questions, which led to identifying trends and gaps in existing literature. As seen in the literature review, one major theoretical framing was to determine where there are gaps of knowledge in regards to how air quality, water quality and climate change affect the health of vulnerable populations. Next, theoretical framings were used as a method of filling in a gap in literature by developing this study which includes an in depth understanding of the five populations that are generally categorized under the term vulnerable populations, and their reasons for being vulnerable to air pollution, water pollution and climate change. To test the theoretical framework, data collection and analysis were used to determine if the framework is reliable. As a result, data provided evidence to back up points made throughout this study.

Research Questions

To lay out the foundation of my research and create both focus and direction the next step in the study was developing key research questions. The research questions used in this study and guidance for locating the answer to the specific research question within this report is shown in Figure 3, below.

Figure 3: Research Questions

Research Questions	Answer or Location to Answer within this Report
What populations are categorized under the term ‘vulnerable populations’?	Children, elderly, people with pre-existing health conditions, low income and minority populations
What are the specific health conditions that children, elderly, people with pre-existing health conditions, low income and minority populations are at risk of developing from exposure to air pollution, contaminated drinking water and climate change?	See results section for the answer to this question.
What are the top health threats vulnerable populations face?	Three of the top threats are: air pollution, water pollution and climate change. With the fact that humans need to breathe air and drink water to survive, I decided to focus on those three burdens in this study.
What are the gaps in literature and how can I fill them?	Answers are in the literature review <u>and</u> this report is filling one gap in literature.
What are environmental injustices and why do they exist in the first place? How did we get here?	Answered in the results section of this report.
What can be done?	Refer to the solutions section of this report.

Epistemology and Various Ways of Knowing or Believing in a Topic

Exploring epistemology, which is the study of knowledge and how we came to know things was one of the methodologies that helped form this study and its results. Epistemology not only captures an individual’s personal relationship with their study but also includes the nature, scope and limitations of knowledge, thereby helping to ground personal reflections ([Tomlinson, 2023](#)). This study was looked at through a positivist epistemological position. Positivism suggests that there is a straightforward relationship between the world (objects, events, phenomena) and our perception, and understanding, of it ([Baillie & Douglas, 2014](#)). In the case of this study, statistics, trends in literature and scientific findings provide a straightforward relationship between air pollution, water pollution and climate change having negative health risks to vulnerable populations.

Below I weave in an epistemological approach to showcase a distinct boundary between what is justified belief and opinion and what is evidence and actual knowledge in terms of the three environmental burdens

this study focuses on. This is done to interpret what the critical issue at hand is, what is true, where there are gaps and to ensure there is a transparent lens on this study.

Epistemological Approach to Climate Change

An epistemological approach would ask what can we know about climate change? There's much unambiguous evidence that the Earth is warming at an unprecedented rate, and this is due to human activity. According to the Intergovernmental Panel on Climate Change (IPCC), "Since systematic scientific assessments began in the 1970s, the influence of human activity on the warming of the climate system has evolved from theory to established fact" ([IPCC n.d.](#)). We know that climate change means the earth is warming, and with that comes evidence of melting glaciers, warming waters, waterways drying out, increased dry seasons creating more susceptibility to worsening wildfires and other disasters. How can we justify our beliefs about climate change? There's hard evidence that the planet's temperature is warming every year, as mentioned above, ice sheets are melting like never before, and sea levels are rising, and other evidence is occurring. These aren't natural causes, we as humans are accelerating the issue, and that's something we know about climate change, that can help to justify our beliefs about it. Can humans have knowledge on this? If so, how? Humans can have knowledge on this through evidence, science, data, and witnessing changes with our own eyes. Numerous studies have found that scientists who study Earth's climate agree that the planet is warming and that humans are the primary cause.

A warming climate has become a fact, not an opinion. "Average global temperatures have increased by 2.2 degrees Fahrenheit, or 1.2 degrees Celsius, since 1880, with the greatest changes happening in the late 20th century. Land areas have warmed more than the sea surface and the Arctic has warmed the most — by more than 4 degrees Fahrenheit just since the 1960s. Temperature extremes have also shifted. In the United States, daily record highs now outnumber record lows two-to-one" ([Rosen, 2021](#)).

More than 99.9% of peer-reviewed scientific papers agree that climate change is mainly caused by humans, according to a new survey of 88,125 climate-related studies ([Ramanujan, 2021](#)). Air and water pollution isn't a coincidence either, this is all caused by human activities. Humans are causing air and water pollution and are worsening the effects of climate change and in turn hurting public health, the two go hand in hand. The main issue is that a majority of the people causing the worst impacts aren't the ones facing the direct health threats, and that's one major reason why there's lack of care to make change.

Epistemological Approach to Air and Water Quality

When taking an epistemological approach one may ask: what can we know about environmental burdens and toxins? Defined well by the Law Insider "Environmental burdens means any significant impact to clean air, water, and land, including any destruction, damage, or impairment of natural resources resulting from intentional or reasonably foreseeable causes. Examples of environmental burdens include climate change; air and water pollution; improper sewage disposal; improper handling of solid wastes and other noxious substances; excessive noise; activities that limit access to green spaces; inadequate remediation of pollution; reduction of groundwater levels; increased flooding or stormwater flows; home and building health hazards, including lead paint, lead plumbing, asbestos, and mold; and damage to inland waterways and water bodies, wetlands, forests, green spaces, or constructed playgrounds or other outdoor recreational facilities and venues from private, industrial, commercial, and government operations or other activity that contaminates or alters the quality of the environment and poses a risk to public health" ([Law Insider, n.d.](#)). These burdens

are caused by human activity, we as humans are creating toxins that hurt the land, air and water around us, as well as human health.

Another question may be: what can we know about environmental burdens and toxins having effects on human health? There's a large amount of evidence proving that environmental toxins and pollutants can cause health problems, and are likely to cause health issues to people living, working or spending large amounts of time near highly polluted areas, or in homes that were built with products that contain toxins, such as lead paint. We know that many of these toxins, depending on what specific toxin one is exposed to, can cause asthma/respiratory issues and disease, such as, heart disease, diabetes and types of cancer.

About 829,000 people die each year from diarrhea caused by unsafe drinking water, sanitation, and hand hygiene, including nearly 300,000 children under the age of five, representing 5.3 percent of all deaths in this age group ([Lin, Yang, & Xu, 2022](#)). More than two million people worldwide die each year from diarrhoeal diseases, with poor sanitation and unsafe drinking water being the leading cause of nearly 90% of deaths and affecting children the most ([United Nations, 2016](#)). More than 50 kinds of diseases are caused by poor drinking water quality, and 80% of diseases and 50% of child deaths are related to poor drinking water quality in the world (Lin et al., 2022).

RESULTS AND DISCUSSION

Through the various extensive methodologies and studies, I was able to determine major factors on why children, minority and low income populations, elderly people, and people with pre-existing medical conditions are most at risk to health effects from air pollution, water pollution and climate change. Below are the key results on the health and behavioral factors that increase susceptibility to health risks from environmental stressors of the five categorized vulnerable populations.

Populations Within the Term 'Vulnerable Populations' Results of the Scientific Health, Social and Economic Factors of Vulnerability

Children

Unlike adults, children are more vulnerable to pollutants due to their biology. The fact that children are still developing means they're most susceptible to health effects, behavior and developmental issues.

In terms of air quality, children eat more food, drink more water, and breathe more air than adults. This means children have increased mouth breathing and less efficient nasal infiltration. Their growing organs are more easily harmed and they're exposed to more pollutants per pound of body weight than adults are. Infants have a higher resting metabolic rate and higher oxygen consumption rate per unit of body weight than adults.

Behaviors in children increase their exposure to environmental pollutants. These behaviors can include dermal, ingestion, and inhalation pathways such as; hand to mouth, object to mouth, breastfeeding, playing close to the ground where pollutants tend to concentrate, increased play activities, extremely curious behavior (ex. touching things), undeveloped and inexperienced decision making (still developing), and increased time spent outside.

When it comes to drinking water sources, children tend to take in more water relative to their body weight than adults do, resulting in children being more likely to have higher exposure to drinking water

contaminants. According to a study done by the U.S. Environmental Protection Agency, drinking water sources may contain a variety of contaminants that are associated with increased risk of a range of diseases in children, including acute diseases such as gastrointestinal illness, developmental effects such as learning disorders, and cancer. Several types of drinking water contaminants are of concern for children's health. Examples include microorganisms, (e.g., Giardia), inorganic chemicals (e.g., lead, arsenic, nitrates, and nitrites), organic chemicals (e.g., atrazine and glyphosate), and disinfection byproducts (e.g., chloroform). Children are particularly sensitive to microbial contaminants, such as Giardia, Cryptosporidium, and E. coli, because their immune systems are less developed than those of most adults. Microbial contaminants include bacteria, viruses, and protozoa that may cause severe gastrointestinal illness. Children are also very sensitive to lead and other contaminants that affect brain development due to their rapidly developing nervous systems ([Environments and Contaminants: Drinking Water Contaminants, 2011](#)).

Elderly People

The elderly may be more vulnerable to chemical exposure because of a decreased capacity to repair DNA damage caused by mutagens. Decreased immunologic defenses may also increase the vulnerability of the elderly to chemical carcinogens ([U.S EPA, 2005](#)). The elderly are also more sensitive because of deterioration in physiologic, biochemical, immunologic, and homeostatic parameters, which affects their ability to defend against environmental stresses ([Hong, 2013](#)). As people get older they go through physiological changes such as weakening immune systems and more susceptibility to toxins or infections.

When the COVID-19 pandemic started, information was stating that elderly, specifically those who are 85 years and older are at the highest risk of symptoms. More than 80% of the global COVID-19-related deaths between 2020 and 2021 occurred among people aged 60 years or older, according to data published by the World Health Organization (WHO) in the Morbidity and Mortality Weekly Report ([Harris, 2023](#)). This is in part due to their weakened immune systems; it's the same case for risks to environmental pollutants and toxins, their weakened immune systems increase their susceptibility to life-threatening conditions. Since 1999, people aged 65+ have been several times more likely to die from heat-related cardiovascular disease than the general population ([US EPA, 2016](#)).

Elderly people typically take longer to recover from illnesses. Similarly they take longer to recover from exposure to pollutants which come with negative health effects. In addition, elderly people are more likely to face health conditions, and people with particular health conditions can have exacerbated effects to environmental burdens.

Persons With Pre-Existing Health Conditions

People with pre-existing health conditions, specifically, diabetes, asthma, heart disease, and respiratory illnesses face the challenge of a weakened body's immune system, which in turn makes them much more susceptible to harmful health effects from environmental pollutants/contaminants and burdens and at times increased harmful effects to their existing health condition. For example, someone who suffers from asthma would have increased issues if they live in an area with poor air quality, which would exacerbate their asthma. Studies have proven that people with compromised immune systems are more vulnerable to pollutants than the general population ([US EPA, 2022](#)).

Minority and Low Income Populations

Low income populations and minority communities, particularly those of lower socioeconomic status are very likely to bear the disproportionate burdens of environmental pollution because these populations are more likely to live in low income households or apartments which are typically older and less well maintained. Substandard and older housing usually contains lead, asbestos and mold, and is more likely to have water coming through lead pipes and service lines, posing health threats.

These populations are also more likely to live near polluting facilities, industrial zones, power plants, highways and waste sites causing air, soil and water quality issues; which again poses negative health threats such as cancer, developmental disorders, asthma and respiratory issues. The burden of air pollution is not evenly shared. Poorer people and some racial and ethnic groups are among those who often face higher exposure to pollutants and who may experience greater responses to such pollution. Many studies have explored the differences in harm from air pollution to racial or ethnic groups and people who are in a low socioeconomic position, have less education, or live nearer to major sources of pollution ([American Lung Association, 2020](#)).

According to Fumes Across the Fence-Line, a report from the NAACP and the Clean Air Task Force—an advocacy group dedicated to reducing air pollution—black people are 75 percent more likely to live in so-called “fence-line” communities that are next to industrial facilities. These facilities release a toxic stew of pollutants—including formaldehyde, which has been linked to cancer, and benzene, which has been linked to brain damage, birth defects, and cancer ([Baptiste, 2017](#)).

A new EPA analysis released shows that the most severe harms from climate change fall disproportionately upon underserved communities who are least able to prepare for, and recover from, heat waves, poor air quality, flooding, and other impacts. EPA’s analysis indicates that racial and ethnic minority communities are particularly vulnerable to the greatest impacts of climate change ([US EPA, 2021](#)).

Health Risks from Air Pollution, Water Pollution and Climate Change

As previously described, there’s complex behavioral, social, scientific, biological, and economic reasoning behind why children, elderly, people with pre-existing health conditions, minority populations and low income populations experience greater health threats from exposure to air pollution, poor drinking water and climate change for their own unique reasons. Below I uncover the specific health conditions each of those environmental stressors can cause to vulnerable populations.

Air

Exposure to polluted air causes risk for diseases and health conditions such as lung diseases (ex. lung cancer), asthma, pneumonia, an increase in respiratory infections, heart disease, strokes, and even premature death. Healthier environments could prevent almost one quarter of the global burden of disease. The World Health Organization (WHO) has estimated that thirteen million deaths annually are attributable to preventable environmental causes ([World Health Organization, 2022](#)). Every day, nearly 1,800 people in developing cities die as a result of exposure to urban air pollution ([Remoundou & Koundouri, 2019](#)). In the United States, air pollution is the leading environmental cause of death and in the U.S exposure to air pollution is still associated with 100,000–200,000 deaths annually ([Thakrar et al., 2020](#)).

Water

Drinking water with unsafe levels of contaminants can cause nervous system and reproductive effects, developmental issues, immune system dysfunction, cancer, kidney impairment, gastrointestinal illnesses, organ damage as well as toxicity to the reproductive organ and spread of disease.

The Agency for Toxic Substances and Disease Registry (ATSDR) has identified exposure to PFAS which is in at least half of drinking water systems in the U.S, increases risk for increased cholesterol levels, lower antibody response to some vaccines, changes in liver enzymes, small decreases in birth weight, kidney and testicular cancer and pregnancy-induced hypertension and preeclampsia ([Agency for Toxic Substances and Disease Registry, 2020](#)).

Climate Change

The impacts of climate change affect everyone and can strain many aspects of our lives, one being our health. Health effects of climate change include cardiovascular and respiratory diseases, premature deaths, food and water borne illnesses and infections, and poor mental-health. The extent to which individuals, societies, and nations experience the adverse health impacts of climate change varies depending on their ability to adapt to the stressors imposed by climate change. Certain populations bear a greater disproportionate burden of the adverse health outcomes as a result of climate change. An understanding of these populations of concern and what underpins their vulnerability helps to inform the appropriate societal and global responses needed to curb adverse health outcomes ([National Institute of Environmental Health Sciences, 2022](#)).

Environmental Justice and Public Health

Why it Matters

There's naturally almost always controversy to anything, it's human nature to have different opinions and viewpoints, but when it comes to the environment and public health, it's hard to argue that everybody has a right to feel safe, to be healthy, and to live in a safe environment. A general middle ground statement would be that access to clean water and living, working and playing in areas with clean air should be a basic human right, not a privilege.

Environmental Injustices and How We Got Here - A 'Forgotten History'

Environmental justice is a public health and human rights issue. Marginalized communities are disproportionately at risk of exposure to lead, air pollution, unsafe drinking water or lack of access to safe drinking water, hazardous waste and extreme heat. Environmental exposures have been linked to various damaging health issues, including cancer, asthma and other respiratory diseases, cardiovascular disease, neurological diseases and developmental disabilities. The threat of climate change further exacerbates these environmental health risks. For example, climate change worsens heat waves, which have more severe impacts on certain populations.

America is segregated, and so is pollution. Race has been the most potent factor in deciding where toxic facilities are located. Racial and ethnic minorities and low-income groups often live in neighborhoods near hazardous waste sites and are disproportionately burdened with environmental pollution ([Beard et al., 2024](#)). Many people understand the environment as a force of nature that cannot favor or disfavor different populations. However, similar to all things on Earth, the environment is subject to human influences. Unfortunately, these influences often tend to lower their hands to the worst of our society including racism and classism. This can ultimately create environmental racism. These disparities are entirely due to power dynamics ([Peña-Parr, 2020](#)). The phrase environmental racism was coined by civil rights leader Dr. Benjamin F. Chavis Jr. He defined it as the intentional siting of polluting and waste facilities in communities primarily populated by African Americans, Latines, Indigenous People, Asian Americans and Pacific Islanders, migrant farmworkers, and low-income workers. Study after study has since shown that those communities are disproportionately exposed to fumes, toxic dust, ash, soot, and other pollutants from such hazardous facilities located in their midst. As a result, they face increased risks of health problems ([Ihejirika, 2023](#)).

Environmental racism exists due to many factors such as intentional and unintentional racism/racial discrimination, alienating low income community members, failing to represent all groups and government, industrialization, unchecked capitalism, discriminatory siting, misguided regulatory policy, segregation, intentional and unintentional neglect and systemic racism ([Ben Crump Law, PLLC, 2024](#)). Environmental injustices occur also largely because of policies and practices that have historically, and to this day, favor the health, well-being, and consumer choices of white communities over those of non-white, low-income communities. While no one wants hazardous waste in their backyard, primarily white, middle- to higher-income communities have always been more successful at preventing it. Conversely, poor communities of color are often perceived as passive and don't have the clout or resources to challenge the dumping of poison where they live ([Ihejirika, 2023](#)).

Redlining in the United States

Through the research done, data collected and experts I talked to as part of this study, redlining was determined as a key factor that has resulted in the most vulnerable communities facing the worst environmental impacts historically and still presently. Redlining can be defined as a discriminatory practice that consists of the systematic denial of services such as mortgages, insurance loans, and other financial services to residents of certain areas, based on their race or ethnicity. Redlining disregards individual's qualifications and creditworthiness to refuse such services, solely based on the residency of those individuals in minority neighborhoods; which were also quite often deemed "hazardous" or "dangerous" ([Cornell Law School, 2022](#)).

How does this affect pollution and cause health threats to vulnerable communities? Throughout redlining's history, local zoning officials worked with businesses to place polluting operations such as industrial plants, major roadways and shipping ports in and around neighborhoods that the federal government marginalized. In the wake of the Great Depression, when the federal government graded neighborhoods in hundreds of cities for real estate investment, Black and immigrant areas were typically outlined in red on maps to denote risky places to lend.

Urban neighborhoods that were redlined by federal officials in the 1930s tended to have higher levels of harmful air pollution. Eight decades later, a new study has been found, adding to a body of evidence that

reveals how racist policies in the past have contributed to inequalities across the United States today ([Zhong & Popovich, 2022](#)). To this day, historically redlined neighborhoods are more likely to have high populations of Black, Latino and Asian residents than areas that were favorably assessed at the time.

Redlining was banned 50 years ago but it still hurts the health of minorities today. Researchers analyzed air quality data in 202 cities where communities were redlined and found a consistent disparity in the level of nitrogen dioxide, which forms smog, and PM2.5 pollution, the small particles that can become embedded in people's lungs and arteries ([Fears, 2022](#)).

A combination of redlining, power dynamics, capitalism and racial discrimination has resulted in polluting industries located in disadvantaged neighborhoods. Today's land uses reflect a multitude of social, economic and political forces that shaped each place over time. Much of research shows that the neighborhoods were already established as low-income and communities of color before the facilities chose to locate there ([Dunagan, 2021](#)). Wealthier populations also had the opportunity to move out of these areas, but lower income areas have to remain there. This boils down to three main points:

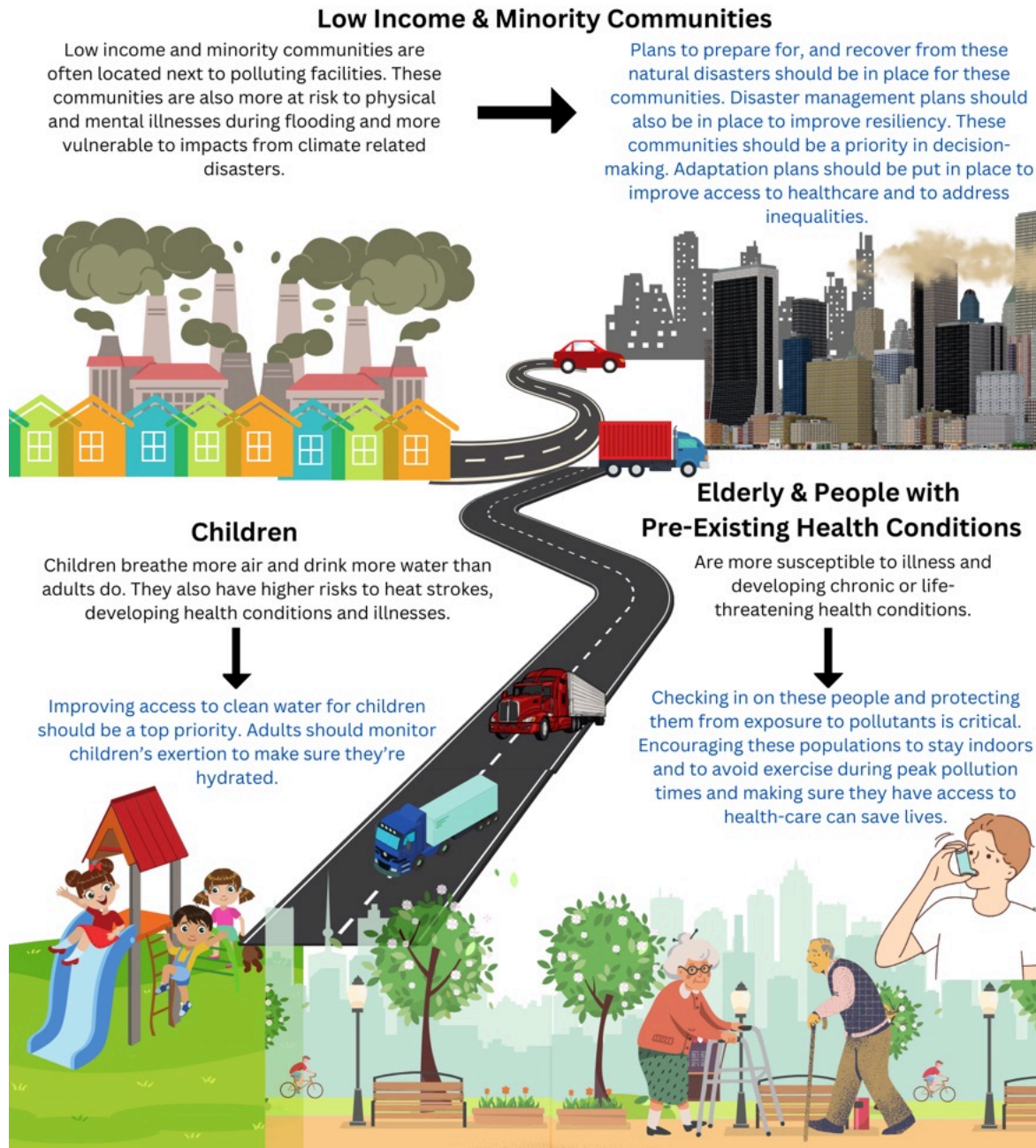
1. **Economic.** This explanation, perhaps cited most frequently to account for disparate siting, focuses on the financial incentives in locating industries in communities where land is cheaper with easier access to transportation and low-cost labor.
2. **Sociopolitical.** Some argue that business owners prefer to take the “path-of-least-resistance,” meaning they choose to locate undesirable businesses where residents are perceived to have little political clout, so their plans face less community resistance, less bad publicity and fewer startup delays.
3. **Racial discrimination.** Researchers differ in their opinions about whether racial hostility is involved in citing industrial facilities and hazardous waste sites. But, even without intent, institutional actions of the past can linger as adverse conditions in the present. ([Dunagan, 2021](#))

Solutions / Making Change to Develop Positive History and Filling in Gaps

Building Resilience and Awareness

It has been made clear that the most vulnerable groups, specifically, children, elderly, people with pre-existing health conditions, people of color, and people with low incomes, are at an even higher risk because of the compounding factors from climate change and pollution. Figure 4 shows solutions for helping people understand and build resilience to environmental stressors.

Figure 4: Methods to Build Resilience



Environmental injustices and health disparities must reflect the experiences of impacted communities, tackle the roots of environmental racism, and promote anti-racist practices. Outcomes from research done for this study and various other studies on the matter conclude that policy changes, health protective recommendations should not be instituted by academics, but by the organizations they serve — emphasizing the need for bidirectional communication and partnerships that involve people as equal partners ([Beard et al., 2024](#)).

Listening, Collaborating, Developing the Conversation, Creating Priorities

First, I want to say, as a white female, I recognize the privilege and power afforded to me by society's structural inequalities, and with that, I am committed to advocating for equity and justice, amplifying the voices of and listening to vulnerable populations, seeking out experiences from marginalized communities, advocating for equity and justice, acknowledging and addressing structural inequities.

As I've developed an understanding of key issues within the context of this study it has allowed me to understand where I can make a difference going forward. Knowing gaps in understanding builds a framework for developing solutions and filling those gaps. Understanding core issues aids room to work towards building answers.

As a staff member of the U.S Environmental Protection Agency within the branch of Children's Health Environmental Justice and Equity, I can confidently say that conversations are being had around how the government has historically failed vulnerable populations, and the goal is to create positive history moving forward, that puts historically disadvantaged and underserved communities as a top priority. One of EPA's major goals in environmental justice is prioritizing funding in disadvantaged communities, gaining trust, and listening to the voices of the people who live, work and play in areas that contain high levels of environmental stressors. The vulnerable populations within the communities we serve encourage me to do my best work. In my role as a public servant for the U.S EPA, I am personally working to create positive change by listening to the people in the communities I serve. I plan to use community collaboration meetings as a major factor in my work; listening to the voices, needs, suggestions and recommendations of the most vulnerable populations, with an understanding that children, elderly people, people with pre-existing health conditions, low income and minority populations all face disproportionate burdens in their own unique way. By developing this capstone project I've learned a lot about how society has gotten to the point of low income and minority communities being disproportionately burdened by environmental stressors and one of the major factors of this is due to the history of redlining. I find it important to recognize history, and in my work going forward to recognize that the government in many ways has historically marginalized certain communities. Gaining trust back from these communities won't happen overnight, but I am here to stand up for and work towards creating positive history moving forward, with these communities on the forefront, and allowing their voices to be heard. The inequities exacerbated by climate change and environmental burdens cannot be communicated without involving the frontline communities that experience its worst impacts.

Advocating for Improved or New Policies

In order to improve public health, the effects of climate change and the amount of pollutants in the environment must be reduced, which requires collective action, large scale changes such as policies focussed on the largest polluters, changes in much of populations consumption habits, technological advances and moving towards a circular economy.

Policy creation is essential to developing positive change for reducing air pollution, water pollution, increasing access to clean water, and reducing the effects of climate change. New policies on the top polluters should contain stricter regulations with how much facilities can pollute and regulations on where they can locate themselves. Policy creation should prioritize the voices of marginalized residents and frontline communities who were left out of decisions in the past. Political power has and always will create

a divide and can be one of the largest barriers to positive change for environmental stressors and their effects on the public. Certain administrations put climate change, reducing pollution, public health and environmental justice as a low priority, which is why there's a significant importance in the power of advocacy, educating citizens on how the environment can affect their health and in voting. The future of people's lives and the planet should be a basic human right, and a top priority of governments, major polluters and people with immense power and ability to implement decision-making.

One of the main issues with water quality in the United States is due to the chronic underinvestment that has left infrastructure outdated and on the verge of collapse in many places across the country ([Greenfield, 2023](#)). Steps towards improvement takes time, laws and policies don't change overnight, but advocating for policies that prioritize public health and environmental protection in regards to improved drinking water standards to protect vulnerable communities from exposure to PFAS is critical.

Filling in Gaps of Existing Policies for Air Pollution

Environmental protections have been made throughout history, but many of them lack specific knowledge for the most vulnerable populations. For example, the Clean Air Act (CAA) (42 U.S.C. 7401 et seq.) is a comprehensive Federal law that regulates all sources of air emissions. The 1970 CAA authorized the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment ([Bureau of Ocean Energy Management, n.d.](#)). The act does not recognize air quality issues based on certain census blocks. Using the Environmental Justice Screening and Mapping tool is a great way to fill in the gaps of the Clean Air Act. The Environmental Justice Screening and Mapping tool can be used as a source to recognize which vulnerable communities are facing air and water pollution issues. This method is a key way to determine where injustices and health disparities exist, and to promote change in those areas.

In Conclusion

Coping with environmental challenges moving forward will require an understanding that not everyone is privileged with the same capacity to adapt. Our ability to sustain a just and safe world is dependent upon how we can avoid the mistakes of the past. Recognizing racist roots, calling out environmental injustices, and ensuring marginalized voices are heard is one small step towards a better future ([Vermeer, 2021](#)).

One of the key takeaways from this study is that all of the populations categorized under the term 'vulnerable populations' do share in common that they are more susceptible to health risks from environmental burdens in comparison to other populations that are not categorized under the term vulnerable, but it's much more complex than that. More literature should bring this into recognition and take it into consideration when using the term. Children, elderly, people with pre-existing health conditions, low income and minority communities are all 'vulnerable' to environmental stressors for different reasons, whether it be behavioral, developmental, biological, social, economic or political; when referring to protecting vulnerable populations against air pollution, water pollution and climate change, one needs to examine deeply the different factors that go into each population under the term 'vulnerable'.

To reiterate an important factor, we as humans all have to breathe air, drink water and exist in a climate to survive, which is why when studies are done on public health; air pollution, drinking water and climate change should be at the forefront of the focus, in addition to increased focus on vulnerable populations.

References

- Agency for Toxic Substances and Disease Registry. (2020, June 24). Potential health effects of PFAS chemicals. Retrieved from www.atsdr.cdc.gov website:
<https://www.atsdr.cdc.gov/pfas/health-effects/index.html>
- American Lung Association. (2020, April 20). Disparities in the Impact of Air Pollution. Retrieved from www.lung.org website: <https://www.lung.org/clean-air/outdoors/who-is-at-risk/disparities>
- American Lung Association. (2023). Key Findings | State of the Air. Retrieved from www.lung.org website:
<https://www.lung.org/research/sota/key-findings#:~:text=The%20%E2%80%9CState%20of%20the%20Air>
- Baptiste, N. (2017, November 14). Study: Black people are 75 percent more likely to live near toxic oil and gas facilities. Retrieved from Mother Jones website:
<https://www.motherjones.com/environment/2017/11/study-black-people-are-75-percent-more-likely-to-live-near-toxic-oil-and-gas-facilities/>
- Beard, S., Freeman, K., Velasco, M. L., Boyd, W., Chamberlain, T., Latoni, A., ... Dixon, D. (2024). Racism as a public health issue in environmental health disparities and environmental justice: working toward solutions. *Environmental Health*, 23(1). <https://doi.org/10.1186/s12940-024-01052-8>
- Billions of people still breathe unhealthy air: new WHO data. (n.d.). Retrieved April 16, 2024, from www.who.int website:
https://www.google.com/url?q=https://www.who.int/news/item/04-04-2022-billions-of-people-still-breathe-unhealthy-air-new-who-data&sa=D&source=docs&ust=1713229884849320&usg=AOvVaw0R4PSz9Kbawwi3DIMNO_bg
- Bureau of Ocean Energy Management. (n.d.). Air Quality Act (1967) Or The Clean Air Act (CAA) | Bureau of Ocean Energy Management. Retrieved from www.boem.gov website:
[https://www.boem.gov/air-quality-act-1967-or-clean-air-act-caa#:~:text=The%20Clean%20Air%20Act%20\(CAA\)%20\(42%20U.S.C.](https://www.boem.gov/air-quality-act-1967-or-clean-air-act-caa#:~:text=The%20Clean%20Air%20Act%20(CAA)%20(42%20U.S.C.)
- Chapter 1: Framing, Context and Methods. (n.d.). Retrieved from www.ipcc.ch website:
<https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-1/>
- Cornell Law School. (2022, April 19). Redlining. Retrieved from Legal Information Institute website:
<https://www.law.cornell.edu/wex/redlining>

- Dunagan, C. (2021, April 12). Why is so much pollution found in disadvantaged communities? | Encyclopedia of Puget Sound. Retrieved from www.eopugetsound.org website: <https://www.eopugetsound.org/magazine/IS/pollution-disadvantaged-communities>
- ECWQ. (2023, November 9). At Least 44 Million People Exposed To PFAS - ECWQ. Retrieved April 16, 2024, from East Coast Water Quality Inc website: <https://eastcoastwaterquality.com/news/44-million-people-exposed-to-pfas/#:~:text=In%20the%20lat est%20data%20under>
- Environmental burdens Definition. (n.d.). Retrieved from Law Insider website: <https://www.lawinsider.com/dictionary/environmental-burdens>
- European Environment Agency. (2023, April 24). Air pollution and children's health — european environment agency. Retrieved from www.eea.europa.eu website: <https://www.eea.europa.eu/publications/air-pollution-and-childrens-health>
- Fears, D. (2022, March 9). Redlining means 45 million Americans are breathing dirtier air, 50 years after it ended. Retrieved from Washington Post website: <https://www.washingtonpost.com/climate-environment/2022/03/09/redlining-pollution-environmental-justice/>
- Gamble, J. L., J. Balbus, M. Berger, K. Bouye, V. Campbell, K. Chief, ... R. Morello-Frosch. (2010). Ch. 9: Populations of Concern. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, 247–286. Retrieved from <https://health2016.globalchange.gov/populations-concern>
- Greenfield, N. (2023, October 5). America's Failing Drinking Water System. Retrieved April 2, 2024, from www.nrdc.org website: <https://www.nrdc.org/stories/americas-failing-drinking-water-system#:~:text=Meanwhile%2C%20lead%2C%20per%2D%20and>
- Harris, E. (2023). Most COVID-19 Deaths Worldwide Were Among Older People. *JAMA*. <https://doi.org/10.1001/jama.2023.1554>
- Hong, Y.-C. (2013). Aging Society and Environmental Health Challenges. *Environmental Health Perspectives*, 121(3). <https://doi.org/10.1289/ehp.1206334>
- How Is Air Quality Measured? | NOAA SciJinks – All About Weather. (n.d.). Retrieved from scijinks.gov website: <https://scijinks.gov/air-quality/#:~:text=of%20the%20environment.->

- Ihejirika, M. (2023, May 24). What Is Environmental Racism? Retrieved from www.nrdc.org website:
<https://www.nrdc.org/stories/what-environmental-racism>
- Lin, L., Yang, H., & Xu, X. (2022). Effects of Water Pollution on Human Health and Disease Heterogeneity: a Review. *Frontiers in Environmental Science*, 10(880246).
<https://doi.org/10.3389/fenvs.2022.880246>
- Maggio, L. A., Sewell, J. L., & Artino, A. R. (2016). The literature review: A foundation for high-quality medical education research. *Journal of Graduate Medical Education*, 8(3), 297–303. NCBI.
<https://doi.org/10.4300/JGME-D-16-00175.1>
- National Oceanic and Atmospheric Administration. (2021, August 13). Climate Change Impacts. Retrieved from National Oceanic and Atmospheric Administration website:
<https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>
- New Poll Shows Many White Americans Unaware of Unequal Burden of Pollution. (n.d.). Retrieved from Environmental Defense Fund website:
<https://www.edf.org/media/new-poll-shows-many-white-americans-unaware-unequal-burden-pollution>
- Peña-Parr, V. (2020, April 8). The complicated history of environmental racism. Retrieved from UNM Newsroom website: <https://news.unm.edu/news/the-complicated-history-of-environmental-racism>
- People Who Are Vulnerable to Climate Change. (2022, August 30). Retrieved from National Institute of Environmental Health Sciences website:
https://www.niehs.nih.gov/research/programs/climatechange/health_impacts/vulnerable_people#:~:text=In%20general%2C%20children%20and%20pregnant
- Public health and environment. (n.d.). Retrieved from www.who.int website:
<https://www.who.int/data/gho/data/themes/public-health-and-environment#:~:text=WHO%20global%20strategy%20on%20health>
- Ramanujan, K. (2021, October 19). More than 99.9% of studies agree: Humans caused climate change. Retrieved from Cornell Chronicle website:
<https://news.cornell.edu/stories/2021/10/more-999-studies-agree-humans-caused-climate-change>
- Remoundou, K., & Koundouri, P. (2019). Environmental Effects on Public Health: An Economic Perspective. *International Journal of Environmental Research and Public Health*, 6(8), 2160–2178.
<https://doi.org/10.3390/ijerph6082160>

- Research on Health Effects from Air Pollution. (2020, October 28). Retrieved from [www.epa.gov](https://www.epa.gov/air-research/research-health-effects-air-pollution#:~:text=Research%20has%20shown%20that%20some) website:
<https://www.epa.gov/air-research/research-health-effects-air-pollution#:~:text=Research%20has%20shown%20that%20some>
- Rosen, J. (2021, April 19). The Science of Climate Change Explained: Facts, Evidence and Proof. Retrieved from New York Times website:
<https://www.nytimes.com/article/climate-change-global-warming-faq.html#:~:text=Land%20areas%20have%20warmed%20more,low%20two%2Dto%2Done.&text=This%20warming%20is%20unprecedented%20in%20recent%20geologic%20history>.
- SDG Target 3.9 Mortality from environmental pollution. (2018). Retrieved from Who.int website:
https://www.who.int/data/gho/data/themes/topics/sdg-target-3_9-mortality-from-environmental-pollution#:~:text=The%20burden%20of%20disease%20attributable
- Shapiro, J. P. (2023, May 2). The thinking error that makes people susceptible to climate change denial. Retrieved from The Conversation website:
<https://theconversation.com/the-thinking-error-that-makes-people-susceptible-to-climate-change-denial-204607>
- Thakrar, S. K., Balasubramanian, S., Adams, P. J., Azevedo, I. M. L., Muller, N. Z., Pandis, S. N., ... Hill, J. D. (2020). Reducing Mortality from Air Pollution in the United States by Targeting Specific Emission Sources. *Environmental Science & Technology Letters*, 7(9), 639–645.
<https://doi.org/10.1021/acs.estlett.0c00424>
- Tomlinson, Y. N. (2023, January 3). The Importance of Engaging with Ontology and Epistemology as an ECR. Retrieved from BPS website:
<https://www.bps.org.uk/psychologist/importance-engaging-ontology-and-epistemology-ecr>
- Turrentine, J. (2022, April 19). Climate Misinformation on Social Media Is Undermining Climate Action. Retrieved from www.nrdc.org website:
<https://www.nrdc.org/stories/climate-misinformation-social-media-undermining-climate-action#:~:text=Fossil%20fuel%20companies%2C%20other%20major>
- U.S Environmental Protection Agency. (2011). *America's Children and the Environment, Third Edition DRAFT Indicators Environments and Contaminants: Drinking Water Contaminants*. Retrieved from <https://www.epa.gov/sites/default/files/2015-06/documents/ace3drinkingwatercontaminantsreviewpackage3-02-11.pdf>

- United States Environmental Protection Agency. (2018, November 7). Learn About Environmental Justice. Retrieved from US EPA website:
<https://www.epa.gov/environmentaljustice/learn-about-environmental-justice>
- Unsafe water, sanitation and hygiene: a persistent health burden. (2023, September 5). Retrieved from www.who.int website:
<https://www.who.int/news/item/05-09-2023-unsafe-water--sanitation-and-hygiene--a-persistent-health-burden#:~:text=An%20editorial%20in%20the%20September>
- US EPA. (2016, July 1). Climate Change Indicators: Heat-Related Deaths. Retrieved from US EPA website:
<https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths>
- US EPA. (2021, September 2). EPA Report Shows Disproportionate Impacts of Climate Change on Socially Vulnerable Populations in the United States. Retrieved from www.epa.gov website:
<https://www.epa.gov/newsreleases/epa-report-shows-disproportionate-impacts-climate-change-socially-vulnerable>
- US EPA, O. (2022a, March 20). Climate Change and the Health of People with Chronic Medical Conditions. Retrieved April 2, 2024, from www.epa.gov website:
<https://www.epa.gov/climateimpacts/climate-change-and-health-people-chronic-medical-conditions#:~:text=Asthmatics%20and%20people%20with%20compromised>
- US EPA, O. (2022b, October 19). Climate Change Impacts on Health. Retrieved from www.epa.gov website: <https://www.epa.gov/climateimpacts/climate-change-impacts-health>
- Vermeer, D. (2021, August 16). Redlining and Environmental Racism. Retrieved from seas.umich.edu website: <https://seas.umich.edu/news/redlining-and-environmental-racism>
- What Causes Environmental Injustice? | Ben Crump Law, PLLC. (2024). Retrieved from Ben Crump Tribal Lawyers for Justice website:
<https://bencrump.com/environmental-justice-lawyer/what-causes-environmental-injustice/#:~:text=Environmental%20injustice%20can%20result%20from>
- World Health Organization. (2019, June 18). 1 in 3 people globally do not have access to safe drinking water – UNICEF, WHO. Retrieved from World Health Organization website:
<https://www.who.int/news/item/18-06-2019-1-in-3-people-globally-do-not-have-access-to-safe-drinking-water-unicef-who>
- World Health Organization. (2022). Environmental health. Retrieved from www.who.int website:
https://www.who.int/health-topics/environmental-health#tab=tab_1

World Health Organization. (2023a, September 13). Drinking water. Retrieved from [www.who.int website:
https://www.who.int/news-room/fact-sheets/detail/drinking-water#:~:text=Contaminated%20water%20and%20poor%20sanitation](https://www.who.int/news-room/fact-sheets/detail/drinking-water#:~:text=Contaminated%20water%20and%20poor%20sanitation)

World Health Organization. (2023b, October 12). Climate Change. Retrieved from World Health Organization website: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>

Zhong, R., & Popovich, N. (2022, March 9). How Air Pollution Across America Reflects Racist Policy From the 1930s. *The New York Times*. Retrieved from <https://www.nytimes.com/2022/03/09/climate/redlining-racism-air-pollution.html>

University Of San Diego

Shiley-Marcos School of Engineering

Master of Science in Engineering, Sustainability, and Health



The Unequal Distribution of Air Pollution Impact in San Diego County: Identifying Intersectional Issues Through A Community Lens

Jonéa Parks

University of San Diego

joneaparks@san Diego.edu

April 14, 2024

ABSTRACT

This study aims to understand the intersectional issues within the unequal distribution of air pollution impact in marginalized communities of San Diego County through a community lens. Marginalized communities are hindered by the disproportionate burden of environmental health hazards, threatening community health. High exposure to toxic pollutants, such as diesel particulate matter (DPM) and fine particulate matter (PM_{2.5}) are byproducts of vehicle emissions, industrialization, and urbanization. To integrate a community lens on air pollution impact in San Diego, ethnographic research and qualitative methods were adapted into the environmental justice framework of the study. Qualitative interviews included baseline questions with listening-based approaches to obtain community feedback. Interviews with community members presented intersectional themes regarding environmental health hazards in relation to air pollution including the following: transboundary pollution, transportation, indoor air quality, redlining, and industrialization. The community members provided information on community-based solutions through their lens. The community members' words and perspectives shine light on community resiliency and the need for interdisciplinary action in mitigating air pollution.

Keywords: *Air quality, air pollution, burden, community, environmental justice, environmental racism, health, inequality, inequity, public, socioeconomic, solutions*

INTRODUCTION

In the pursuit of global development with excelled population expansion, advanced technology, and an unsatisfiable hunger for economic growth, environmental health remains detrimental to the ever-changing developments of urbanization. Environmental hazards remain a threat to human health, directly and indirectly chipping away at quality of life. Some may argue that some societies have been largely disconnected to their natural environments, altering our relationship with nature and natural systems. As we structure our societies and adapt our built environment to modern-day needs, we continue to rely on outdated and unequal systems to ensure our productivity. Although, what if it is our built environment that is slowly killing us? Even worse, what if only a specific percentage of the population was burdened the most by it?

Environmental factors such as air, water, and soil are environmental health determinants crucial to our well-being and health. These factors are prevalent in the environments we are surrounded by and oftentimes can influence health disparities intersecting with social and economic inequities. Social determinants in health often include differences in cultural influences, access to health services, education access, and behavioral differences ([U.S. Department of Health and Human Services n.d.](#)). With the combination of these social determinants and inequity as a product of environmental health hazards, health disparities increase within these disproportionately burdened communities. The disproportionate distribution of environmental health hazards is embedded in systematic and oppressive structure that can be found throughout global systems.

San Diego County is one of the largest industrialized counties located in Southern California, incorporating 18 cities expanding along the Pacific Coast. With its booming job economy and vibrant weather, San Diego draws in a range of individuals which has contributed to its diverse culture. Even within a highly popularized metropolitan area, marginalized communities fall burden to the environmental health hazards as a result of San Diego's historical background of housing discrimination and environmental racism. While there are numerous environmental and social indicators identified throughout the region, understanding the disproportionate impact of air pollution is crucial to California's efforts to reduce emissions. Advocating for clean air has been a focal point in the environmental justice movement as Indigenous and minority communities have combated the health burdens from pollution for decades. Air pollution impact in San Diego County has been prevalent since the industrial period and has only increased with housing development, production, and vehicles. As GHG emissions from these sources contribute to poor air quality, about 42% of air pollution comes from mobile vehicles ([Smith 2017](#)). In comparison to stationary sources, one may believe that mobile vehicles are the only source of emissions, however, this is a misconception. "Many of the industries also generate considerable diesel mobile source emissions, so that the separation between industry and mobile sources is not real. Locations with dense concentrations of industry and mobile sources together will have higher health hazard of toxins from all these sources" ([Smith 2017](#)). Facilities that operate adjacent to residential areas emit toxic pollutants and expose high concentrations of pollutants to populations nearby. Environmental justice studies have shown that minorities and low-income groups often live in neighborhoods near hazardous waste and are disproportionately burdened with environmental pollution ([Beard et al 2024](#)). Using health and environmental indicators to collect census data tracking, San Diego has identified environmental justice communities of concern (EJCOC) throughout the county. By definition, an environmental justice (EJ) community is a neighborhood or community, composed predominantly of people of color or a substantial proportion of people below the poverty line, that is subjected to a disproportionate burden of environmental hazards and/or experiences a significantly reduced quality of life relative to surrounding or comparative communities ([NMDH n.d.](#)).

There are profound disparities associated with pollution found in the individual- and population-level indicators. As we recognize the historical background of San Diego's environmental inequalities, we can understand how systematic racism and housing discrimination factored into community development, allowing environmental injustice to persist. In the novel *A Terrible Thing to Waste: Environmental Racism and Its Assault on the American Mind*, Harriet A. Washington highlights how these toxic and deadly environments affect American citizens, specifically communities of color who are susceptible to these environmental health hazards and how it robs communities of color of their intellectual power (Washington 2022). It remains an injustice when city officials and the government do not take procedural action to alleviate the environmental inequalities that regress our efforts to move toward a sustainable future. California will never be successful in its route to net-zero emissions without prioritizing environmental justice (EJ) communities. It is important to recognize community advocacy and involvement in progressing the environmental justice movement into climate action plans. Even in the face of inequality and indifference, these resilient communities have persevered by taking action and advocating for justice. There are fundamental patterns between systematic oppression facilitating intersectional issues that degrade both environmental and human health. Who better to identify these intersectional issues, than the community members experiencing it themselves?

LITERATURE REVIEW

Historical Background & Racial Discrimination in Housing

The first recorded settlers of Coastal California was the Kumeyaay Nation, a nation that extended from San Diego and Imperial Counties in California to 60 miles south of the Mexican border ([Connolly and Carter n.d.](#)). When the first European settlement occurred in 1769, the mission period began, and the conversion of faith was forced on to the Kumeyaay Nation ([Connolly and Carter n.d.](#)). Due to colonization and unethical treatment of the Kumeyaay Natives, many Indigenous members were displaced, beaten, and forced off of their land by history of war. By the 1900s, the total of Native American population dropped to about 16,500 in California and 11,800 of that population was considered "landless" ([Connolly and Carter n.d.](#)). Today, one of the remaining 12 bands of the Kumeyaay Nation resides in Viejas Valley, east of the community of Alpine in San Diego County ([Viejas n.d.](#)). Recognized as a sovereign government by the United States, Viejas Band maintains a government-to-government relationship as the tribal members are divided into 12 separate bands along the Southern California coast ([Viejas n.d.](#)). As we know in today's society, Indigenous Peoples around the globe are the largest protectors and advocates for our remaining biodiversity and natural ecosystems, and this is evident in the Kumeyaay history as they engaged in environmental management of their land and resources ([Viejas n.d.](#)). It is important to recognize all global Indigenous Tribes as their traditional practices and cultural influences have developed human society even during the years of suppression and displacement.

As we venture into the history and culture of south-central San Diego, one of the many beautiful gems located near downtown is the Chicano Memorial Park. Chicano Park is a National Landmark located in Logan Heights and known as the emotional heart of Barrio Logan ([SanDiego.Org n.d.](#)). This beautiful landmark is hard to miss, with the largest and colorful collection of Chicano murals within a beautiful seven acres of recreational space to enjoy. Throughout the years, I have witnessed community events such as music festivals, traditional Aztec dance, art galleries, and cultural learning opportunities allowing the community members to participate and unify in a culturally diverse space. With many art galleries and displays throughout the storefronts, the whole district is filled with lively business such as boutiques, brewpubs, and craft coffee ([SanDiego.Org n.d.](#)). Prior to the 1920s, many residents were living and working on both sides of the border ([Rios 2022](#)). In 1924, the creation of the Tijuana border check was an attempt to

stop the migrations, and surely disrupted the economy of the neighborhood as a shortage in labor jobs began ([Rios 2022](#)). The growth of the industrialization surrounding the ship industry in San Diego Bay called for rezoning the waterfront, converting residential areas for industrial use ([Rios 2022](#)). As job opportunities continuously fluctuated, the area began deteriorating and was associated as a “slum” and low-income area ([Rios 2022](#)). In many ways, the residents of Barrio Logan and Logan Heights have been through many hardships that displaced the communities that occupied it, battling years of racial bias within industrial development. One of the few trademarks the community tried to preserve is now known as Chicano Park. The authenticity and culture in Chicano Park is what makes it the unique historic landmark it is; however, it is also one of the few “green spaces” accessible to the community. I emphasize “green space” as Chicano Park is technically located beneath the I-5 freeway and extends under the San Diego-Coronado bridge. It is important to note that a national landmark and historic area as such for the community to gather and unify, is located in an area with high concentration of toxic pollutants. Due to the development of the I-5 freeway by the California Department of Transportation in the 1960s, the community was promised the land to be turned into a park; however, in the 1970s, the land was almost converted into a California Highway Patrol station ([SanDiego.Org n.d.](#)). Community members spread the word about the construction and unified to halt the development of the station, creating a human chain of hundreds of men, women, and children to prevent the demolition and there is record of the community members holding their resilience 12 days strong ([SanDiego.Org n.d.](#)). After months of negotiation arguing over land use and ownership, residents kept the pressure on until Chicano Park was signed into law in 1971 ([SanDiego.Org n.d.](#)) Local and national artists were invited to begin the mural paintings about two years later where the contribution of the murals ranges from Pre-Columbian, colonial, modern, and contemporary imagery ([SanDiego.Org n.d.](#)). Many of the murals represent Mexican, Chicano, Latinx, and Indigenous cultural remembrance.

Collection of Murals and Sculptures in Chicano Park

Image 1: Hasta La Bahia



Victor Ochoa. (1978). *Hasta La Bahia*. Chicano Park Museum and Cultural Center, San Diego, CA.

Image 2: La Trinidad es Amor



Raul José Jaquez. (1997). *La Trinidad es Amor*. Chicano Park Museum and Cultural Center, San Diego, CA.

Image 3: Mural in Chicano Park



Bernice Badillo. (1997). *Mural in Chicano Park*. Chicano Park Museum and Cultural Center, San Diego, CA.

Images 1-3: Collection of Murals and Sculptures in Chicano Park ([Chicano Park Museum 2023](#)). This collection of images were photographed in 2022 by Jonéa Parks, while exploring Chicano Park located directly under the San Diego-Coronado Bridge in Barrio Logan. Chicano Park Museum and Cultural Center includes an array of historical, cultural, and traditional artwork sharing various stories of the history and communities throughout the area. As stated before, the contribution of the murals ranges from Pre-Columbian, colonial, modern, and contemporary imagery throughout the Park ([SanDiego.Org n.d.](#)). Pictures of Chicano Park and the community are beautifully displayed through imagery, but an in-person view of the park is mesmerizing for all that visit.

The cities of south-central San Diego consist of predominantly Hispanic and Latinx communities, however, San Diego also has a long history and settlement of Black/African American populations. Black history in San Diego can be dated back to the 1820s, and was home to many Black entrepreneurs, pioneers, and icons ([SanDiego.Org n.d.](#)). By 1850, only eight African Americans in a total population of 798 residents resided in San Diego County ([San Diego History Center 2016](#)). Prior to the population growth of the 1880s, the majority of the new African American arrivals were slaves, ex-slaves, or “employees” of whites whom they previously were enslaved by ([San Diego History Center 2016](#)). During the early period and first arrival of Black populations, Blacks preferred to live in more rural areas as it provided more economic advantages but as the economy started to pick up in the 1890s in the development of railroads, the construction of downtown San Diego rose the city’s Black population by 298 residents ([San Diego History Center 2016](#)). As many African American populations migrated between the 1910-1970, also known as the Great Migration, many moved to the north in hopes to escape the racial violence, oppression from the Jim Crow laws, and to pursue better economic and educational opportunities ([National Archives and Records Administration n.d.](#)). The second phase of the Great Migration (1940-1970) after World War II, African American populations migrated more Northwest into Washington, Oregon, and California-occupying cities such as Oakland, Los Angeles, and San Francisco ([National Archives and Records Administration n.d.](#)). Blacks were not welcomed upon arrival in these states as well, as there was much racial discrimination in housing and segregated neighborhoods ([National Archives and Records Administration n.d.](#)). These implemented racist restrictive covenants and redlining are the foundation and root of inequity for communities of color in the United States. After World War II, the increase and migration of African American communities came from the opportunity to fill in industrial jobs and the hopes of seeking out better opportunities. However, as there was just as much racial discrimination and prejudice in San Diego during this period, Logan Heights was one of the first African American neighborhoods established in San Diego ([Le 2019](#)). As more minority communities migrated into these areas, the incorporation of acts and laws to diminish the housing discrimination appeared in the late 1960s ([Le 2019](#)). This led to large numbers of white populations to move out toward suburban regions, buying housing in predominantly white areas where many African Americans would be deterred by prejudiced realtors ([Le 2019](#)).

Figure 1: Disproportionate Burden of Environmental Pollutants

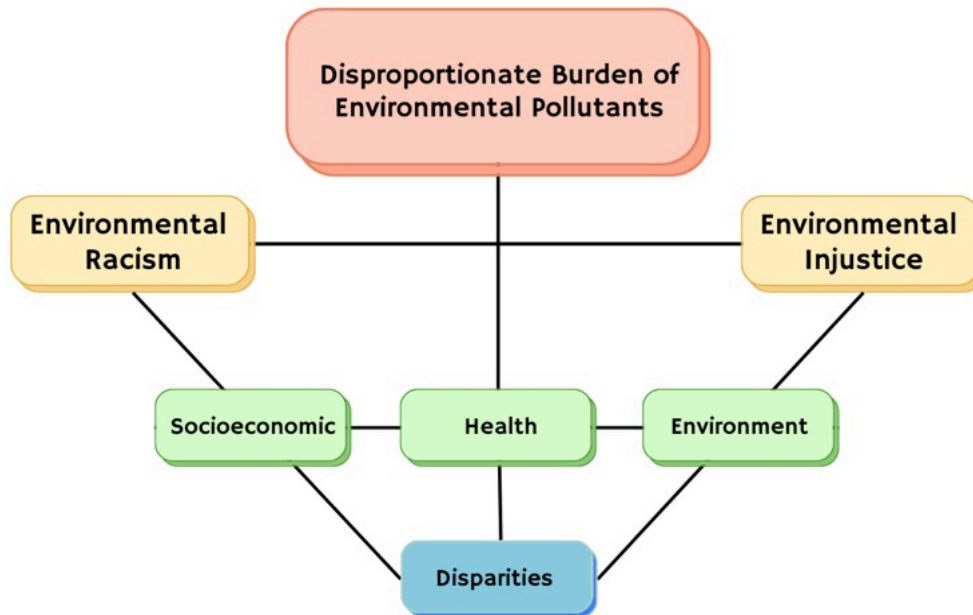


Figure 1: Disproportionate Burden of Environmental Pollutants. This diagram displays the connection between unequal distribution of environmental pollutants in marginalized communities as a result of environmental racism and injustice. The impact of high exposures to hazardous waste, such as air pollution, often affects health, can interfere with socioeconomic status, and degrade the environment. Disparities persist as a result of structurally oppressive systems of inequality amongst indicators.

To fully understand how marginalized communities bear the brunt of environmental inequalities, research into San Diego’s historical and industrial revolution is vital in understanding the structure of the systematic oppression. Principles of the environmental justice framework include justice as recognition which prioritizes the understanding of historical context and identifies vulnerabilities contributing to inequity. While air pollution remains a threat to public health around the county, many are still unaware of the health disparities associated with high exposure.

Environmental and Health Indicators of Air Pollution Burden

My interest to explore further into air pollution impact stemmed from the County of San Diego Office of Sustainability and Environmental Justice (OSEJ) StoryMap online tool, also known as the CalEnviroScreen 4.0, that allows public access to explore health and environmental indicators. By using the StoryMap tool, health and environmental indicators are the densest in south-central San Diego. Census tracking displays the highest concentrations of diesel particulate matter (DPM) within the same vicinity. DPM contains hundreds of toxic chemicals harmful to human health. “The highest levels of diesel PM are near ports, rail yards and freeways. People are exposed to diesel PM from breathing air containing diesel exhaust” ([County of San Diego n.d.](#)). For all people, clean air is critical to lung development and health, and the World Health Organization (WHO) estimates that more than 90% of the world’s population air pollution exceeds the ambient air quality recommendations ([HA 2020](#)). Air pollution is an accumulation of environmental toxicants consisting of particulate matter, metals, organic compound gasses, and other chemicals found in the air ([HA 2020](#)). Air pollution can vary in concentrations, its sources ranging from refinery emissions to residential fuel emissions. The I-5 Freeway construction and development of the

Coronado Bridge splitting two cities in San Diego (Barrio Logan and Logan Heights) contributes to the high concentrations of diesel PM and fine particulate matter ($PM_{2.5}$). Increased exposure to air pollution toxins can be most deadly to neurological development of our youth. Asthma is one of the many lung diseases impacted by air pollution; however, exposure of toxic chemicals to the young developing brain can lead to many neurological disruptors and long-term brain disorders (Washington 2020). Air pollution is only one of the indicators impacting communities of color and disproportionately impacting the youth of marginalized communities in San Diego. However, there are many other leading health-risk exposures to the residents; lead contaminated housing, low food access, park deficient (fewer to no green areas), and low income housing all factor into inequality.

Figure 2: County of San Diego Office of Sustainability and Environmental Justice StoryMap

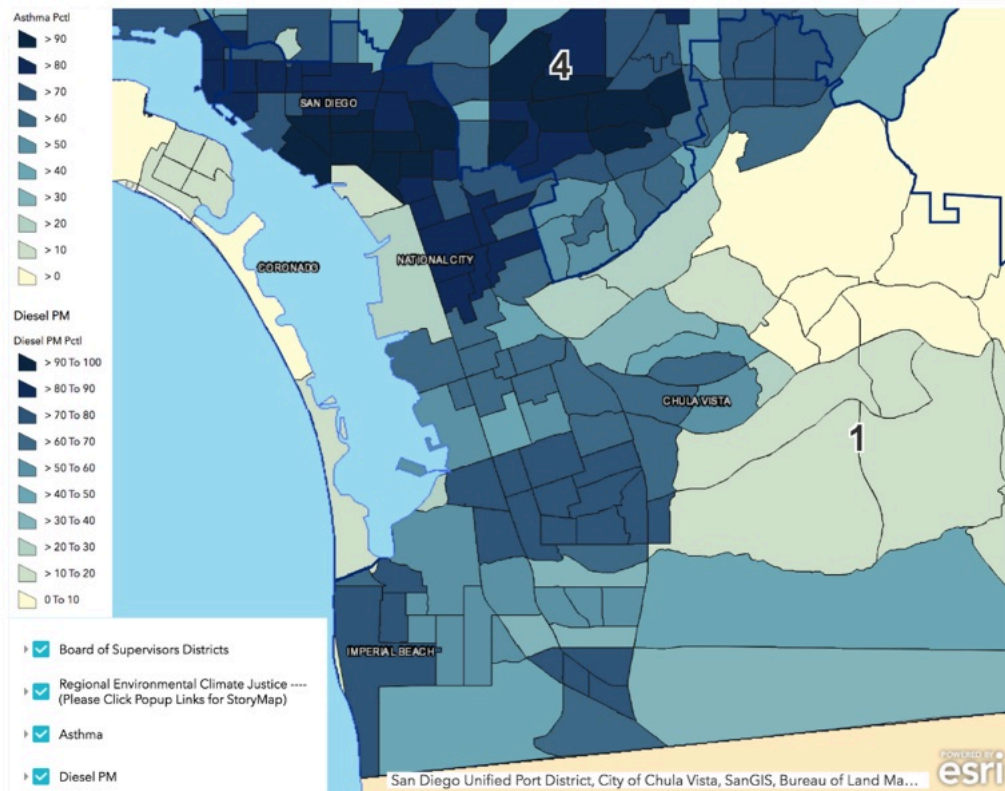


Figure 2: County of San Diego Office of Sustainability and Environmental Justice StoryMap. This image was taken from the [County of San Diego Office of Sustainability and Environmental Justice](#) (OSEJ) StoryMap, originally created by the Board of Supervisors back in July 2021. The StoryMap was created to integrate equity into the Regional Decarbonization Framework for a user-friendly regional portal for various datasets on equity and climate impacts. While the map contains many visual environmental health concerns,

the image above is an overlay of two indicators: diesel particulate matter (DPM) and asthma ([County of San Diego n.d.](#)).

Based on reports conducted by the American Lung Association (ALA), San Diego County has been ranked among one of the most ozone polluted cities in the country; ranked 8 worst for high ozone days out of 227 metropolitan areas, ranked 16 worst for 24-hour pollution out of 223 metropolitan areas, and ranked 37 worst for annual particulate pollution out of 200 metropolitan areas ([ALA n.d.](#)). Industrialization growth and expansion were not only the contributing factors to mass production. The City of Chula Vista, the second-largest city in the San Diego metropolitan area, rapidly grew in 1940 after World War II brought in many changes. The relocation of the Rohr Aircraft Corporation back 1941 led Rohr hiring over 9,000 workers for wartime production and in 1950, the population tripled ([City of Chula Vista n.d.](#)). In the aftermath of war, many of these citizens stayed settled in Chula Vista, which prompted the rapid development of social facilities such as schools, shopping centers, banks, homes, gas stations, and more ([City of Chula Vista n.d.](#)). Chula Vista is not the only city with militarized industrial history. Portside communities that consist of Barrio Logan, Logan Heights, Chula Vista, National City, and Imperial Beach have many residential areas adjacent to heavily trafficked operations of the Port of San Diego and U.S. Naval Base of San Diego. As for operations at the ports and the U.S. Naval stations there are limitations in environmental policies when it comes to military operations. One business in particular that stretches along the ports is General Dynamics. Reiterating the description from the company, “General Dynamics NASSCO has been designing and building ships in San Diego’s industrial corridor since 1960 and is the only full-service shipyard on the West Coast of the United States. The company specializes in the design and construction of auxiliary and support ships for the U.S. Navy and oil tankers and dry cargo carriers for commercial markets. It is also a major provider of repair services for the U.S. Navy’s global force for good, with capabilities in San Diego, Norfolk, Mayport, and Bremerton” ([General Dynamics n.d.](#)). Shipyards and manufacturing have the high potential for waste pollution in oil spills that can contaminate the water and ship-sourced pollutants can be linked to greenhouse gas (GHG) emissions, nitrogen oxides (NO_x), sulfur oxides (SO_x) and particulate matter ([Clear Seas n.d.](#)). Residing near these heavily polluted areas can result in high exposures to toxins in neighboring communities, leaving residents to endure these conditions.

Image 4: ¿Por qué Nosotros?



Mario Torero, Carmen Kalo Linares, and Fuerza Team. (1996). *¿Por qué Nosotros?*. Chicano Park Museum and Cultural Center, San Diego, CA.

Image 4: ¿Por qué Nosotros? This image came from The Guide of Murals in Chicano Park from Chicano Park Museum and Cultural Center website ([Chicano Park Museum 2023](#)). Following the discussion on

General Dynamic NASSCO, the artist captures the disparity and injustice of toxins being released into the community. General Dynamics NASSCO is located on Harbor Drive, adjacent to Barrio Logan. The Naval Base San Diego can also be found on S 32nd Street & Harbor Drive. The mural provides a different perspective through a community lens on the history of environmental injustice in Barrio Logan.

Vehicle Emissions

There are community-based organizations (CBOs) and city plans to initiate change in the inequalities of pollution burden in San Diego, such as California's efforts to cut carbon emissions by 2030 and to reach carbon neutrality by 2045. According to the San Diego Air Quality Index (AQI), high concentrations of pollution comes from vehicle emissions; fine particulate matter (PM_{2.5}) is a large contributor, commonly affecting human health ([IOAir n.d.](#)). "Ozone is a corrosive gas pollutant composed of three oxygen atoms. Due to ozone's highly reactive nature, prolonged exposure can cause damage to the lung tissue, leading to the early aging of the lungs and the worsening of chronic lung disease. Short term effects can trigger asthma attacks, coughing and difficulty breathing. These effects are more acute in sensitive groups including children, the elderly, and individuals with pre-existing heart and lung conditions" ([IOAir n.d.](#)). PM_{2.5} concentrations often exceed limits in highly populated and congested urban areas. As PM_{2.5} is associated with respiratory issues, urban traffic increases morbidity and mortality to exposed populations exuberating impact on both environmental and human health. "The World Health Organization [WHO] has recommended the use of indicators based on PM_{2.5} (as opposed to those based on PM₁₀) because PM_{2.5}: *i*) are considered a better indicator of urban pollution due to their mainly anthropogenic origin as they come largely from diesel emissions, and *ii*) imply serious effects on human health due to their composition rich in very toxic compounds and their great capacity of penetration in the respiratory tract" ([Bernardo et al. 2021](#)). Increased exposure to PM_{2.5} factors into the unequal distribution of pollutants in communities adjacent to freeways and highways with heavy traffic flow. To facilitate the reduction of GHG emissions from vehicle combustion and apply principles of environmental justice to ensure equitable access.

With many new policies in place and active air pollution reports, it is said a notable amount of air pollution has been reduced. However, we must ask ourselves, how many more generations are at risk by not taking further action? Continuous exposure will continue to disproportionately impact social determinants of health. Throughout the MESH program, I volunteered with the City of Chula Vista Office of Sustainability providing research to support updates on their Climate Action Plan (CAP) and Climate Equity Index (CEI). Working with the City of Chula Vista not only allowed the opportunity to expand my project, but also allowed me to research more into national equity plans. During my visits down to San Diego for field observations, I spent time in Chula Vista observing the beauty and culture of the city. With the expansion and new development erupting in the area, the genuine curiosity to learn more from community members and the city's public outreach efforts drew me in.

METHODOLOGY

OSEJ's StoryMap tool allows a visual of the vulnerability amongst marginalized populations, exposing the burdens within low-income housing, asthma rates, DPM concentrations, and other indicators. In the amount of archival information on San Diego County's development and other historical context, the integration of community voices are not amplified in most quantitative studies. Oftentimes, communities will be lumped into census tracking information, and while this data produces statistical results, people just become a number or percentage. Throughout our program and primarily our last capstone project, elevating community voices has been prominent in addressing environmental injustice. Ethnography is a qualitative method for collecting data often used in the social and behavioral sciences; data can be collected through observations and interviews, which are then used to draw conclusions about how societies and individuals

function ([University of Virginia n.d.](#)). Qualitative interviews are a research method for interviewing that, usually includes follow-up questions in a conversational format. In choosing to integrate community voices into this study with the research method of qualitative interviews, participants did not have limitations in how they wanted to respond to my baseline interview questions. Through my critical friends group and mentor weekly meetups, I decided to construct a flyer that I could post in public settings where members of the community could volunteer to participate in these interviews. I limited the amount of information just enough to capture a reader's interest and encourage voluntary participation. A summarized explanation of the study was then provided to community members if they chose to participate.

Figure 3: Public Flyer for Community Interviews

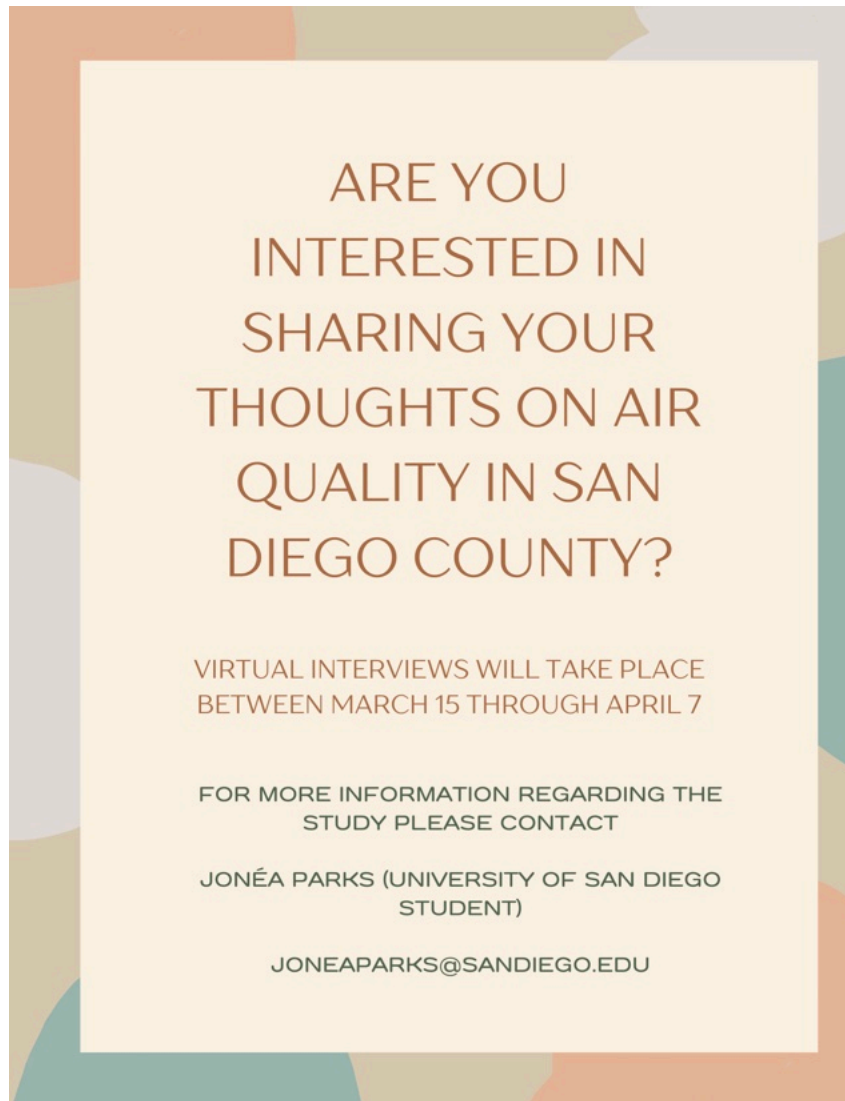


Figure 3: Public Flyer for Community Interviews. This flyer was created to prompt voluntary participation in my capstone project. The flyer was posted throughout local businesses, shops, and facilities in Chula Vista and Barrio Logan.

Prior to distributing this flyer for interviews, I inquired about the application process for the Institutional Review Board (IRB) to ensure I was proposing an ethical and regulatory overview of a study involving human subjects. The process of the IRB application gave me a better understanding about ethical approaches involving human subjects in research and defined a thin line between potential positive and negative consequences for the people involved in the study. Throughout the development of the capstone project, personal questions arose in the name of ethics: *What is the purpose of the project? What are some negative intended and unintended consequences that can arise from my findings? How intrusive are my questions to the individuals and communities involved?* In the end, IRB approval was not necessary as my research was deemed as minimally invasive. However, it has prepared me for human dimension research I may partake in for the future.

The flyer for the project was presented to the City of Chula Vista Office of Sustainability who were very on board with posting it to their March newsletter and social media page. I have previously added a piece to their February newsletter that focused on indoor air quality- specifically affecting vulnerable groups, such as expecting mothers and children. The office provided me information regarding the audience of the newsletter:

- About 1200 recipients receive the newsletter via email.
- The main targeted audience is residents of Chula Vista.
- There is no available feedback or commentary option for the public via the newsletter website, however, there are links with additional email information for them to follow up.
- People and local organizations are only added if they sign up for the mailing list.

There were a few limitations with just posting the flyer only in the newsletter: (1) it mainly consisted of residents of Chula Vista, and (2) only those who are registered on the emailing list would receive access to it. This prompted me to pass out the flyer physically visiting local businesses, facilities, and centers throughout Chula Vista and Barrio Logan. While there were still limitations with passing out flyers, this allowed me the opportunity to engage with community members and spend time in the area. The community was open to taking my flyer and asking me questions about my study. I did not receive any negative feedback in regard to the project, but there were a mix of questions as to why I chose to conduct this study and concerns about air quality.

For a few weeks, I did not hear from anyone which was a bit discouraging. As I know people are busy, I remained hopeful someone would reach out via email. It took some time but in the recent weeks of organizing my paper, I did receive voluntary participants who were eager to contribute their stories to the project. The qualitative interviews were taken within a two-week period from March 25th to April 7th 2024. In total, three community members participated in virtual interviews. Through video and audio recording, interviews ranged from 40 minutes to an hour. Below I included the baseline interview questions that were asked throughout the interview:

1. What city do you currently reside in and how long have you been a San Diego resident?
 - a. If not, where did you previously live and what brought you to San Diego?
2. What do you think of the air quality in the area you currently reside?
 - a. Have you noticed any changes in air quality over the past 5 years?
 - b. How about 10 years?
3. How has air quality impacted you or your family?
 - a. Health disparities?

- b. Does anyone in your immediate family suffer from asthma?
 - c. Any lung-related health conditions persist in your family?
4. What are your thoughts on clean transportation alternatives in your community/city?

Depending on the flow and comfortability of our discussion, these interview questions were not necessarily asked in chronological order. As my study has expanded throughout San Diego County, it was vital to understand where these residents currently and previously resided. While these questions are directly related to air quality in some way, getting to know the participants' background and interest in participating in the study was vital in many ways. I expressed at the beginning of the interview that I did not want them to feel as though they were being interviewed but rather to open up freely on any information directly or indirectly related to air pollution.

FINDINGS

Participant Background

The following findings were generated from voluntary participation qualitative interviews for the capstone project. To conceal the identity of participants, I titled each by the following description:

Participant 1 = “P1”

Participant 2 = “P2”

Participant 3 = “P3”

Participant 1

Participant 1 has lived all throughout San Diego for over 50+ years and is very familiar with the cities throughout. P1 was a bit of an outlier when it came to the recruitment process for this interview as I currently work with them and knew of their residence in Chula Vista. Prior to beginning my capstone project and mentioning it to P1, we were having a conversation on environmental hazards and I described the MESH program. He was extremely fascinated by the program outline and instantly started opening up about environmental pollutants within Chula Vista. He is very passionate about community health and justice, instantly divulging his knowledge on topics such as air pollution, waste management, and clean energy. Not only is his experience as a resident very informative, but also his current knowledge on public utilities and the energy sector as a whole due to his career path as a developer. P1 mindfulness for the environment and humanity showed throughout in his storytelling.

Participant 2

Participant 2 has lived in the City of Chula Vista for over 20 years and is an educator at a local high school. P2 was very excited to discuss air quality as she has previously collaborated with the City of Chula Vista Office of Sustainability and her students offered feedback on their Climate Equity Index. P2 teaches AP Environmental Science where her students conduct air quality monitoring with sensors on a yearly basis and work across different GIS tools. Students have the opportunity to use air particulate slabs to collect data in a form of increment approaches presenting different test variations. The students involved in this course live throughout southern San Diego, such as Imperial Beach, San Ysidro, and Otay Ranch. The various areas where the students reside has allowed for variation in air quality testing across the county. P2 passion for students' well-being shined through the entire interview.

Participant 3

Participant 3 is a retired teacher (taught for over 24 years), and climate advocate that has resided in Chula Vista for many years. P3 explained that when she initially moved to Chula Vista, the I-805 (a major north-south auxiliary interstate highway in Southern California) did not exist yet and it was a much smaller community. Offering some historical background, she stated that back in the 1970s, there had been concerns and announcements about air pollution regularly. P3 said that the Climate Equity Index adopted by the city was a huge relief and life-changer for her as she was a stakeholder. Her activism journey began in 2016 centralizing around equity and human rights. While she acknowledged that we all breathe the same air and are impacted, she brings light to communities who are disproportionately impacted and need additional support in access to clean air. P3 embodies the passion and perseverance of community activism that spreads largely throughout the communities. Her work in a facet of community-based organizations was truly inspiring.

Aside from P1, each participant reached out to me via email to coordinate an interview slot. The City of Chula Vista Office of Sustainability supported me with advertising my flyer to community members connected to the office which is how P2 and P3 found out about the study. Each participant came from relatively different backgrounds with a variety of knowledge.

Environmental and Health Concerns

P1 was eager to interview and share his thoughts on air quality in San Diego County. Residing in San Diego for 53 years now, P1 has moved around the region all throughout his life. He stated that living throughout certain areas such as La Mesa, National City, Bonita, and visiting family on smaller reservations around the county, he has seen a variety of developmental changes throughout. P1 stated that the air quality and waterway pollution has worsened over the years. First, P1 brought up pollution in waterways, specifically the Tijuana River Estuary and Imperial Beach sewage contamination and how community members have often complained about smells. P1 stated, ***“Over the years, things have really changed in the South Bay area. There's more of a toxic, paint-like smell and you really can't go a day without gasping...”*** stated P1, ***“My neighbors can also contest this, and it has been discussed between us over the years. We all can smell it. If you really want to talk about the air quality changing, Imperial Beach is huge with all the sewer runoff because of the breaks in the sewer lines right on the border. Air quality has dropped down over the past 10 to 15 years greatly. It's to the point right now where some residents just walk around with a mask all day, even before COVID. The smell from the sewage that goes in the air as well as on the coastline Imperial Beach is just so powerful and the water itself the ocean water at any given point of the day, it could be brown like a sewer. It clears up sometimes, but most of the time, it's just toxic.”***

We do not always associate sewage run-off to impact air quality. Oftentimes, people will attribute visible vapors, wildfire smoke, and GHG emissions to air pollution, but members of these communities can contest the fact that poor water quality can be contributing to odors. P1 mentions how the expansion of freeways into suburban areas is not only worsening toxic air pollution in nearby neighborhoods but also contributing to storm water runoff into local waterways. P1's mention of the sewage contamination in the Tijuana Estuary and the contamination in Imperial Beach as the first transboundary pollution issue to be discussed in these interviews. Typically, one may not consider water contamination to be such a crucial issue to air quality, but after speaking to this community member, he notes this as an ongoing occurrence.

When asking the second question of the interview, I wanted to make sure I was conscious and respectful in asking questions related to health disparities for the individual and family members that also resided in the area during this time. The response to the question was very open and informative. P1

expressed that over the years, his health has deteriorated for multiple reasons and he's not entirely sure if it can be attributed to increased pollution. He did state that his asthma symptoms had worsened over time and said that his eldest son suffers from chronic asthma, needing to use an inhaler about 3 to 4 times a day. P2 also expressed that a handful of her students also suffered from asthma and are more sensitive to the particulates in the air. The students have participated in health related studies in regard to cardiovascular health, looking into COPD or and lung related health issues with their adult parents and family members. Whether or not the individual smoked previously or not, there were a number of people with these lung-related issues. However, P2 did state that this could be from a variety of issues, not necessarily an attribute of poor air quality. There remains to be blurred lines in the correlation between public health and exposure to environmental toxins due to the limited studies on individual community health. While large operations such as WHO and IQAir can provide context on how chemical pollutants deteriorate human health over long periods of exposure, specifically here in San Diego County there is limited information on how air pollution from direct sources alters community health.

WASTE POLLUTION & LANDFILL GASSES

In ESH 521: Getting to Zero Waste, I spent time analyzing how landfill gas contributes to air pollution, highlighting the excess waste from overconsumption and transporting waste to rural low-income communities of the Global South for disposal. National and international policies for waste management vary across borders, leaving many communities unprotected by hazardous excessive waste. P1 first mentioned some background on local facilities and businesses that used to be landfill sites for years prior to the redevelopment. Over the years, the city's effort to alter the environment still does not fabricate the underlying health impacts. ***“Paradise Hills [an urban neighborhood in the southeastern area of the city of San Diego, California] was actually built on top of an old dump site. Various communities have been built around in the South Bay on old landfill mountains that big communities are being developed over there. The area even right now, it smells so bad, but there's all these apartments and condos going in. I'm not sure how they're going to hide that smell. But the air quality is so bad because a lot of gasses are seeping up from the dump- which is actually breaking down, that's causing a lot of chemical smells and it's coming in from the ground”*** stated P1.

Landfills consisted of mixed glass, paper, cardboard, plastic, composite materials, e-waste, and other municipal waste by the tons all breaking down- not to mention the amount of human (ie. diapers) and pet waste that also makes its way into landfills. The breakdown of all these materials is complex on its own. “When MSW is first deposited in a landfill, it undergoes an aerobic (with oxygen) decomposition stage when little methane is generated. Then, typically within less than 1 year, anaerobic conditions are established and methane-producing bacteria begin to decompose the waste and generate methane” ([EPA n.d.](#)). The landfill being discussed is the Old Sweetwater Landfill, which was a facility I brought up in our Zero Waste course. In the ESH 521: Getting to Zero Waste course, I touched on Bell Middle School, located in San Diego County bordering between the cities of La Mesa and Chula Vista, California. How exactly does a middle school get constructed over a landfill? The Sweetwater II Landfill operated between 1960 to 1967, with a waste footprint underneath a portion of the school. The Bell Environmental Report of 2011 report reveals “The site is located east of Briarwood Road on a bluff with descending slopes to the north, west, and south ([CBS News 8 n.d.](#)). The northern portion of the site is occupied by Bell Junior High School which includes classrooms, administration buildings, storage buildings, utility buildings, asphalt-paved parking lots, athletic fields, and landscaped areas. The central area of the southern portion of the site is the location of the Bell Junior High School Landfill, which is also known as the Sweetwater II Landfill” ([CBS News 8 n.d.](#)). The report goes on to say that types of wastes received at the landfill were unknown but had been believed to be MSW. Shortly after the closure of the landfill, the school was constructed between 1967 to

1968 ([CBS News 8 n.d.](#)). Landfills on their own ensue dangerous exposure of toxic chemicals for both humans and environmental health. Uncontrolled landfill emissions plague nearby communities and persist as detrimental harm to planetary health. The mix of organic, composite, and recyclable material collected within landfills contributes to water, air, and soil pollution both nationally and internationally. With municipal waste being the third largest source of human related methane emissions in the United States, poor air quality remains a prevalent issue in urban and suburban areas that are densely populated.

P2 also brought up landfill odors as a concern in southeast Chula Vista, near Otay Ranch. The further south of San Diego, you are much closer to the U.S. and Mexico border, where numerous cities are adjacent. In this case, many transboundary issues arrive in terms of air, water, and soil health. P2 stated that students have complained about odors and air pollution closer south to the border: ***“I did notice though, when I was living off of Olympic [a freeway that stretches east to west from Chula Vista to Otay Ranch], there were a few times when we could smell trash-whether it was from landfill or another odor. It did improve, there were fewer days where you could smell things, but the students were mentioning where they could smell, it almost smelled like something was being incinerated. Whether it's trash, or I don't know, if it's like plastic waste or something. I don't know what it was. But, I mean, I remember smelling that. And that wouldn't have come from the landfill because of course they don't do that here. You know, that's not permitted. So just thinking about it, that had to come from somewhere else, where it wasn't being regulated. Or maybe across the border, where I know, they do sometimes incinerate garbage down there.”***

It is an assumption that landfill odors could be coming south of the border. The need for cross-boundary initiatives to address the pollution south of the border is vital for approving environmental health on both sides of the border. However, both participants mentioned landfills on numerous occasions when discussing air pollution impact. When asked if conditions had improved, P2 had expressed that she moved to another area of Chula Vista in which she no longer dealt with the smell. However, her students could attest that bad odors can still be present in the area. P1 stated that the conditions of air quality have worsened in his neighborhood, and it is something discussed amongst neighbors regularly.

Clean Transportation: EV Technology and Low-Income Communities

P1 opened many different perspectives on clean transportation alternatives and shared his thoughts on the expansion of clean mobility. P1 expressed that when EV technology first came to San Diego, it was the latest and greatest technology. Soon after, the city realized that they did not have the infrastructure for the impact it would have on the energy grid. P1 mentioned the malfunctioning of initial EV rollouts that contributed to e-waste by manufacturers. P1 was one of the only community members that dived deeper into toxins involved in the manufacturing EV components. P1 stated, ***“People don't realize these batteries are made up of multiple smaller components and batteries. These batteries aren't biodegradable, if one goes out sometimes the entire unit needs to be replaced. So all that chemical waste is going to dump sites or wherever they are putting these things...But as a result of the communities, it is a lot healthier for the electrical cars to come out.”***

Throughout this discussion, I noticed his mindfulness to the environmental and economic degradation of EV technology. The transition to EV is very controversial in the extractive and exploitative nature of lithium mining. According to the U.S. Department of Energy, “Most of today's all-electric vehicles and plug-in hybrid electric vehicles (PHEV) use lithium-ion batteries, though the exact chemistry often varies from that of consumer electronics batteries” ([USDE n.d.](#)). The vast supply of salt flats for lithium reserves in Bolivia, Chile, and Argentina, many are unaware that lithium is a non-renewable mineral and does not replenish quickly ([Ahmad 2020](#)). The continued damage of lithium mining has caused great concerns and limitation of resources for the Indigenous communities. Electronic devices and materials are

not disposed of appropriately allowing for tons of e-waste to collect in landfills where toxic substances from the product leech into the ground. The ones suffering the most from global e-waste are the marginalized, rural communities being exploited for illegal dumping, and poor disposal practices. While P1 agreed in terms of reducing emissions in San Diego communities transitioning to EVs, he also had a lot to say regarding the affordability of electric vehicles in low-income communities. P1 stated, ***“I’ll tell you straight out there’s no way a low-income family will be able to obtain an electric vehicle. You have to understand that electric vehicles are primarily maintained by the dealerships. Very few people will be able to take their electric vehicles to a mechanic to fix, most mechanics won’t even touch them. They are just too complex- too much wiring, too much programming. So, if you ask someone, they would most likely want a gas operated vehicle where they can actually fix it themselves or take it to a local mechanic. Those costs and visits are not always considered in incentives if something goes wrong with the car.”*** Discussing clean transportation and mobility options with both participants presented many similar trends. Noting that there are many incentives and even rebate opportunities to switch to EV, it seems there was limited information to the public on EV incentives. Through my volunteer work with the City of Chula Vista, I have learned more about community-based programs to support low-income families with the expenses of EVs. However, these programs often come with limitations that determine the qualifications for application.

Throughout the interview, both participants expand on the portside communities such as National City and Barrio Logan, that are vastly impacted by industrialized emissions. The transportation to and from the border and the operations of the Ports of San Diego leading to heavily trafficked corridors for neighboring communities. Portside communities are adjacent to the Tenth Avenue Marine Terminal (TAMT) and the National City Marine Terminal (NCMT). Transportation to and from the ports leads to concentrations of PM10 and PM2.5 in residential neighborhoods directly impacting air quality (Karner et al. 2009).

P2 said that within her AP Environmental Science course, students participate in air quality studies and use monitors to get a reading on particulate matter. Purple Air Monitors measures real-time PM2.5 concentrations for residential, commercial, or industrial use and can be installed indoors or outdoors. Built-in WiFi enables the air quality measurement device to transmit data to the real-time PurpleAir Map, which is stored and made available to any smart device ([Purple Air, Inc n.d.](#)). P2 said the students had to install an app to have these readings transmitted to smart devices, however, processing data was relatively easy. Students even attached monitors to cars that were parked noting how particulate matter can still exhaust from a tailpipe even without the car being in operation. As heavy-duty trucks are transporting to and from the border, P2 expressed that many industrial and commercial vehicles do not seem to abide by smog regulations and policies: ***“One of the things that they [AP Environmental high school students] were observing is that all the trucks that are coming in, assumedly, they’re coming across the border. They were trying to identify cars, that might be our vehicles, and the trucks that may be gross polluters. They did see a lot of trucks that were coming up. I am not aware of all the regulations, but I know there was supposed to be a point where there were low-traffic times by which commercial trucks were supposed to be making their runs, but now it seems they are coming at all times of the day. So they’re exacerbating the traffic problem. But it seems like there are a lot of not just commercial trucks, but cars that don’t seem to be adhering to smog standards down there.”***

According to California’s Department of Transportation, there is no legal basis on restrictions for trucks during peak- and low- hour traffic. Heavy-duty diesel trucks and commercial cars often travel through corridors of business and residential areas leading to concentrations of air and noise pollution. Upon further research, I found the Advanced Clean Fleet Regulations by California Air Resource Board (CARB): The Advanced Clean Fleets (ACF) regulation is part of the CARB’s overall approach to accelerate a large-scale

transition to zero-emission medium- and heavy-duty vehicles. This regulation works in conjunction with the Advanced Clean Trucks (ACT) regulation, approved March 2021, which helps ensure that zero-emission vehicles (ZEV) are brought to market. ([CARB n.d.](#)) While the goal for CARB is to transition from medium and heavy-duty diesel-burning vehicles to zero-emission vehicles by 2045, this seems to be a hard implementation for transporting goods and cargo across the border. Otay Mesa border crossing is one out of San Diego's three major ports of entry through the United-States and Mexico Border. Otay Ranch (the area in which P2 reported a handful of her students live) is about 20 minutes north of the border. While ACF touched on how this regulation will improve disproportionately advantaged communities, there was limited information in terms of border crossing regulations. In the Voice of San Diego, author Sandra Dibble wrote an article titled *Border Report: Cross-Border Truckers Brace for California's New Environmental Rules*, where she expresses the concerns on both sides of the border being worried about the disruption to crucial trade corridors. She brings light to the transboundary economic constraints stating, "Cross-border truckers and their clients say the Mexican side is not prepared to transition to zero emission vehicles. Mexico lacks zero-emission trucks, charging stations, regulations and programs to incentivize and fund such changes. They worry the transition will disrupt trade at Otay Mesa— the busiest commercial crossing on the California-Mexico border – drive up transportation costs, and cause companies to move away from the region. 'We do not have comparable financial incentives, federal government programs, private enterprise resources and infrastructure,' he [Baja California's secretary of the economy and innovation, Kurt Honold] said 'Adopting the rules as it will have drastic inflationary impacts in California and major supply chain delays'." ([Dibble 2023](#)).

P2 suggested strategic regulatory action when it came to heavy-duty truck policies, but also brought awareness that some of these polluters can be outside of California's domain and regulations in abiding to a clean fleet. Previously, I have looked into low-emission zones (LEZ) studies and thought this could be a potential solution. In the journal article *Pollution and Congestion in Urban Areas: The Effects of Low Emission Zones* by [Bernardo et al.](#) (2021), the case study examines how effective Low-Emissions Zones (LEZs) are and compares these results with the existing effectiveness of urban tolls. LEZs have been applied to a few cities, and some have suggested a change in pollution and air quality have occurred in the restrictions of vehicles with high emissions in certain areas. An additional study by Panteliades et al. (2014) on LEZ implemented in Amsterdam a gradually banned heavy-duty vehicles based upon their emission category. With a concluded decrease in emissions, the comparative roadside concentrations reduced by 4.9% for NO₂, 5.8% for NO_x, and 5.8% in terms of PM₁₀ (Panteliades et al. 2014). [Bernardo et al.](#) (2021) study further investigate the impact of LEZs on PM_{2.5} as this is the most important pollutant in terms of health damage and exposure. Using data from European cities that adopted LEZs, they measured the effects on both pollution and congestion; urban tolls were found to be more effective in reducing congestion, whereas LEZs were more effective in reducing pollution ([Bernardo et al. 2021](#)). As the authors point out the acceptability of policy measures surrounding urban tolls and congestion, LEZs seem to be more popular. In the adaptation of LEZ and Zero- Emissions Delivery Zone (ZEDZ), these areas can either restrict the use of, fine, or penalize those upon entry of heavy-polluting vehicles, incentivizing stakeholders and companies to transition to electrification. While this involves roadmapping specific zones that can be a potential solution to improve disproportionately impacted areas, I worry that this will only be a small dent in the issue. Finding adaptive solutions can be complex in finalizing the outcome across all communities, but becomes an even more complex problem in terms of transboundary pollution. The cost, infrastructure, and stability of the transition to a fully electric fleet may not be possible for Mexico and cross border partnerships by 2045.

INDOOR AIR QUALITY

In a home equipped with gas appliances, some of the deadly toxins we thought we could seal our windows to loom just below our noses. “Natural gas appliances, including furnaces, water heaters, and stoves emit carbon dioxide through combustion and also emit methane directly into air through leaks and incomplete combustion” (Kashtan et al. 2023). Gas-powered appliances can emit toxic chemicals, such as carbon monoxide (CO), formaldehyde (HCHO), and Nitrogen dioxide (NO₂), all being associated with lung and respiratory damage (Kashtan et al. 2023). According to the World Health Organization 2022 *Household Air Pollution*, women and children disproportionately bear the greatest health burden from polluting fuels and technologies in homes as they typically labor over household chores such as cooking and spend more time exposed to harmful smoke from polluting stoves and fuels (WHO 2022). Without facilitating any questions that related to indoor air quality and/or gas appliances, all community members in the interviews were conscious of the impacts of both outdoor and indoor air pollution. However, participant 3 was very keen on discussing the toxicity of indoor air quality. P3 shared a personal story about a gas leak that was occurring right underneath her home, in which she and her husband did not have the slightest idea of. ***“One impact we actually had was right here in our house. First of all, we were part of a study about gas appliances. I didn’t think about it very much before but the City of Chula Vista was teaching us to switch over to better appliances and there’s a lot of money involved in projects like this. So we started to switch our appliances and it turns out that when they came over to check out the construction they were going to do on the furnace, it turned out there was a gas leak under our house. My house is over 75 years old, I live in an older part of Chula Vista- and I am thinking to myself if that is happening within my house, then what about everyone else around us?”***

After discovering the gas leak within the P3 household, P3 expressed how uncomfortable she felt using the gas stove and immediately switched over to the induction stovetop. She did acknowledge that this was a costly transition but then began to explain community resources that can support and spread awareness on the detrimental impacts of gas leaks. ***“After discovering this, I decided to join the Chula Vista Climate Action Challenge...It's a website with information about changes you can make and how much GHG emissions you can save if you make this change [to electric appliances] in your household. The Chula Vista Climate Action Challenge held meetings for the public so they could receive more information on how to change out things in your home and switch to more efficient appliances. The problem with it, is that it is a big expense upfront for people to make these transitions and get money back, like a rebate... There needs to be more help with that.”***

When it came to more community-based solutions P3 mentioned GRID Alternatives, a non-profit installer of clean energy technologies. When I previously worked on the Chula Vista Office of Sustainability February newsletter about indoor air quality, the office introduced me to GRID Alternatives and I had previously written about the organization in ESH 530: *Environmental Justice*. GRID Alternatives is a community-powered solution that provides knowledge on solar power, how renewable energy sources (RES) can provide cleaner and equitable environmental conditions, and implements many projects and installations in low-income communities (GRID Alternatives n.d.). As a certified non-profit organization originally based in Oakland, this organization holds eight affiliate offices nationwide and have both Tribal and international programs to support economic and environmental justice communities transition to clean and affordable renewable energy sources (GRID Alternatives n.d.). Organizations as such can support implementing procedural justice surrounding energy equity. As P3 had mentioned in our interview, she has just one of the many older residences in the area and it often is a lot of money upfront to electrify one's home. However, spreading information on these community-based organizations through outreach measures has become a priority for P3.

DISCUSSION

While there was tons of information discussed with the community members that participated in these interviews, it was important to identify the intersectional themes that arise when asking these participants their thoughts on air quality. The themes that followed throughout this study include: (1) transboundary pollution; water contamination in relation to Tijuana River sewage run off and vehicle emissions from transportation through U.S.-Mexico border crossings; (2) health risk in conjunction with increased exposure to indoor and outdoor air pollution from the use of fossil fuels; (3) the acknowledgement of San Diego's historical redlining and racial discrimination relative to environmental racism; (4) unaffordability for electric technology in terms of both EVs and electrification of household appliances; (5) industrialization emissions from manufacturer and business operations near residential areas; and (6) a lack of awareness on health disparities that correlate with high exposure to air pollution, in addition to the lack of awareness to community-based resources to mitigate these issues.

Figure 4: Community Members' Feedback on Air Pollution Impact: Intersectional Issues Identified

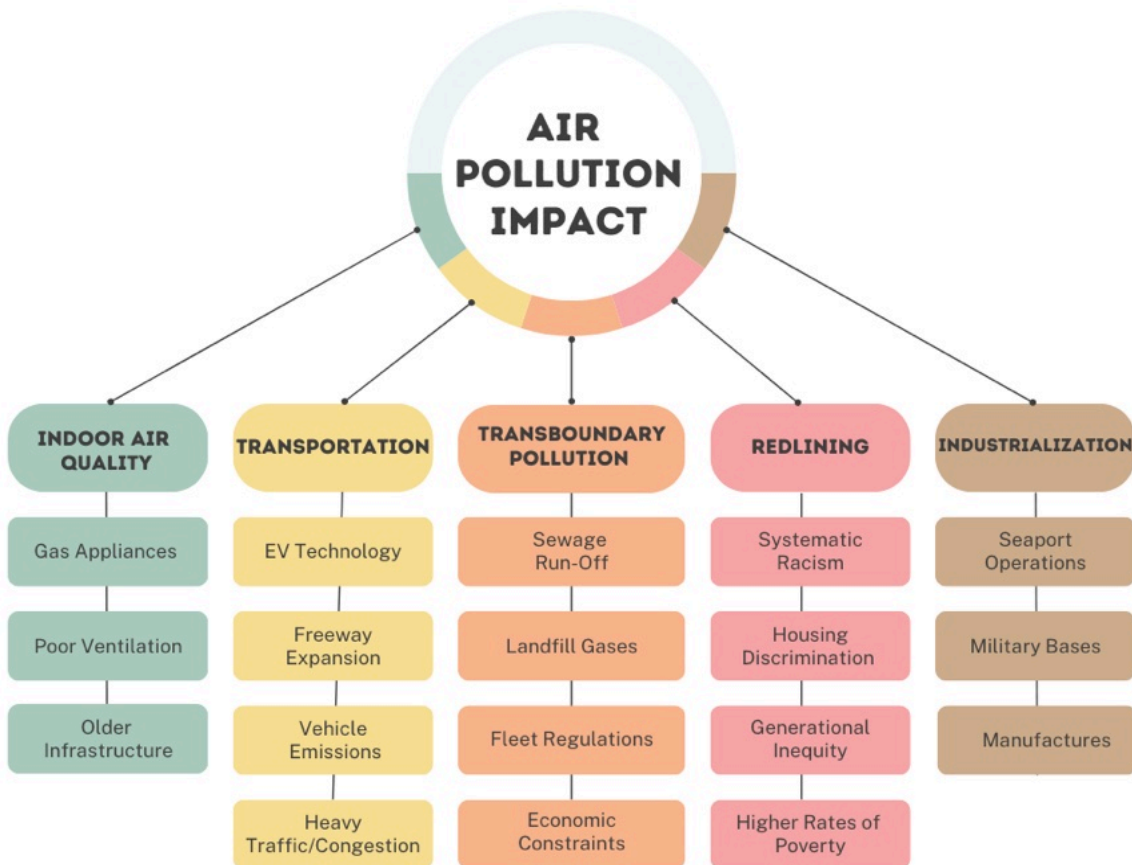


Figure 4: Community Members Feedback on Air Pollution Impact: Intersectional Issues Identified. This diagram outlines the common themes throughout the community interviews. (1) indoor air quality, (2) transportation, (3) transboundary pollution, (4) redlining, and (5) industrialization. Community members touched on a few of these topics throughout the interviews explaining how they connect to air pollution impact and the inequality in the exposure to toxic pollutants.

Community-Based Solutions

Throughout this research, I did not ask a baseline question on what community-based solutions could be adapted. The community members were vocal on the potential outcomes of integrating community feedback into mitigating the disproportionate burden of environmental health hazards within marginalized communities. While all members acknowledged the need for transdisciplinary approaches to implement solutions, P3 offered many community-based resources and organizations aligning to incorporate equity and environmental justice framework through community participation.

P1 stated, ***“If anyone would like proof of anything we have discussed here today, you can actually go to these places and see it with your own eyes. You can go to Imperial Beach and Tijuana Estuary, and see the sewer run off in certain areas. You can go to the Logan Heights area and see all the manufacturers working along the residential homes. You can go down to the downtown area and smell the jet fuel [downtown is adjacent to San Diego International Airport]. It’s in the air. It’s all around us. Big changes have to happen to purify the air, or eventually we may all just have to walk around with a mask.”*** The interview with P1 truly shined a light on the complexity of navigating transboundary pollution and ensuring ethical balance on waste pollution in the Global South and Global North. His understanding of the environmental and social impacts both nationally and internationally opened a platform for cross-boundary spanning on these issues. His words made me reflect on *The Principles of Environmental Justice*, principle 3 states, “Environmental Justice mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things” (EWG n.d.). Consumption and production in California’s efforts to mitigate environmental harm throughout the state can also have detrimental impact to rural communities and environments.

P2 encapsulated the necessary passion and excitement needed in our youth. While she may not have stated this as a community-based solution, her position as an educator is a huge community resource within itself. The students involved in this course have the ability to conduct monitoring studies within their own communities allowing knowledge to carry into future generations to spread awareness to advocate for change. These air monitoring studies provide information that can be shared to the public, stakeholders, business, families, and more - a powerful tool indeed. Reflecting on the novel *A Terrible Thing to Waste: Environmental Racism and Its Assault on the American Mind*, Harriet A. Washington novel highlights how these toxic and deadly environments to American citizens, specifically BIPOC communities are susceptible to these environmental health hazards and how it robs communities of color of intellectual power (Washington 2022). I can’t help but connect the influences of educators, such as P2 and the academic course material offered at this high school level, brings that power back to the communities.

P3 world of knowledge and deep connections with numerous CBOs, background as a stakeholder and clean energy, and facet information on community resources had lots to contribute on the importance of equity in climate action. ***“I’ve been in a lot of stakeholder groups to try to reach more people to help people understand about the impacts of climate, and what they can do. San Diego Community Power now has many programs, just to help people have a more efficient home. I really was happy about the Climate Equity Index because when we were initially talking about the Climate Action Plan, there were several of us constantly asking what we’re going to do to have an equity portion in the Climate Action Plan. The city finally did it and it’s amazing. And now, we’re still working on implementation and trying to get these things done. San Diego Community Power is doing a lot of outreach...”***

When it came to clean energy suppliers, P3 noted that San Diego Community Power (SDCP) was going above and beyond to ensure that everyone has equitable access to clean energy. San Diego Community Power is a non-profit community driven energy provider that purchases electricity from cleaner

renewable sources to then distribute throughout the region. P3 specifically mentions the Community Power Plan (CPP) the SDCP developed between July 2022 to 2023 engaging in crucial first steps of listening to community members assessing their needs and prioritizing their concerns. Additionally, the information gathered from the community was then paired with a market assessment to determine potential programs that could meet community needs, leading to funding for the CPP draft ([SDCP 2023](#)).

San Diego Community Power Community Power Plan Program Development



Figure 5: [San Diego Community Power Community Power Plan Program Development](#). This figure displays the San Diego Community Power development plan for the CPP which focused on community needs and engagement to rule out potential programs ([SDCP 2023](#)).

SDCP also hopes to implement a Regional Energy Network (REN) to implement and administer energy efficiency programs throughout various service territories. While the application is still under administration of California’s Public Utilities Commission (CPUC), SDCP states the following, “SDREN aims to empower residents and stakeholders through a variety of programs that contribute to local and state energy efficiency and climate goals.” P3 expressed the power in the adoption of community participation efforts and how these workshops open the lens for numerous stakeholders and government entities.

The opportunity to interview these community members was eye-opening in many ways, leaving me with a vast amount of knowledge. In the same time that these three community members were experts on these topics, many of them expressed how important studies such as this were, as many are unaware of these intersectional issues. As stated in the indoor air quality section, P3 made it clear that she was unaware of the effects of gas appliances up until the moment they discovered the gas leak underneath her home. Many of the community members expressed that topics as such are not typically discussed in everyday conversations and often become overlooked. I cannot help but wonder if communities that are disproportionately disadvantaged by high exposures of toxic pollutants often normalize conditions, especially when they persist from generation to generation. Even with today’s evident changes in climate, a large percentage are in denial of the urgency in climate action and justice.

Limitations & Future Research Directions

The themes identified throughout the findings were solely gathered from the community members that participated in the interviews and do not represent the entirety of the communities and cities documented in this. As stated in the participant description, all three community members resided in the City of Chula Vista. In my effort to obtain participants from the neighboring communities (Barrio Logan, Logan Heights, National City, San Ysidro, Imperial Beach, etc...) no community members for these neighboring cities responded to my flyer. All three community members at one point mentioned the severity of the issues occurring within these communities-specifically paying note to communities closest to the border and seaport operations. When I originally began this study, the OSEJ’S StoryMap helped identify the EJ communities that were disproportionately impacted by DPM and Asthma. As I have spent time in these

communities and began to expand my study throughout southern San Diego, I wish I had the opportunity to grasp more community voices from these neighborhoods. Even though I did not have this opportunity, the community members who shared their stories still shined a light on the desperate need for intervention throughout the county. Limitations in the advertisement for interviews delayed the beginning of the interview process, not leaving room for multiple interviews. There were no responses the first two weeks of online advertisement. In an effort to reach community members, I traveled to the area to post physical copies and interact face-to-face. Due to time and travel constraints, this was completed within a small window with no responses. Attending more events and workshops to engage with the community members could have been incorporated in outreach efforts.

CONCLUSION

San Diego's journey to reach net zero emissions goals really begins with systematic change. The County of San Diego has adapted many government offices and departments, such as OSEJ and Office of Equity and Racial Justice. However, how is change actually being implemented? While there is various information out there regarding the environmental injustice, pollution, and planetary health, many of these quantitative studies often separate the people from the impact. Quantitative data is vital to understand this data and is a key reason as to why I chose to study air pollution impact. However, the same can be said about the individuals experiencing injustice and sharing their stories. This qualitative study has proven that community members are just as aware of the interdisciplinary approaches needed to address environmental impact. The community members did not have quantitative results to prove their stories, but have experienced these conditions themselves. While climate change may take a facet of scientific data, climate justice does not.

“Environmental Justice demands the right to participate as equal partners at every level of decision-making, including needs assessment, planning, implementation, enforcement and evaluation.”

-National People of Color Environmental Leadership Summit (1991) ([EWG n.d.](#))

The achievement of equitable conditions has no timeline and will take years of deeply embedded systematic deconstruction. The resilience and strength of communities has only grown since the beginning of the movement, and even in today's societies, we see passionate individuals asserting themselves in the discussion amplifying their voices. Adopting the principles of environmental justice and inserting the framework in the action plans has exacerbated the expansion of equity plans and needs assessment. In my research for the City of Chula Vista Office of Sustainability Climate Equity Index, gathering information from equity plans throughout the nation opened the opportunity to adopt different approaches and solutions that could potentially serve various communities. At the same time, I was in awe at how many cities throughout the United States did not have any sort of climate equity plan. While many express that San Diego County should be doing more (and definitely should), I want to acknowledge the absence of these discussions all throughout the nation-throughout the world. In the environmental justice movements there are three components: distributive justices, procedural justice, and justice as recognition. As all three components of justice are attributes of the movement, I want to emphasize the importance of historical context when it comes to recognition justice. Outlining San Diego County's redlining and community demographics is necessary in understanding the racial inequalities in the distribution of hazardous waste and poor environmental conditions. This was something not evident in individual city action plans.

While this capstone project comes to an end, I hope that this paper can be used to initiate further research into the unequal distribution of air pollution burden in San Diego County. Honestly, I hope this paper can open the conversation on all the issues shared by community members directly and indirectly

relating to air quality. I hope that everyone throughout the county can review this study and be reminded of the importance in sharing their stories. We need more community knowledge to make changes in this built environment. The communities enduring these conditions have a right to be heard, and have the right to breathe clean air.

REFERENCES

- Ahmad, S. (2020). *The lithium triangle: Where Chile, Argentina, and Bolivia meet*. Harvard International Review. <https://hir.harvard.edu/lithium-triangle/>
- American Lung Association [ALA]. (n.d.). *San Diego-chula vista-carlsbad, CA*. American Lung Association. <https://www.lung.org/research/sota/city-rankings/msas/san-diego-chula-vista-carlsbad-ca>
- Beard, S., Freeman, K., Velasco, M. L., Boyd, W., Chamberlain, T., Latoni, A., Lasko, D., Lunn, R. M., O'Fallon, L., Pakenham, J., Smarr, M. M., Arnette, R., Cavalier-Keck, C., Keck, J., Muhammad, N., Wilson, O., Wilson, B., Wilson, A., & Dixon, D. (2024). *Racism as a public health issue in environmental health disparities and environmental justice: Working Toward Solutions - Environmental Health*. BioMed Central. <https://ehjournal.biomedcentral.com/articles/10.1186/s12940-024-01052-8#:~:text=America%20is%20segregated%2C%20and%20so,pollution%20%5B4%2C%205%5D>
- Bernardo, V., Fageda, X., & Flores-Fillol, R. (2021). Pollution and congestion in urban areas: The effects of low emission zones. *Economics of Transportation*, 26–27, 100221. <https://doi.org/10.1016/j.ecotra.2021.100221>
- CBS News 8 . (n.d.). *CBS News 8 - san diego, CA News Station - KFMB channel 8 | cbs8.com*. CBS News 8 . <https://www.cbs8.com/>
- California Air Resources Board [CARB]. (n.d.). *California Air Resources Board*. Advanced Clean Fleets Regulation Summary | California Air Resources Board. <https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-regulation-summary>
- Chicano Park Museum and Cultural Center. (2023). *Guide to the Murals of Chicano Park*. Chicano Park Museum - Logan Heights Archival Project. <https://chicanoparkmuseum.org/murals/>
- City of Chula Vista. (n.d.). *History | city of chula vista*. City of Chula Vista. <https://www.chulavistaca.gov/residents/about-chula-vista/history>
- Clear Seas. (n.d.). *Air Pollution & Marine Shipping*. Air Pollution | Clear Seas. <https://clearseas.org/air-pollution/#:~:text=Ship%2Dsource%20pollutants%20most%20closely,SOx>
- Connolly, M., & Carter, N. C. (n.d.). *Kumeyaay Timeline*. Kumeyaay.com. <https://www.kumeyaay.com/>
- County of San Diego. (n.d.). *Environmental Justice StoryMap Raises Awareness*. Office of Sustainability and Environmental Justice [OSEJ]. <https://www.sandiegocounty.gov/content/sdc/lueg/Office-of-Environmental-and-Climate-Justice/>

Dibble, S. (2023). *Border report: Cross-border Truckers Brace for California's new environmental rules*. Voice of San Diego.

<https://voiceofsandiego.org/2023/05/01/border-report-cross-border-truckers-brace-for-californias-new-environmental-rules/>

New Mexico Department of Health [NMDH]. (n.d.). *Environmental justice definitions*. New Mexico Department of Health. <https://www.nmhealth.org/publication/view/help/309/>

Environmental Protection Agency. (n.d.). *Basic Information about Landfill Gas*. EPA.

<https://www.epa.gov/lmop/basic-information-about-landfill-gas#:~:text=When%20MSW%20is%20first%20deposited,the%20waste%20and%20generate%20methane.>

Environmental Working Group [EWG]. (n.d.). *17 principles of environmental justice*. Environmental Working Group. <https://www.ewg.org/news-insights/news/17-principles-environmental-justice>

General Dynamics [GD]. (2023). *About Us*. General Dynamics NASSCO. <https://nassco.com/about-us/>

GRID Alternatives. (n.d.). *GRID Alternatives- What we do*. GRID Alternatives.

<https://gridalternatives.org/what-we-do>

Ha, S. (2020). Air pollution and neurological development in children. *Developmental Medicine & Child Neurology*, 63(4), 374–381. <https://doi.org/10.1111/dmcn.14758>

IQAir. (n.d.-a). *San Diego Air Quality index (AQI) and California Air Pollution*. IQAir.

<https://www.iqair.com/us/usa/california/san-diego>

Karner, A., Eisinger, D., Bai, S., & Niemeier, D. (2009). Mitigating diesel truck impacts in environmental justice communities. *Transportation Research Record: Journal of the Transportation Research Board*, 2125(1), 1–8. <https://doi.org/10.3141/2125-01>

Kashtan, Y. S., Nicholson, M., Finnegan, C., Ouyang, Z., Lebel, E. D., Michanowicz, D. R., Shonkoff, S. B. C., & Jackson, R. B. (2023). Gas and propane combustion from stoves emits benzene and increases indoor air pollution. *Environmental Science & Technology*, 57(26), 9653–9663.

<https://doi.org/10.1021/acs.est.2c09289>

Le, C. (2019, May 7). *The African American presence in Logan heights- Christina Le*. Studies of Black History at the University of San Diego. Retrieved October 11, 2022, from

<https://sites.sandiego.edu/blackhistoryatusd/2019/05/07/the-african-american-presence-in-logan-heights-christina-le/>

National Archives and Records Administration. (n.d.). *The Great Migration (1910-1970)*. National Archives and Records Administration. Retrieved October 11, 2022, from

<https://www.archives.gov/research/african-americans/migrations/great-migration#:~:text=The%20Great%20Migration%20was%20one,the%201910s%20until%20the%201970s>.

Panteliadis, P., Strak, M., Hoek, G., Weijers, E., van der Zee, S., & Dijkema, M. (2014). Implementation of a low emission zone and evaluation of effects on air quality by long-term monitoring. *Atmospheric Environment*, 86, 113–119. <https://doi.org/10.1016/j.atmosenv.2013.12.035>

PurpleAir, Inc. (n.d.). *Purpleair Classic Air Quality Monitor*. PurpleAir, Inc. https://www2.purpleair.com/products/purpleair-pa-ii?gad_source=1&gclid=Cj0KCQjw8J6wBhDXARIsAPo7QA9RQvxqKijjwdfUsLjyhRzi4fqgT779NjpQ2UNcz7vH35kT2bdfatcaAlCEEALw_wcB

Rios, M. (2022, October 9). *Addressing inequity at Barrio Logan*. UrbanEcology.org. Retrieved October 11, 2022, from <http://www.urbanecology.org/addressing-inequity-barrio-logan/>

San Diego Community Power. (2023b, December 4). *Community power plan (CPP)*. San Diego Community Power. <https://sdcommunitypower.org/community-power-plan-cpp/>

San Diego History Center. (n.d.). *Black Pioneers in San Diego 1880 - 1920 - San Diego history center: San Diego, CA: Our city, our story*. San Diego History Center | San Diego, CA | Our City, Our Story. (2016). Retrieved October 11, 2022, from <https://sandieghistory.org/journal/1981/april/blacks/>

SanDiego.Org. (n.d.). *Chicano park: National Landmark, local treasure*. National Landmark, Local San Diego Treasure. <https://www.sandiego.org/articles/parks-gardens/chicano-park.aspx>

SanDiego.Org. (n.d.-b). *The Black History of San Diego*. San Diego's Black Heritage and Notable Early Residents. <https://www.sandiego.org/articles/history/black-history.aspx>

Smith, J. E. (2017). *Toxic air pollution report finds continued gains*. Tribune. <https://www.sandiegouniontribune.com/news/environment/sd-me-toxics-report-20170125-story.html>

University of Virginia . (n.d.). *Ethnographic research*. University of Virginia . <https://research.virginia.edu/irb-sbs/ethnographic-research>

U.S. Department of Energy [USDE]. (n.d.). *Batteries for Electric Vehicles*. Alternative Fuels Data Center: Batteries for Electric Vehicles. <https://afdc.energy.gov/vehicles/electric-batteries>

U.S. Department of Health and Human Services. (n.d.). *Environmental health disparities and environmental justice*. National Institute of Environmental Health Sciences. <https://www.niehs.nih.gov/research/supported/translational/justice>

Viejas Band of Kumeyaay Indians. Viejas Band of Kumeyaay Indians. (2016, November 8). Retrieved October 11, 2022, from

<https://viejasbandofkumeyaay.org/viejascommunity/kumeyaay-history/#:~:text=The%20Viejas%20Band%20of%20Kumeyaay,in%20San%20Diego%20County%2C%20California.>

Washington, H. A. (2020). *A terrible thing to waste: Environmental racism and its assault on the American mind*. Little, Brown Spark.

World Health Organization [WHO]. (2022). *Household air pollution*. World Health Organization. <https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/household-air-pollution>

Learning from the past and present, how can we implement better water conservation practices for tomorrow's water climate? A Southern California Perspective (with a focus on Riverside County - Inland Empire region)

By

Jon C Colón

Presented to:

The Faculty of Transdisciplinary Engineering for Social Good

Department of Engineering, Sustainability and Health

Shirley Marcos College of Engineering

University of San Diego

For the Degree of Masters in Science for Engineering, Sustainability and Health (MESH)

Under the guidance of:

Dr. Caroline Baillie and Professor Willy Oppenheim

San Diego, California

Mar 31, 2024

Table of Contents

ABSTRACT.....

INTRODUCTION.....

REVIEW OF LITERATURE.....

METHODOLOGY.....

RESULTS AND DISCUSSIONS.....

 Past Practices.....

 Water Resource Policies.....

 Indigenous Practices (Cahuilla Tribe).....

 Indigenous Practices (Hopi Tribe).....

 Present Efforts.....

 California Water Conservation Efforts.....

 Riverside County Survey.....

 Other Regional Efforts.....

 Future Proposals.....

 Legislation.....

 Water Policing.....

 Community Involvement.....

 Reservoir Storage Capacities.....

 Societal Norms.....

CONCLUSION.....

APPENDIX A - Survey Results.....

ABSTRACT

In recent years, evidence of climate change has never been so apparent as we are now seeing its effects on our weather system and environment. Southern California is no exception, as water security has always been a key topic of concern. The Southern California area is naturally a desert region that offers little resources for community growth and relies heavily on resource imports and precipitation. Being that this region is heavily dependent on precipitation, I wanted to learn more about how the Riverside region of the Inland Empire came to be with limited water resources. My initial thoughts were that the indigenous tribes before us had to have practice water conservation methods for them to be able to survive in such a dry and arid area. With a focus on the Cahuilla Tribe, who to this day have called the Riverside area their home, I explored the methods they used to thrive in this region as well as looked to other tribal nations for inspiration. I researched current methods as well in an effort to learn what is working and what is not. I believe we can learn more efficient practices with inspiration from indigenous methods and other regions so that we can implement them into practices that we can use going forward. With the development of newer practices we can then be assured that future generations will be able to benefit regardless of race, religion or income. What I learned in my quest of more efficient water conservation methods is that although we continue to see water levels in our reservoirs drop, through efficient water conservation efforts, we can maintain sustainable water supplies. The key to this is having a social understanding that water conservation is important to practice every day regardless of rainfall totals. In Southern California, water conservation is a way of life that needs to be accepted as a community. With the ever increasing effects of climate change and the unpredictability of our weather, we do not know when our next rainfall will occur. With careful planning and forecasting, we can maintain water security for generations to come.

INTRODUCTION

Due to the exponential increase of greenhouse gasses(GHG), our weather climate is in an ever changing state. Because of this we are seeing extreme weather conditions that are creating Category 5 hurricanes and mass flooding in the eastern areas of the United States. Here in Southern California, although we have seen record rainfall in the past years, our natural underground water reservoirs continue to become depleted, as in 2022 underground reservoir water levels were at their lowest levels ever (Ding, 2022). This has been a continuing trend for the past 20 plus years with it becoming more deficient every year.

In 2022, we saw weather events that were never seen before in the history of California. Record breaking snowfall and rain led to extreme flooding and the returning of historical lakes such as Lake Tulare, devastating existing farmlands for as far as the eye could see. Today Lake Tulare remains despite great effort to disperse the water to nearby farmlands (Cal OES, 2023). However, although we have had all this snowfall and rain, our underground water supply continues to struggle to keep up with the demand.

However, driving through Southern California neighborhoods, you wouldn't know that we are experiencing a water crisis. With the abundance of lush green front lawns and water overflowing into the streets from over watered gardens, you have to ask yourself "Are we really making every effort possible to conserve water?"

Have we done a good enough job educating everyone on how to conserve water?" Although we must realize that some try to conserve, based on the ever depleting reservoirs, we can assume that the majority have no regard to the severity of our water crisis. If we continue down this path of destruction, how do we expect to survive? Who is to blame for this destruction? Do us consumers take full responsibility or are the water authorities responsible? These are all great questions I will attempt to shed some light on.

For this study, I will be focusing on Riverside County located in the California inland empire area, home to the Cahuilla tribe. The area was once home to one of Southern California's largest citrus industries as water was plentiful during the early years of its development. Today, although some orange groves still exist, many corporations including Sunkist have moved to other areas of the country. Being a community that was founded on a large agricultural premise, we still to this day consume large amounts of water. Because of our thirsty appetite, our water supply continues to dwindle. For this reason, we need to find better ways to conserve the water we have. Although our community does have an active water conservation program, we continue to see our water levels decline. For my study, I will explore reasons why this is occurring and try to identify whether stricter regulations are needed or better innovations that can help consumers be more water conscious. I would like to explore other practices that are being implemented in other regions and their effect on the communities they serve in hopes to find better methods that can be adopted in our area. I also will explore the water conservation practices of local tribes as well as tribes of other regions in hopes of being able to adapt their practices in our community.

There may be potential side effects resulting from the use of less water and some industries may be affected. Identifying these potential challenges and mitigating them will help ensure new regulations and guidelines will be just for all. In order to be effective, social acceptance will need to be acceptable to all so that the effort will be effective.

We also have to understand some water regulations that were created over 100 years ago still exist today. Regulations which were created in 1922 during a water surplus year and are still in practice today, have

greatly contributed to our water deficiencies ([Brocius A, 2021](#)). As a result we have been in a decline since its inception.

There are many reasons that can be attributed to challenges that we are faced with today. Throughout the course of this paper, I will attempt to bring to light the many challenges that we face to include proposing possible solutions that help to achieve positive results in our attempt to conserve water in an effort to maintain a sustainable water future in our community.

REVIEW OF LITERATURE

During the creation of my literature review, I was able to gain a better sense of the challenges that needed to be addressed for us to be efficient in our water use. I also was made aware of the challenges that the community will face during our transition into a waterless environment. Maintaining a focus on Southern California, Riverside County area, allowed me to be able to target specific practices in my region that can be further explored so that we are more efficient on our consumption.

To begin focusing on effective practices, we must understand what events put us on this path of self destruction. Having this understanding of where it all began will help us focus and move in a path that will provide clarity of where we are currently and where we need to go. From an article published on the United State Bureau of Reclamation website ([Bureau of Reclaim, 2021](#)) that describes the details of the Colorado River Storage Project as well as the history and present regulatory status of water allocations, I was able to learn more about the project which gave me a better sense as to which states were entitled to water rights from the Colorado River. Southern California is always in a drought regardless of the amount of rainfall we receive. Reading through the article allowed me to understand and learn more about the project's flawed hydrological data that was used to create the Colorado River Compact. With this information, I began to understand why we are so heavily dependent on imported water from the northern and eastern portions of the state.

Water scarcity is a fact that is known by many of the native people that reside in Southern California but most notably known best by the indigenous tribes that were here long before there were any settlements. Most noted were the Cahuilla people who for thousands of years thrived in the dry arid desert area that is known today as Palm Springs. The article written by the Native American Rights Fund (NARF) provided me with more of an understanding of the practices the Cahuilla people were able to use so that they could overcome the challenges of extreme drought conditions. The article described their development of walk-in groundwater wells that were used to provide water during extreme droughts and how they allocated nearby streams for crop irrigation ([NARF, 2022](#)). With this information, I intend to explore these practices further so that I can learn better methods in effort to adapt them to future water conservation standards.

Riverside County is known for its strong roots in the citrus industry. To this day it is considered an agriculturally rich area. Being so, crop irrigation is vital to the livelihood of many in the community. With the information from the article written by [Suetopka, R](#), I was able to learn more about the dry farming practices of the Hopi Tribe, a sovereign nation in north-east Arizona. Their centuries old dry farming technique allowed farmers to plant crops in the driest conditions ([Suetopka, 2010](#)). By spacing out the plants so that they do not compete for the available water in the soil, they were able to grow their crops in the harshest of climates. Learning and understanding water conservation practices similar to those of the native indigenous tribes of our area can provide us with beneficial water conservation practices that can be adopted into modern society.

Per the archived article written on the state of California's governor's website, Governor Jerry Brown initiated the first ever statewide mandatory water restriction. This new mandate required all Californians to cut water use by 20% due to the ever-decreasing water levels in our underground reservoirs. The article was able to provide information that helped me gain a better understanding of the state's water levels. It indicated that California was aware of the critical reservoir water levels and advised consumers of the critical water climate that we were in. During this time, California had no other choice but to mandate water conservation practices as well as advise those who broke these newly instated laws that serious repercussions would follow. This article helped me reiterate the fact that although consumers were aware of the critical state of the water climate many of these laws were ignored and not effective. During the 2015 state-wide water conservation mandate, while reading an article on the Riverside County website, I discovered that the Riverside County Watershed Protection agency issued a water conservation guideline that indicated best water conservation practices in our area. The effort was to save at least 15 gallons of water a day by taking shorter showers, letting your grass grow longer before cutting, planting drought resistant native plants ([Riverside Watershed, 2015](#)) and other practices. Today these are the same guidelines being asked to follow with no new practices implemented. How effective were these guidelines? As I drive through the neighborhoods in my area, I can clearly see that most do not practice water conservation by the indication of all the well-manicured green lawns which can be seen for miles.

In order to gain a sense of understanding of water conservation guidelines, I created an online survey that was sent out to most of my community. With the results of this survey I was able to gain a better sense of the mental state of water conservation in my community.

Another concern was if current water consumers were being made aware of their water usage. How are they being informed of their water usage? I believe this is important to understand as I assume that all water consumers know what their usage is. I think having an understanding of how this will help me identify which practices are needed. For this I turned to my county water bill which had information on our monthly consumption and the rates I was being charged. Mostly what I was looking for was some sort of indication of water usage. I found that a water usage graph as well as tiered rates for over use was made available to me. I think this is important for us water consumers to know as we can learn to cut back on certain usage while maintaining use of water in other areas.

I also wanted to find out if there were any platforms made available to the public that would bring awareness to the current water crisis. I was pleased to find a statewide water conservation partnership program called [Save Our Water](#) which assists water consumers by providing tips on current water practices and the current state of our water climate. This strategic community and statewide program are responsible for spreading the word about water conservation to all Californians. This program is involved in all social media platforms so that water conservation is made aware to all groups of all ages.

While researching future methods and technologies on water conservation techniques, I wanted to find out what other districts were doing in their effort towards water conservation. What I found is that the State of Nevada has developed a model of future innovative ideas for water conservation. The [Las Vegas Valley Water District \(LVVWD\)](#) website contained information of its implementation of a water conservation program that has become a model that others can follow. What I learned is that they have created a water policy that effectively manages their water use. They have hired additional staff known as Water Police, that patrol the streets in search of excessive water use and fine them. Although we have received much rainfall in the past year, the LVVWD still recognizes that we are in a drought and to this day has remained constant

with their water restrictions in effect. In comparison, many communities in Southern California have lifted their water use restrictions.

During my research I came across an article written by the [Western Municipal Water District](#) (WMWD) that describes their efforts to create additional water storage within the water infrastructure of the Santa Ana Watershed. This project would allow for increased underground water storage capacities throughout all water districts in our region. WMWD has been known to be water conservation stewards and is one of the largest water districts here in the Inland Empire (Riverside & San Bernardino Counties). With collaboration from the [Santa Ana River Conservation and Conjunctive Use Program](#) (SARRCUP), they have worked on creating distribution systems that will enable additional underground water to be used all across the region during times of increased drought.

An article that I came across when trying to learn more about how our role in society helps strengthen the trust we have on one another when it comes to water conservation was the article “Social Comparison as a Tool to Promote Residential Water Conservation” written by Wesley Shultz, et al. in 2019. This article described a social model that promotes residential water conservation ([Schultz, 2019](#)) by reviewing a study of residential water customers and the relationship between water reports that were generated for specific customers and their water usage. The study found that those who received the report had a decrease in usage in comparison to previous usage. It also indicated that the behavior of water consumers drives water consumption. This article helped me reinforce the fact that social change is needed to overcome the water shortages we are faced with.

Not only does water conservation take place in the home, but also in your garden. While searching for other methods to conserve water at home, I came across an article “Composting 101” which describes the benefits of composting and how it can help eliminate water waste by reducing our in-home waste through the use of composting. By composting our waste instead of throwing scraps into the garbage we can lessen waste at the municipal level where water is used to break down garbage ([Hu, 2020](#)).

METHODOLOGY

My research has been based on the different methods of practicing water conservation, from past practices to present with a focus on the Riverside County region, a dry and arid area of Southern California. With an understanding that this area was once considered a desert, I wanted to learn more of the changes that were implemented in this area that helped it to become one of the largest citrus empires of our country. To gain this understanding, I looked into water management policies that were put into place to create this transformation. Knowing that California relies heavily on snowfall from the local San Bernardino mountains and Sierra Nevada mountain range, as well as water imported from the mighty Colorado River, my first approach was to look into the [Colorado River Compact](#) of 1922. In the article written by the Bureau of Reclamation, I learned that a flawed policy written over 100 years ago was still in effect today. The flawed information used to create the policy gave way to the drought-like conditions we see today. With the challenge of climate change now driving our water climate, we will continue to struggle with water security which is why water conservation is so important in California and especially in the Riverside County region.

During my research in past practices, I wanted to learn more about the indigenous tribes that thrived in this region. I felt this was important to discover as they were able to survive in such a dry and arid environment for so long. One of my main focuses was on the [Cahuilla Tribe](#) and their techniques. In order to learn more

about the Cahuilla Tribe, I turned my attention to the internet which led me to the Cahuilla Tribe website landing page where I was able to find out more about how they survived in the Riverside County region. The website offered historical information on who the tribe was, how they came to call this area home, and how they lived. When searching for other indigenous tribes in the Riverside County region, I came across another tribe known as the [Hopi Tribe](#) of northeastern Arizona. While the Hopi did not reside in my area, the climate of this area can share similar traits as the Inland Empire and Riverside areas. What I found most fascinating was their 2000 years of practice in dry farming. I believed this to be important to learn as there are many local farms located in the Inland Empire region and that these practices can be taught to the local farmers in effort to help them conserve the water they rely on for growing their crops.

In order to gain a better understanding of how the Riverside community currently considers water conservation, I thought it would be best to create a simple survey that will help me understand the community's perception as to their understanding of water conservation. I reviewed many of my local water agency websites in an effort to learn more about what types of questions they would ask of their water consumers. Having a better understanding of what questions to ask, I developed a simple 10 question survey and posted them on a free well known survey website known as "Survey Monkey" ([SurveyMonkey.com](#)). With the assistance of this website, I was able to send out approximately 50 surveys to members of my community. Appendix A shows the results of my survey. I received many results back from my survey but found that I had to filter out some as they would not have been representative of my area and would have thrown off the percentages. After filtering through the results so that my data set consisted of only Riverside communities (including the Inland Empire), I was able to gain a better understanding of the current state of water conservation practices. With this information, I was able to determine which methods of water conservation practices were most effective and accepted. Taking this information into consideration as well as past indigenous techniques, I can begin to see better ways we can develop water conservation practices for the future that will be widely adopted and easy to implement.

I also looked to other regions that share the same climate as Riverside County. This led me to Las Vegas Nevada where I was able to learn more about the many ways they tackle water conservation in their region. The Las Vegas Valley Water District is responsible for providing water to most of the Las Vegas area where they see tourist visits in great numbers. Being their climate is dry and arid similar to Riverside County, I thought it would be great to learn more about how they conserve water. Researching their website found that they are water conservation stewards with water restriction and regulations that can be adopted here in Riverside County and provide efficient water consumption practices.

Local water agencies should be responsible for enforcing water conservation measures, however it is the responsibility of us consumers to also be conscious of our water consumption. To help us consumers be more aware of our consumption we need to rely on technological solutions. With this in mind, I began to research ways technology can help and what I found was an article on the Los Angeles Department of Water and Power website that provided information of a partnership with the [FLUME](#) corporation. With this article, I was able to identify the effort LADWP was making to educate its customers on the importance of water conservation.

RESULTS AND DISCUSSIONS

Past Practices

Water Resource Policies

One hundred years ago, when the west was in a rapid succession of growth and the demand for water intensified due to settlers finding a new home in California, a new water law known as the Colorado River Compact was written. This law identified the equitable distribution of the Colorado River into two basins, the upper and lower. The upper basin consists of Northern Arizona, Colorado, New Mexico, Utah and Wyoming, while the lower basin consists of Arizona, California, Nevada, lower New Mexico and Utah. This compact established the allotment of water that would be distributed to each state and provided a framework for river management for the years to come ([Watereducation,2022](#)). However, the compact was flawed from the beginning as it used flawed hydrological data that indicated a much higher river flow than what it really was. This was due to a surplus of rainfall that year which did not represent the average, but a peak flow rate. The hydrological data was then revised a few years later, however the allocations that were determined prior remained in effect and are used today making our current water allotment in Southern California much less than what we originally were intended to have. Add this failed policy to our current state of drought, and we can now understand the intensity of the situation that we are in today. Although today's water requirements are much more intense with a booming population and vast number of commercial agricultural farms, it is surprising that we have not run out of water completely.

In 2026, the guidelines that were written over 100 years ago are set to expire making way for a new set of allocations to be established. However, with climate change, the decreasing river water flow and unpredictable rainfall, a showdown between state water agencies is looming ([Brocius A, 2021](#)). With all seven basin states preparing for negotiations of a dwindling water supply, we need to discover better methods of conserving the water that we do have.

Indigenous Practices (Cahuilla Tribe)

For more than 5,000 years, the Cahuilla Tribe has called the Coachella Valley, a dry arid area north of Palm Springs, California, their home. With their special skills and experience, they have been able to survive the worst of drought Southern California has to offer. How were they able to circumvent their demise in such an area that experiences over 130 degree days and months of unreliable water that often is available seasonally at most? The Cahuilla people are stewards when it comes to water conservation. During times of drought, they were able to survive by developing walk-in groundwater wells and used nearby streams only for crop irrigation ([NARF, 2022](#)). They also created rock-lined ditches, dams, to help with storing and channeling water to the reservoirs they created ([NARF, 2022](#)). The Coachella Valley and Palm Springs area is known for its hot springs that still exist today. The Cahuilla Tribe made use of these hot springs for their drinking water and bathing as they were considered to be a spiritual connection to their “nukatem”, or place of ancient spiritual beings and often use them as a place for healing.

What the Cahuilla Tribe knows that many others did not was that under all the layers of sand and gravel lies an immense reservoir of clean pristine water. It is known as the Coachella Valley Aquifer. It is a resource that is seen as sacred by the Cahuilla people which has been adversely impacted by pollution from nearby developments and continuously depleted by the growing popularity of the Coachella Valley area ([NARF, 2022](#)). The aquifer is being pumped out at a rate of approximately 1 foot per year. This poses a threat to not

only complete depletion, but also aquifer collapse. In an effort to offset this threat, local water agencies began importing water from the Colorado River. This created another issue, poor water quality. The Coachella Valley Aquifer is naturally replenished by rainfall and snowpack that filters through the layers of sand and gravel and by artificial pumping water, this is creating a water quality crisis as the Colorado River is naturally turbid. High levels of total dissolved solids that contaminate the river from mining operations upstream of the Colorado are now being introduced into the aquifer which are affecting the health and livelihood of not only the community but the Cahuilla Tribe who have depended on this water for centuries (NARF, 2022).

Indigenous Practices (Hopi Tribe)

With the vast amount of agricultural farming that California has, learning new ways to conserve water while farming is important so that we are not wasting the water we do have. To learn better farming water conservation practices, I turn my attention to the Hopi Tribe of Northern Arizona. The Hopi Tribe has been able to thrive in a region that receives an average rainfall of 12 inches or less per year. Using a 2000 year old method known as dry farming, the Hopi Tribe have been able to sustain their crops using only natural precipitation. What the Hopi have learned from centuries of experience is that by providing the correct amount of spacing between crops and planting at the correct depth, they are able to yield bountiful harvests of corn, squash, beans, melons, peaches and sunflowers all in the dry wash areas of the Hopi Reservation (Suetopka, 2010). The dry farming method is done exclusively by hand amongst family members. This allows for the tradition to be passed down and shared within family members and the community. They grow and harvest an abundance of crops so that they can store them in case of famine or drought (Suetopka, 2010). Agriculture is so significant to the Hopi Tribe that their way of life revolves around agriculture cycles. The techniques that the Hopi Tribe have been practicing for centuries can be adapted to modern farming practices so that their water usage can be limited when growing their crops. Being that California produces approximately 13% of the nation's crops (Carter, 2000), the amount of water consumed for large corporate farms accounts for 80% of the state's water supply (CDWR, 2016). In today's water climate, the techniques that the Hopi Tribe uses can be adopted so that these large farms can begin to use less water while still providing for a profitable crop yield.

Present Efforts

California Water Conservation Efforts

In 2015, then Gov. Jerry Brown created a directive for all Californians to cut water use by 25% which would have saved approximately 1.5 million acre-feet of water or enough water to fill Lake Oroville (Brown, 2015), which has a total capacity of approximately 3.5 million acre-feet of water and is considered the second largest water reservoir in California (DWR, 2024). In 2022, Gov. Gavin Newsom pleaded with Californians to cut their water use by 15% to avoid detrimental effects of the drought (Ding, 2022). However, despite these efforts, the water conservation figures never were realized which led to severe water shortages that at one point would have shut down California's most relied upon resources, the Hoover Dam Hydroelectric Power Plant in Clark County Nevada. Since 2000, water levels in the Lake Mead reservoir have been in a decline and in 2022, threats of the plant shut down loomed as the lake water levels were nearing the 950 foot minimum water level that was required to keep the plant in operation. In 2023, an abundance of rain in early spring raised water levels up to an operational level, however Lake Mead still continues to decline (Skinner, 2022). With the dwindling water levels of the Colorado River which feeds

into Lake Mead, we need to focus our efforts on conserving water and not on finding better ways to increase the supply.

Riverside County Survey

[Riverside County](#) and San Bernardino County are located approximately 50 miles from the California coast and make up the Inland Empire portion of Southern California. Orange County and San Diego County make up most of the coastal communities with some inland regions. Los Angeles contains both inland regions and coastal regions. Dividing the Inland Empire from the coastal communities is the Santa Ana Mountains which act as a climate barrier between the regions.

With the assistance of an online survey provider, [Survey Monkey](#), I created a survey that consisted of 10 questions that were related to water conservation. A total of 50 surveys were sent out and after filtering through the survey so that it would focus specifically on my community including the Inland Empire, I was able to gain a better understanding of my focused area.

From these results I found that most of my community does believe that water conservation is important and should be practiced not only during emergencies but all the time. I do believe that there is a social presence in water conservation among my community and to think otherwise would go against societal norms. Many do believe that our current water climate is at risk due to global warming and regardless of intense rainfall or snowfall this does not change their focus on the importance of water conservation.

The survey results did indicate that most feel that in-home water conservation practices are important and necessary regardless of whether or not you are a homeowner. It also identified that although most still water their lawns with a sprinkler system, some are watering their lawns with smart irrigation systems as well as drip irrigation in their gardens. This is an important question as it is estimated that 80% of our potable water use is used for irrigation ([Hu, 2020](#)). With water rates expected to increase 10% in the coming years, consumers really should consider replacing their lawns with dryscape or native drought tolerant plants as this will help them lower their water usage and costs. My survey also Identified whether or not their neighborhood had a community garden. Community gardens help feed neighborhoods eliminating the need for home gardens and help conserve water usage. It was unfortunate to learn that most did not have one and believe that local governments should assist with setting up a dedicated space for these in every neighborhood. This not only will help with reducing our water usage, but it will also help with food insecurity as well as strengthening neighborhood bonds.

Learning more about my community through the survey responses indicated that the majority of them do not have a swimming pool and rely on community swimming pools during the hot summer months. This was great to learn as swimming pools consume great amounts of water and energy. Swimming pools require regular maintenance that includes refilling water levels and chemicals to sanitize the water. There are many sustainable practices that can be implemented to reduce the impact of swimming pools on the environment. Those being the use of pool covers to reduce evaporation, using environmentally friendly chemicals like salt for chlorination, rainwater harvesting for topping off pool water levels, and recycling used pool water during backwashing so that it can be used for irrigation.

Overall what I learned from this survey is that although I was expecting most to respond that they do practice water conservation, I did also expect some to indicate that they do not. Intentionally I posted this

survey during a large rain storm that was affecting our area in hopes to see if the abundant rainfall would influence the responses in any way. I expected most to indicate that it wasn't necessary as we weren't in a water shortage anymore. I did find out that the majority of the respondents in the age group of 30 to 50 years of age felt that water conservation was important to practice all the time. My survey consisted of only multiple choice questions, however if I were to post this survey again, I would post more open ended questions. What I learned is that those that responded with comments, I was able to capture more insight from those responses. Also, I would ask more questions that pertained to specific water conservation practices. For example, I would like to have learned of those that had a personal garden and if so did they practice composting. I believe if I had posted this survey earlier, I would have received more responses as well as been able to post another with open ended questions. Overall though I do feel the responses were adequate in helping me learn more about my community.

Other Regional Efforts

I also looked into other regions that share a similar climate as the Riverside County community that have been leading the effort to adapt to climate change. This path led me to Las Vegas Nevada. Although our climates are not exactly the same, there is a lot to be learned from the [Las Vegas Valley Water District \(LVVWD\)](#) when it comes to water conservation. The LVVWD has implemented a program that has become a model to what other districts should be focusing on now. They have created a water policy that effectively manages their water use, and fines those who do not comply. They have hired additional staff that will patrol the streets for excessive water use and fine them. However, one could argue that they are not aware of their water usage as many districts do not have a billing system that can educate the customer as to how much water they are using and should not be fined. The LVVWD has taken care of this as they provide a water usage history on their bills so that the customer can monitor their water usage. This is something I believe we can implement here in Southern California as well in effort to find gross water consumers and hold them accountable.

During my research I also learned that the [Los Angeles Department of Water and Power \(LADWP\)](#) has partnered with a company by the name of FLUME corporation. They have created a product that is easily adapted to your existing water meter, and through use of an application on your smart device, it can provide you with your household water usage information. It will also alert you of any leaks in your system as well as excessive water usage. Innovations like this will allow you to better understand your water consumption as well as allow for better management of your consumption.

These types of innovations are needed so that water districts can give the consumer the ability to be better water managers in their home and become more aware of their consumption. However, at a cost of approximately \$250 this makes devices like this unattainable for many. Fortunately, through a partnership with the LADWP, all account holders can receive an incentive making their cost only \$49 making it much more affordable. With better incentives for innovations similar to this, we can be assured that this technology would be affordable to all regardless of income.

Future Proposals

Legislation

Recently the California Department of Water Resources announced that they have approved a proposal that will allow sewage water to be treated for use in drinking water. It is dubbed "Toilet to Tap" ([Becker, 2023](#)).

This new measure will allow all untreated wastewater to be treated for reuse as potable water. This is not a new measure for other states as Colorado and Texas have already been using this practice to treat wastewater. Through an extensive filtration process, California will be able to recapture wastewater that would otherwise have been flushed out to the ocean. However, the high cost involved in treating the wastewater will limit this technology to large urban water producers (Becker, 2023). With the ever advancements in technology and process improvements, the costs will be reduced allowing smaller water systems to adopt this technology and become widely available to all. Also, this measure is not meant to replace existing practices of water production but provide a supplemental resource for times of drought. During droughts, the wastewater that is produced will have a chance to be recaptured for treatment and reuse. Currently this process is much more expensive than simply importing water from another region outside of California, in the long term this will provide for a much more resilient water source as it will decrease our dependence on imported water. As climate change continues to cause disruptive weather patterns and water sources dwindle this technology will provide a reliable water source for California (Becker, 2023). Water conservation measures like this in addition to standard water conservation practices will help us secure a reliable and sustainable water supply for future generations.

Water Policing

Another proposal for ensuring that we are conserving water would be to impose fines on those who over consume water. Similar to the Las Vegas Valley Water District (LVVWD), fines can be imposed on overconsumers. With the aid of neighborhood volunteers, similar to a neighborhood watch program, residents can be given the initiative to report any misuse of water in their community. This helps with conserving water as well as allowing for the creation of a positive water standard in society. In turn this would strengthen the bond in neighborhoods and encourage compliance within the community.

Community Involvement

Speaking of community compliance, another proposal would be to implement educational workshops at local community centers or nurseries. This would be a great way to provide education on water conservation and its importance. With dedicated staff and water conservation specialists, these workshops could assist the community in applying for any water conservation incentives or credits. There would be guest speakers from local tribes, corporations, or nurseries that would educate the community in water conservation techniques that can be used in today's water climate. I believe that these workshops would be free to the community so that everyone can participate regardless of income.

Reservoir Storage Capacities

Western Municipal Water District (WMWD) is planning for future drought impacts by proposing to increase the capacities of all water reservoirs in their district. This proactive approach will allow for them to raise intake towers at the reservoirs in effort to allow more water to collect. With the anticipation of excessive snow and rainfall due to climate change, Western is hoping that the reservoirs will be able to absorb this additional water ([Western, 2024](#)). In collaboration with the [Santa Ana River Conservation and Conjunctive Use Program](#) (SARRCUP), they have created a regional groundwater banking initiative that will help develop the infrastructure needed to distribute the banked water across regional boundaries. This will assist in providing a more resilient and efficient water supply system in the region (Western, 2024). WMWD understands the importance of capturing as much of the water as they can during these extreme rainfall events in an effort to avoid the catastrophic drought conditions that we experienced in the past. This effort shows similarity to the Cahuilla Tribes effort in capturing rainfall in the underground wells which were used

only during drought conditions. WMWD are known as regional leaders in water conservation as they believe in working with key stakeholders at all levels. They understand the importance of water conservation and their leadership in these efforts will help California develop water conservation practices that provide sustainable solutions for all water needs.

Societal Norms

The Journal of Agricultural Education indicates that “Attitude toward water conservation refers to the degree to which a resident has a positive or negative attitude toward water conservation” (Chaudhary, 2017). Humans are creatures of habit, and water conservation is a habit that needs to be practiced in order for it to be adopted into society. Our habits are influenced by many different factors that can provide us with the right motivation to change that behavior. These factors can be personal in that our age, education level, and income all play a role in determining our behaviors and habits. Strong motivation towards changing a behavior can be influenced by social behaviors. The need for social acceptance in a community can be an example of such influences, as one would not want to be an outlier in their community in fear of being seen as the social outcast. Social acceptance plays a large role in creating a good attitude or behavior towards water conservation. If you can show that conserving water is a socially responsible behavior that can be rewarding to some as well as offering financial assistance and incentives to those that show good judgment in water conservation.

CONCLUSION

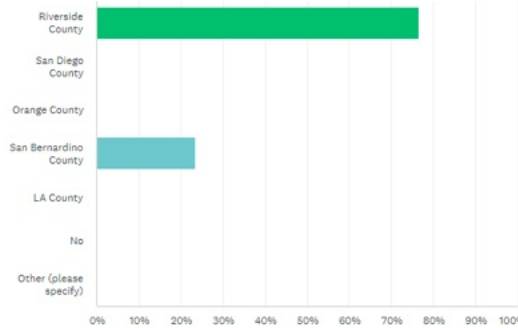
With the ever advancing climate change and the unpredictability of weather events, it has never been so apparent that stricter water conservation standards are needed now. Riverside County, as well as the rest of the Inland Empire, has experienced a wide variety of unpredictable weather patterns. At the time of writing this paper, our rainfall seems to be very abundant. We cannot take this for granted as we do not know when the next rain will come. Although my research has shown that water conservation practices are being practiced in my community with the unpredictability in our climate, present day techniques are not enough. Lessons from the Cahuilla Tribe of Agua Caliente as well as the Hopi Tribe of Northern Arizona can be taught in an effort to adapt to the challenges that lie ahead. Mastering techniques learned from indigenous traditions will allow us to secure a water climate that is sustainable and just for all. Local water agencies and districts, with larger budgets, can offer better incentives to water consumers that allows consumers to acquire the latest technologies and practices needed to make them better informed of their water usage. Other regional practices can serve as an example to our community and provide empirically based data that allows for implementation of proven practices. Examples such as those learned from the Las Vegas Valley Water District can be adopted here locally so that water consumers are held accountable for their water usage. Stricter irrigation guidelines should be implemented with dedicated outdoor watering days and quantities. The efforts being made by our local water district, Western Municipal Water District, should be followed by other agencies in our community so that excessive rainfall can be collected and used during the drought season. In Southern California, water conservation should be a way of life regardless of the rainfall we receive. As our global temperatures continue to increase, so do the uncertainties of our water climate. Water conservation is no longer optional, but a requirement..

Water is life...

APPENDIX A - Survey Results

Q1. Do you live in Southern California?

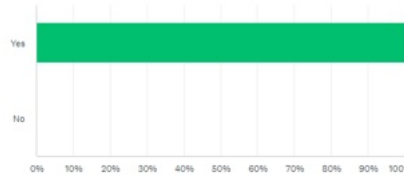
76.47% - Live in Riverside
 0% - Live in San Diego County
 0% - Live in Orange County
 23.53% - Live in San Bernardino County
 0% - Live in LA County
 0% - Live outside of Southern California



County

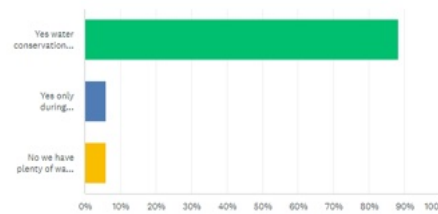
Q2. Do you practice water conservation?

100% - Yes
 0% - No



Q3. Do you feel it is necessary to practice water conservation in today's water climate?

88.24% - Yes water conservation is important to the time.
 5.88% - Yes only during emergency drought
 5.88% - No, we have plenty of water because of

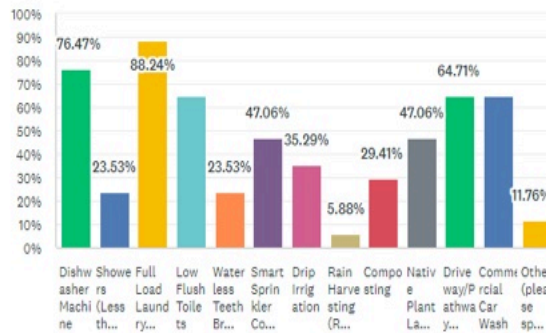


conservation

practice all situations. all the rain.

Q4. The list below identifies water conservation practices. Please check which methods you practice at home and work:

76.47% - Dishwasher
 23.53% - Showers (Less than 5 minutes)
 88.24% - Full Load Laundry Washing
 64.71% - Low Flush Toilets
 23.53% - Waterless Teeth Brushing
 47.06% - Smart Sprinkler Controller
 35.29% - Drip Irrigation
 5.88% - Rain Harvesting (Rain Barrel,



etc...)

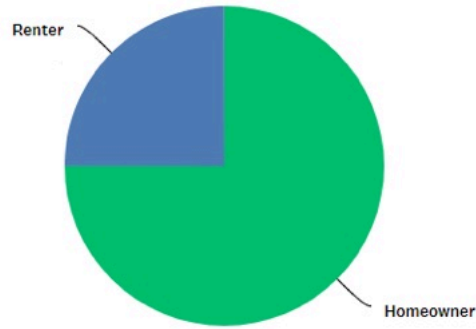
- 29.41% - Composting
- 64.71% - Driveway/Pathway Sweeping (instead of hosing down)
- 64.71% - Commercial Car Wash
- 11.76% - Other (See responses below)

Other responses:

Commercial Car Wash depends, but limits the usage amount of water when doing home car wash. Native plant landscaping in portions of the yard, but not everywhere yet. Planning to upgrade toilets for efficiency and conservation.

Q5. Are you a homeowner or renter?

- 75% - Homeowner
- 25% - Renter

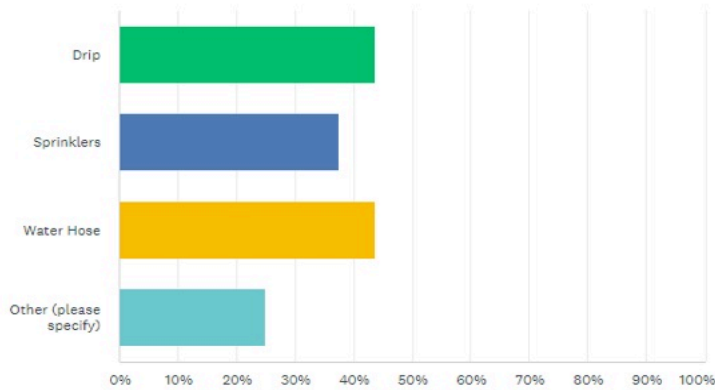


Q6. Do you have a garden or fruit so, do you water with: (check all apply)

- 43.75% - Drip Irrigation
- 37.50% - Sprinklers
- 43.75% - Water Hose
- 25% - Other (Please specify)

Responses:

Bucket/Watering Can/Root Watering



trees? If that

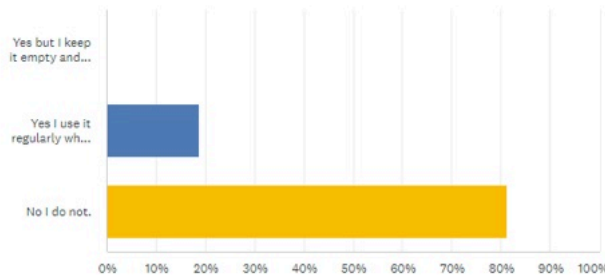
Q7. Do you have a community

- 5.88% - Yes and I help contribute
- 5.88% - Yes, but I do not help contribute
- 88.24% - No we do not



garden?

Q8. Do you have a swimming

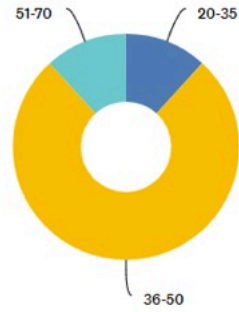


pool?

81.25% - No I do not
18.75% - Yes, I use it regularly when I can
0% - Yes, but I keep it empty and protected

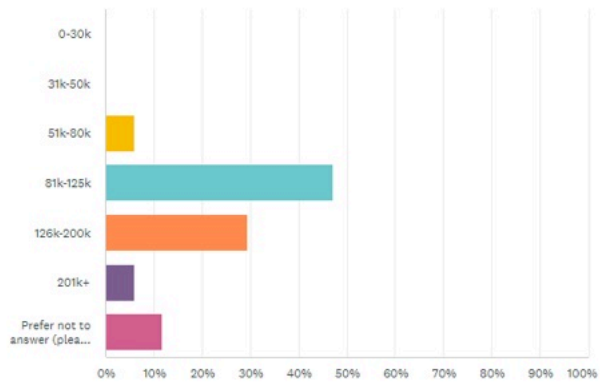
Q9. What age group are you in?

0% - 10 to 19
11.76% - 20 to 35
76.47% - 36 to 50
11.76% - 51 to 70
0% - 70+



Q10. What income bracket do you fall in? (Check all that apply)

0-30K - 0%
31k - 50K - 0%
51K - 80K - 5.88%
81K - 125K 47.06%
126K - 200K - 29.41%
201K+ - 5.88%



Bibliography

- Native American Rights Fund. (2022, October 9). Agua Caliente Water Rights Confirmed. <https://narf.org/cases/agua-caliente-v-coachella/#:~:text=The%20Cahuilla%20people%20developed%20walk,ancient%20Cahuilla%20ways%20and%20knowledge.>
- Suetopka, R. (2010, June) Hopi Farmers continue to utilize centuries-old dry farming methods. Retrieved October 20, 2022, from <https://www.nhnews.com/news/2010/jun/29/hopi-farmers-continue-to-utilize-centuries-old-dr/>
- California, S. of. (2015, April 1). Governor Brown directs first ever statewide mandatory water reductions. Governor Edmund G Brown Jr. <https://archive.gov.ca.gov/archive/gov39/2015/04/01/news18913/index.html>
- Watershed, R. C. (2015, December 15). How can I conserve water? - riverside county watershed protection test. Riverside County Watershed Protection. <https://rewatershed.org/2015/12/15/how-can-i-conserve-water/>
- Schultz, W., Javey, S., Sorokina, A. (2019, July 10). Social comparison as a tool to promote residential water conservation. *Frontiers in Water*. Retrieved September 26, 2022, from <https://www.frontiersin.org/articles/10.3389/frwa.2019.00002/full>
- Hu, S. (2020, July 20). Composting 101. NRDC. Retrieved September 26, 2022, from <https://www.nrdc.org/stories/composting-101#benefits>
- California, S. of. (2023, September 1). Tulare Lake updates – September 2023. Tulare Lake Updates-September 2023 | CalOESNews. <https://news.caloes.ca.gov/tulare-lake-updates-september-2023>
- Riverside, C. (2013.). History of riverside. Riverside, California | City of Arts & Innovation, <https://www.riversideca.gov/visiting-aboutriv.asp#:~:text=History%20of%20Riverside,was%20once%20a%20Spanish%20rancho>
- Ariana Brocious, A. P. M. L. P. (2021, March 19). A Colorado River Showdown is looming. Let the posturing begin. *AZPM*. Retrieved October 21, 2022, from <https://news.azpm.org/p/newsfeature/2021/3/23/191619-a-colorado-river-showdown-is-looming-let-t-he-posturing-begin/>
- Johnston W, Carter H. 2000. Structural adjustment, resources, global economy to challenge California agriculture. *Calif Agr* 54(4):16-22. <https://doi.org/10.3733/ca.v054n04p16>
- California, State. (2024, January 30). Lake Oroville Operations Update -- January 30, 2024. Department of Water Resources. <https://water.ca.gov/News/Blog/2024/Jan-24/Oroville-Operations-Update-1-30-24>

- Brown Jr, Edmund G (2015, April 01) Governor Brown Directs First Ever Statewide Mandatory Water Reductions, Office of Governor,
<https://archive.gov.ca.gov/archive/gov39/2015/04/01/news18913/index.htm>
- Ding, Jamie (2022, May 7); California's water conservation has been a bust so far. Will drought restrictions work? Los Angeles Times
<https://www.latimes.com/environment/story/2022-05-07/why-has-water-conservation-in-california-been-a-bust-so-far>
- Skinner, A. (2022, November 21). Hoover dam brings electricity to 1.3 million-it's at risk of shutting down. Newsweek.
<https://www.newsweek.com/hover-dam-brings-electricity-1-million-risk-shutting-down-1760762>
- Becker, Rachel (2023, December 19); California Approves rules that turn sewage into water, Calmatters.org;
<https://calmatters.org/environment/2023/12/california-rules-turn-sewage-into-drinking-water/>
- Western, Water (2024, February 14) Western Water Launches Groundwater Storage Program; Western Municipal Water District <https://www.wmwd.com/CivicAlerts.aspx?AID=417>
- Herberger, Michael (2014, June 01) Urban Water Conservation and Efficiency Potential in California; Pacific Institute www.nrdc.org/sites/default/files/ca-water-supply-solutions-urban-IB.pdf
- Bachu, Rajeshwar (20203, April 12) How Swimming Pool are Harming the Planet and Causing a Water Problem?; LinkedIn
<https://www.linkedin.com/pulse/how-swimming-pools-harming-planet-causing-water-rajeshwar-bachu>
- Reclamation, B. of. (2021, August 19). *Interior region 7 • upper colorado basin*. Colorado River Storage Project | UC Region | Bureau of Reclamation. <https://www.usbr.gov/uc/rm/crsp/index.html>
- Chaudhary, Anil K., Warner Laura, et. al.; Using the Theory of Planned Behavior to Encourage Water Conservation among Extension Clients; Journal of Agricultural Education, 58(3), 185-202
<https://doi.org/10.5032/jae.2017.03185>



From Observations to Action: Breaking Beyond the Paradox of Unsustainable Food Conditions

An Urban Lower-Income Story

Ceon Heck 4/14/24 ESH 540: Capstone

Table of Contents

Abstract	
	...
Introduction	
 Literature
Review	
Literature: Food Access.....	
Literature: Food Literacy.....	
Methodology	
....	
Questioning.....	
...	
Epistemology.....	
Applied Methodology.....	
Drawing Conclusions.....	
Results &	
Discussion	
..... Observations: Object	
Analysis.....	
Observations: Photo Diary.....	
Observations: Compare & Contrast.....	
Increasing Recognition & Polyvocality	
Increasing Polyvocality.....	
Survey Results	
Summary	

Abstract

The road to sustainability requires enduring technological shifts, system changes, and, most importantly, the test of time. This journey emphasizes endurance and adaptability, and with the absence of these tools, managing loads could prove impossible, therefore increasing risks of vulnerability. Unfortunately, recognizing these vulnerabilities and gaps within a community is not always apparent, especially to those living within these conditions. Questions are then raised about the responsibility of addressing these challenges. Should informed actors be the primary custodians of marginalized community development? Certainly, they are pivotal in the construction of the broader aspects of society, but what about addressing the intricacies that produce unsustainable/poor conditions? Implications towards the concentration of power suggest that further investigation regarding underserved community development must ensue for sustainable transitioning.

Within the complexities of systems lie systematic inequalities, poor behaviors, and juxtaposing elements that lend to inefficiencies and a flailing planet. The above factors compose a more detrimental state of affairs that celebrates these elements, breeding complacency, dictation, and destruction. Left unchecked, these affairs will become the dominant narrative, resulting in global vulnerabilities. The Unsustainable Matrix emerges from this skewed perspective. Subsequently, this produces a paradox where root causes are disregarded in favor of profit, untethered control, and predominant narratives/biases under the guise of freedom, liberty, and justice. This exact reference perpetuates poor conditions amongst Urban Lower-Income (ULI) communities.

The following study scrutinizes one aspect that contributes to the Matrix's prolongation: the unsustainable food conditions within ULI communities. This investigation discovered that ULI communities could experience improvements in their vitality, community resilience, and development if they engaged in sustainable practices that lend to liberation and polyvocality. Observations and critical reflections were evaluated to ensure these measures were met and that sustainability remained steadfast in dismantling the Unsustainable Matrix.

Project Introduction

The need for fundamental rights is at the forefront of social development. We have seen many social movements within the last five years focused on improving the conditions in which people are treated, whether through prejudice reconstruction, rehabilitated laws, or opposition to war efforts. People have been outspoken about their most passionate issues and have found solace in their ability to incite change. Speaking up is slowly transitioning from taboo to a societal norm. Well, at least on the surface. Many unforeseen issues lie within the macroscopic (surface social injustices), and if not critically analyzed, many issues may continue to flourish under the guise of development.

Allow me to elaborate. Put simply, their concerns tend to address symptoms rather than delving into the root causes beneath the surface. There are a few reasons for this revelation. One of the reasons why the root causes are not being addressed is people's selective outrage. People get too caught up in the macros or specifics of an issue that they

forget to analyze properly, leaving many stones unturned. We later discover that imagery lends to this habit. Moreover, root causes are neglected due to people's unwillingness to entertain the unknown. Instead, they are comfortable with allowing things to stay the way they have been for generations, which breeds complacency within the Unsustainable Matrix/Paradox. This underscores the urgent need for critical analysis of social injustices, a key focus of my research project.

Here is where the subtleties of speaking up come into play. "Should I say something about these issues?" "If I do, things may look drastically different." "Would my family and friends perceive me in a different light?" "I am not ready to be outcasted from my society."—These are a few internal dialogues people may have concerning the notion of speaking up/out, and they are not wrong for having their doubts. It is in human nature to be a part of social acceptance. My only discourse with allowing these doubts to dictate your actions is the concern for planetary health.

To achieve positive planetary health, every system on this planet must be ensured; this includes the health of humans, animals, plants, water bodies, air, and soil. So, in securing healthy systems, we must not overlook the subtleties or microscopies that make up our world. We must fight our urge to disavow the root causes of societal issues and be willing to highlight the voices of the small guy (those subtleties and microscopies). By embracing the voices of all individuals and their unique systems, we can achieve authentic justice and promote positive planetary health, ultimately liberating ourselves from the constraints of the Unsustainable Matrix.

Embracing this philosophy, my project seeks to do just that: improve planetary health and injustices by highlighting the voices of communities that are heard but not heeded and, in turn, address the issue that is the Unsustainable Matrix/Paradox. It is my belief that the climate struggles we are facing are not solely the responsibility of affluent communities, which, as of now, dictate the narrative by controlling knowledge, remediation, and allocation of climate related problems, but are the combined responsibility of all communities that make up the Anthropocene. Excluding communities from these talks and decisions only proves detrimental to achieving planetary health, especially since each community plays an essential role in the planet's ecosystem.

Within each community, there is knowledge to be unearthed, alongside root causes to be addressed concerning a healthy and equitable planet. My project considers these factors; it understands that far cries may be heard by going through one ear and out the other, and it supersedes the idea of minuscule, an idea that flourishes under the Unsustainable Matrix/Paradox. Nothing or no one should be written off as too small for consideration, whether it is consideration of advice or help; voices must be highlighted.

You will find in my effort to improve the conditions of Urban Lower-Income (ULI) communities by introducing sustainable food practices that I consider the subtleties of the root causes for these communities' disparities. I dive into the microscopic view of these communities' unsustainable food practices and examine ways to improve their community's and overall planetary health. This time, I will spearhead a social movement to tackle the

concept of the Unsustainable Matrix, paving the way for creating a comprehensive framework that could serve as a blueprint for advancing ULI community development and analysis.

Literature Review

Introduction

Poor food access and knowledge create unsustainable conditions for Urban, Lower Income (ULI) communities, thus perpetuating the reality of the Unsustainable Matrix/Paradox. You will find that some communities develop disparities from lack of resourcefulness and education, not at their demise, but because there has not been further investigation into their developing conditions. These conditions are viewed as a standard characteristic, yet are a fallacy not supplemented by facts but built on discrimination and lies.

First, food access, whether oversaturation to unhealthy foods or lack of access to healthy foods, negatively affects a community's health, increasing its vulnerability. Secondly, food knowledge/literacy determines consumer behavior, which in turn affects how communities respond to food access. This, too, influences the community's ability to sustain itself or its resilience. While both factors are independent determinants of poor food practices, they are interdependent when considering the root causes of ULI community vulnerability.

The resources gathered in this literature review are referenced to support these two factors that contribute to unsustainable communities and the perpetuation of the Unsustainable Matrix: poor food access and poor food literacy. Within the referenced materials, you will find that I draw parallels between the problem statement and my observations by gathering materials/data that aid the problem identification, solutions, and potential benefits of solution implementation. Framing my work as such allowed me to construct an if/then statement that revolves around the theory of proposing my findings for further investigation and possible solution implementation. So, when obtaining my reference materials, I included information that mirrored my observations of my local ULI communities. In addition, I found data that highlighted health concerns, geospatial access, and socioeconomic demographics. Note that some data is specified to the community, while other sets reflect the whole city, state, or nation.

Literature that Supports Food Access

Obesity is at the forefront of American development. As the country continues its path to economic dominance, consumer behavior reflects the people's need for convenience.

Moreover, the need for instant gratification can be reflected in American work ethics. America is a country that prides itself on working primarily to increase socioeconomic status. Here is the correlation between American work ethics, instant gratification, and obesity. The more an individual works, the less time they have to maintain a healthy body.

Individuals then find solace in convenient or instant products/nutrition. Overconsumption of these fast foods leads to unhealthy bodies and obesity. So, if you come from a low socioeconomic background, you must work long hours to support yourself and your family. This leaves little time for cooking meals that contain proper nutrition. Thus, the individual relies on unhealthy fast-food options.

However, what if socioeconomics was not the only determinant of fast-food consumption? What if access played a role in developing high-obesity neighborhoods? The lack of access to healthy foods is referred to as a food desert. Food deserts also contribute to poor food nutrition and obesity. The development of food deserts began in the 1950s with the onslaught of suburban communities (Jin et al.; Y., 2021). During the 1970s and 80s, US cities underwent a major transformation, referred to as the “urban crisis” (Jin et al.; Y., 2021). Within this urban crisis, American middle-class citizens fled the inner cities for more affluent suburban neighborhoods; soon following them were fresh supermarkets and groceries (Jin et al.; Y., 2021).

The change left lower-income families to fend for themselves in the inner cities. These residents needed a supplemental nutrition option that catered to their needs, affordable and convenient. In response to this revelation, fast-food industries began inserting themselves into these communities. Fast foods brought high-calorie, energy-dense, convenient, and affordable foods into the inner cities. The people’s reliance on these options exploded the fast food market, which created communities saturated in unhealthy, convenient food options referred to as food swamps (Jin et al.; Y., 2021).

Since the urban crisis, there have been new developments in American cities. We see middle- and even upper-middle-class individuals return to the inner cities. So, now the question is whether geospatial access alone determines food swamps/deserts. The evidence shows that in coupling with socioeconomics, race, and ethnicity contribute to the development of poorly planned food areas. While we understand that obesity is America’s problem, there are indications that health disparities and obesity affect individuals of color and lower-income more substantially (James P. et al., 2014).

Research has been explored to determine whether increased access to unhealthy foods follows minority and socioeconomic trends. Though knowledge of the overall distribution of fast-food establishments around the nation is limited, fostering understanding between minority obesity rates and fast-food access can help determine an intervention area (James P. et al., 2014). Studies using Census Block Groups (CBGs) were conducted to calculate the distance from residents to the five closest restaurants. The results showed that areas with higher concentrations of poverty and minorities had greater access to fast food (James P. et al., 2014). Overall, the analysis of data used in the study was based on national data from the CBGs and found that higher access to fast foods was linked to higher concentrations of minority residents and persists regardless of population density (inner cities) and poverty (socioeconomics) (James P. et al., 2014).

Further implications reinforce the nation’s obesity problem, claiming that 35% of adults in the US are classified as obese (Cooksey-Stowers K. et al., 2017). However, there are disparities within these numbers; higher obesity rates are found among minorities and low

income individuals, and even geographics play a role in obesity statistics. Again, we see that food access determines an individual's chances of engaging in unhealthy food habits. Food swamps, areas where unhealthy food options outnumber healthy alternatives, are shown to be relatively closer to lower-income, racial-ethnic minorities (Cooksey-Stowers K. et al., 2017). The study examines the relationship between obesity rates and food swamps within the US by considering the occurrence of frequent fast-food locations within high-obesity areas. Researchers claim that food swamps can act as a predictor of potential obesity environments (Cooksey Stowers K. et al., 2017).

If food swamps can indeed predict high obesity rates, it is pertinent that measures be taken to alleviate potential health risks. Suggestions to reduce food swamps are recommended through zoning reevaluation, in which future zoning regulations define specific zoning policies regarding fast-food restaurant developments (Cooksey-Stowers K. et al., 2017). In all, the recommendations do not suggest that limiting unhealthy food options is enough to quell food insecurities, but with the insertion of new healthy alternatives, obesity rates should decrease (Cooksey-Stowers K. et al., 2017).

Literature that Supports Food Comprehension/Literacy

Food accessibility is only one-half of the equation. When tackling the root causes of unsustainable food conditions amongst ULI communities, considerations for consumer behavior must be evaluated. Why or why aren't people engaging in healthy or unhealthy dietary habits? Of course, access plays a role in food engagement. People will consume foods that are near to them; if they are near fast foods, they are more likely to engage in their consumption, and vice versa for healthy food alternatives.

However, what happens when consumer behavior does not reflect access? What about when people are given opportunities to consume healthier foods but choose to still engage with unhealthy, convenient junk foods? In this situation, access no longer poses a problem. Knowledge of foods and their nutritional values and benefits become the underlying issue. Consumer behavior is not solely defined by geospatial access. Perhaps these individuals are near fresh markets but cannot afford to purchase healthy alternatives. Instead, given their incomes, they are coerced into purchasing convenient, unhealthy options.

While this may very well be the case for individuals who may have fallen on hard times (meaning they were not always within a low socioeconomic position), this statement holds little merit to individuals who were born into low socioeconomics. Those consumers have been taught to engage in affordable, convenient food options due to circumstances that left little to no room for nutritional education and food literacy. It is the idea that "we eat these foods to survive, not to thrive." Furthermore, for all it is worth, adults who learn food literacy as they mature still engage in poor food choices because they are comforting (a part of habit).

If these nuances were not the case, then there would not be any explanation for America's hunger-obesity paradox. Studies have shown that despite the increase in US obesity rates, there are still many food-insecure households. This phenomenon particularly affects lower-income communities (Wiig K. et al., 2009). One might associate food insecurity

with hunger and the lack of food intake, but food insecurity also considers the nutritional intake of foods. So, suppose an individual is eating foods high in unsaturated fats that contribute to health implications and is not receiving the proper nutrients for a healthy body. In that case, they fall under the umbrella of food insecurity – their food insecurity contributes to malnutrition. Also, within the hunger obesity paradox, there is the notion that adolescents of low socioeconomic status may experience hunger within their formative years, which leads to them overindulging in foods as adults (Wiig K. et al., 2009)—both iterations of the hunger-obesity paradox hint at why consumer behavior and obesity are tied to socioeconomics.

The government's response to low-income food insecurity was to provide citizens with funding for food purchasing. On paper, this effort may seem helpful in reducing malnutrition. Low-income consumers can afford to buy healthy alternatives with funding assistance. In reality, this assistance only helps alleviate food insecurities for some. Many within this system fall victim to poor food literacy – they, in turn, continue to purchase unhealthy foods out of habit.

Wiig et al. (2009) suggest that purchasing prioritization for low-income families relies on a few factors:

- **Fulfillment**—How do these foods satisfy appetites? Foods with higher starch concentrations provided more sustained energy and were more fulfilling than fresh produce.
- **Storage**—Food shelf life is important in low-income households because purchasing frequency is limited due to inadequate funds.
- **Children-** influence purchasing in two ways.
 - 1) The parents purchase what the children like, regardless of nutritional value. Again, the notion that no food goes to waste is important to low income households.
 - 2) The parent purchases quick/ convenient foods that the child could cook themselves. Parents in these situations are often overworked, and once they get home, they do not have the energy to cook a complete nutritional meal.

Conclusion

Evidence throughout this literature review has shown that food access and food literacy are responsible for unsustainable food conditions. In addition, a few variables determine whether unsustainable food conditions persist. These variables include but are not limited to socioeconomics, race, gender, and geography. Understanding how these variables influence poor food planning helps delineate between coincidence and negligence.

Data later reinforces the idea that specific communities are neglected due to these

variables and subsequently targeted because of the exact specifications. However, one may argue that data or the lack of data shows that the targeting or placement of certain establishments is random. To that end, further investigations into trends should be conducted. For example, what are the predictors or precursors for establishment placement? Moreover, why are these locations preferred? Are site selections determined by engagement or demographics? If so, why is engagement with these establishments high? – The literature within this review answered several of these questions. Still, there are gaps that require further investigation.

Thankfully, drawing parallels between food consumption behaviors and food access can be made if observed references and health implications are compared – are high obesity rates attached to these particular foods? Does this establishment offer these foods? What are the alternatives within this area? Discovering the link between food nutrition, food choices, and establishment placement assists in fleshing out particulates within unsustainable food conditions and their persistence.

To that end, literature that supports potential solutions and their benefits will follow similar trends. Trends that reference the effects of proper food access and education would be evaluated to the extent that supports health and resource equity – prime indicators of resilient communities. After these evaluations, comparisons between relevant data of affluent communities (with strong community resilience) and lower-income communities will be made.

Here is where the relevancy of my work shines; the literature within the review only accounts for food access or food knowledge/consumer behaviors and seeks solutions from their respective perspectives. As I mentioned, both of these factors are interdependent. A bridge must be drawn between the two to understand what solutions are necessary and why the implementation of these solutions is essential for the community, planetary health, and liberation from the Unsustainable Matrix.

Methodology

The Questioning

At the forefront of any methodology comes questioning. We must ask ourselves and our targeted audience questions that further the discussion. My project was no exception. I began my journey to rectify ULI communities' unsustainable conditions by questioning the nuances that allow them to persist and how to ensure sustainable measures are met. In pursuit of these questions, I found myself questioning everything. What I thought to be absolute turned out to be questionable, and what I thought to be questionable was still very much questionable, but instead, it was layered. What was once one substantial question was then broken into smaller questions followed by more questions. Despite undergoing what seemed to be a carousel of questions, I realized that approaching research as such was better this way – for the truth is only unveiled when we seek multiple perspectives, shared experiences, or questions. Furthermore, living in absolutes is detrimental to progression and understanding. As I battled with perceived truths, I witnessed an awakening in my approach to knowledge comprehension (epistemology) and research. Subsequently, I asked several

questions as I fleshed out my project. These questions included but were not limited to the following:

1. Who do I want my research to reach?
2. Why should I research these topics (Sustainability and ULI)?
3. How do I ensure my research touches many people, not only informed and inquiring minds?
4. Who benefits from my research?
5. Why am I invested in these topics?
6. Where do I see this research taking me?
7. What is the longevity of this research? Will it contribute to society?

While I explored these questions, a few things became apparent. First, the center of my research was the community. However, I found there were many emphases on myself. Although these emphases were unintentional, they did persist. I had to be careful not to tell a single-sided story. Secondly, my project's engagement was determined by how I presented my findings/research, meaning I had to emphasize creativity. Finally, the success of the project, which is determined by engagement, impact, and longevity (i.e., being foundational for other research), was closely tied to the project's methodology.

Relevant Epistemology

Understanding epistemology can be complicated. It is difficult for most to understand how they have reached the truths or narratives they have reached. I had to come to this realization as well. How was I arriving at my conclusions? What makes these conclusions valid? I understood there is a small quantity of selfishness within most of us that would instead back our findings with, "It is true because I have experienced it and because I say it is true." Unfortunately, that is not how validity works. For something to hold validity, it must be backed by evidence. This evidence could be something as simple as having shared experiences. You observed something, and several others observed the same, bringing you all to similar or even exact experiences.

To help me understand the form that my epistemology took, I turned to Bengtson & Barnett's (2020) "The Four Pillars of Philosophy in Higher Education," which states that there are four epistemology philosophies within higher education. These four pillars are as follows:

1. Knowledge
2. Truth
3. Critical Thinking
4. Culture

In other words, these four philosophies can influence our epistemology (how we derive our research and findings).

- **Knowledge** – we form links between academics and observations.
- **Truth** – we seek the truth amongst academics and perceived truths.
- **Critical Thinking** – we address the degree of critical assessment within higher education research.
 - **Culture** – we seek the possibility that our research could contribute to societal development, albeit mediating between differences in values or beliefs.

In the case of my project, I found that all four philosophies were relevant, although I had a slight preference for *knowledge* and *critical assessment*.

Applied Methodology

Relevancy within my epistemological approach was primarily geared towards knowledge and critical assessment. I considered both of these philosophies when developing my methodology, though I did not realize until afterward that this was done subconsciously and not with intent. My methodology began with a hands-on and experimental approach, which emphasized making and comparing observations, followed by a critical assessment. Based on my findings/research, which I compared with my observations, I adjusted my hypotheses to match the validity of my research.

To add further validity to this methodology, I included shared observations. These shared observations arrived in the form of a survey. The questionnaire asked people to describe their experiences with community conditions. For example – Do they think there are disparities amongst their communities? How often do they think about these disparities? What do they think should be done to change these conditions if disparities persist? These were a few questions that were asked to develop my project's further observations. Once these shared observations were gathered, I compared them with my observations and academic research. Finally, I drew conclusions from them that could help construct sustainable solutions.

In all, this process took the following steps:

1. Based on personal experiences and observations, I began questioning the conditions of the ULI communities surrounding NC A&T, ultimately forming my initial hypothesis.
2. I researched evidence that supported my claims. This initial research did not account for community-shared experiences or polyvocality. Instead, it defined the parameters of my initial observations, i.e., what unsustainable conditions I witnessed during my observation.
3. I began emphasizing the communities' polyvocality by gathering shared experiences and observations, allowing me to understand real-world context and firsthand experiences. The survey was integral in providing unbiased opinions.
4. I made critical assessments by comparing and contrasting observations (mine and

gathered observations) and evaluating results/evidence. This step aimed to enhance my findings while supporting unbiased polyvocality.

5. Finally, I revisited my hypothesis and drew conclusions based on the culmination of my observations, the communities' polyvocality, and supporting evidence. The newly drawn conclusion paved the way for possible solution implementation.

Drawing Conclusions

As mentioned, conclusions were drawn from comparing data and observations. I found relevant data to back up the project's observations. This included gathering information that identified key problem areas within the project's scope. So, while I viewed relevant materials, I took into consideration my observations and shared observations; if shared observations differed from my own, I was obligated to research materials that supported their experiences. The goal was to find the link between each experience (mine and shared) and relate this information to academic findings. If none can be found (a link between academics and observations), then that could be a sign that extensive research must be conducted. This idea further supported my notion that communities are often heard but not heeded, meaning they do not receive the support and recognition they need to thrive. As a result, viewing this information heightened my level of awareness, and I was able to determine a link between community identified problems and academic data.

Results and Discussion

My Initial Observations

Have you ever been in a situation where you know something is off but can not quite put your finger on it? It is that feeling of uncertainty, unrealistic expectations, and a general sense of being out-of-body. Yes! That feeling is reminiscent of the cult-classic phenomenon "The Matrix" – we exist but are not aware of the reality that is life. We only know what has been taught or given to us due to our circumstances but are unaware of what it takes to live or thrive. So, in turn, we accept the conditions of our contract, unbeknownst to the fact that we could change our circumstances with a small amount of observation, investigation, and implementation.

Unfortunately, this was the reality I faced while making my initial claims. I was aware that something was off within the surrounding NC A&T communities, but I could not put my finger on it. This gut feeling was something that I quarreled with for years and led me to an endless internal dialogue – 'why are these communities' conditions subpar? What is the reason for these conditions? Who is most affected by these conditions? What can be done to rectify these conditions?' These are a few of the internal discourses that I had arrived at.

Although I had made these observations, I had not yet broken free of what I like to call the Unsustainable Matrix. If you are a fan of the Matrix Trilogy, you know that the war for humanity was fought on two fronts, one within the Matrix and the other within reality. At my initial observance, I had only begun fighting poor community conditions from a non knowledgeable or Unsustainable Matrix perspective, not quite grasping the root cause of

these

conditions, which was our reality. As I gained knowledge, I began linking my observed surroundings to self-sufficiency and, later, sustainability. As a result, my initial observation began to take form. ‘These communities are experiencing hardships because they lack resilience (sustainability) and are left vulnerable because of their lack of self-sufficiency.’

Once I had established that NC A&T’s surrounding communities were unsustainable, the question of what was causing these vulnerabilities remained. In light of this revelation, I continued to observe the area and found that poor infrastructure (engineering) and system health (the communities’ health) are alongside unsustainable conditions. The triage (engineering, sustainability, and health) that comprised these communities’ unfavorable conditions were *meshed* together and partly explained why conditions persist in these neighborhoods in contrast to their across-town counterparts. To experience self-sufficiency/sustainability, you must be capable of securing resources. The securement of resources is met through financial means that communities like the ones surrounding NC A&T lacked. This meant that improving infrastructures, community health, and sustainability were closely tied to socioeconomics; those experiencing low income were more likely to experience vulnerabilities and unsustainable conditions.

Observations that I made within the Unsustainable Matrix forewarned me that something was erroneous within the surrounding NC A&T communities. The observations I perceived within reality alerted me to the triage that contributed to the development of unsustainable conditions: poor infrastructure (engineering), community health, and self-sufficiency. These are all factors that could be alleviated with the help of proper funding and resourcing. My initial and newly found observations alluded to community redevelopment. However, what root cause of these Urban and Lower-Income communities’ circumstances was worth investigating? While I pondered this question, I began to think of an issue that constantly irritated me: the unsightly food conditions that riddled these communities. Within the surrounding areas, there was little to no access to fresh/healthy food options and an oversaturation of convenient/unhealthy foods. This made it nearly impossible to grasp a healthy lifestyle, which inflicted poor resilience on these communities.

The outcome of my initial observations led me to the following hypothesis. The ULI communities surrounding NC A&T face unsustainable conditions due to the poor food practices plaguing these neighborhoods. These conditions could be improved by implementing initiatives supporting the revitalization of food infrastructures (improved markets and restaurants), increasing access to healthy/nutritious food options, and engaging communities through educational food programs. Through these efforts, these communities can witness improvements in their resilience, community health, and quality of life. Furthermore, I hypothesize that relative observations and shared experiences will add context to the project’s intent, and supporting evidence will serve as the foundational elements for further investigations into ULI community redevelopment.

Investigation of Unsustainable Food Conditions

Throughout the course of my project, I reflected on three primary forms of observations:

1. **Object Analysis**—I observed an object related to unsustainable food

conditions and insecurity. Analyzing this object reveals a deep understanding of present circumstances.

2. **Photographic Support** – I documented my observations through visual evidence, which supported my initial hypothesis.
3. **Contrast and Comparison**—Through my observations, I compared the conditions of NC A&T ULI communities with those of their counterparts in more affluent neighborhoods.

By integrating these three forms of observations, I gained unique insights into these communities' development, ultimately contributing to a more holistic understanding of their contribution to planetary health. For example, these observations revealed that implications for financial circumstances and nutritional knowledge affected community resources. Subsequently, they affected health—all of which can be witnessed by observing healthy food prices.

Regrettably, those who are stuck within the Unsustainable Matrix/Paradox do not recognize these conditions and instead contribute these inflictions to circumstances. To an extent, they are correct; inflated food prices are being witnessed nationwide despite condition, quality, and nutritional values. Still, healthy foods are twice as expensive as those of lower value. Lower income individuals would be hard-pressed to discover quality and healthy produce within their neighborhoods because of American implications towards capitalism (profit-based marketing). I found that later observations supported these claims.

Observations: Object Analysis

As mentioned in the previous section, living under the guise of the Unsustainable Matrix indicates that food prices are generally inflated – I found this to be accurate, and I am sure many of you have as well. Inflated food prices are present, so financial stability and budgeting are warranted to maintain life in today's climate. Suppose you are unable to perform these tasks properly. In that case, you might find yourself drowning in society's burdens: securing provisions for your family and self, maintaining reliable transportation, and fitting into social acceptances, such as maintaining proper attire and social-related expenditures/costs. I noted that these costs could be overwhelming if you lack financial literacy. However, there is an additional layer to this discussion. What is the price of your well-being? Should there be a price for maintaining a healthy body? Amid our financial debacle, these are the unfortunate nuances attached to our longevity and self-sufficiency.

As a fortunate, financially stable, and food-literate individual, I found myself purchasing higher-quality foods more often than not. I was cognizant of what foods were essential to maintaining a healthy body, and I had limited my intake of those poorly designed foods. These habits had taken form post-Unsustainable Matrix awakening. Still, I understood that purchasing these foods would not have been possible without setting aside a substantial grocery shopping budget. The quality and healthy foods I desired came at a cost, and an expensive one, to be transparent. Despite these expenses, my financial freedom and nutritional knowledge allowed me to engage in these sustainable practices in one of two ways:

1. Being financially free/stable encouraged me to purchase higher quality products with

little consideration for budget. Yes, being financially savvy (which bred my financial freedom) means considering your budget and spending costs efficiently. However, since I emphasized health and prosperity, I was less inclined to purchase cheap/unhealthy options at the cost of quality and health.

2. Engaging in food literacy practices improved my understanding of nutrition. It also made me aware of the foods that were in season, which helped determine pricing. Mastering this knowledge could help me budget groceries accordingly.

The importance of object analysis is to merit meaningful reflection and foster a deeper understanding of perceived circumstances. What on the surface may seem to be an everyday object could eventually unveil the key to successful community development. I did not come to this revelation until I allotted time to observe a recent grocery store receipt. In its context, it had revealed to me just how costly the intent to be healthy was, and given my background (that of lower socioeconomic circumstances), this observation caused me to have an intense internal discourse. On one hand, I was elated that I could shop for quality foods at a quality establishment. This luxury brought about a sense of pride you can only receive knowing that you are taking the proper measures to ensure success. Nevertheless, on the other hand, I felt compelled to dispute my spending and even felt the need to hide the amount reflected on the receipt; this brought me shame.

So, what did this observation mean in terms of ULI community development? Did the observation reflect a system of poverty or progression? It was simple: The object in question, my store receipt, presented a profound notion that a healthy lifestyle may not be within reach for those in lower socioeconomic circumstances. While the contents of this receipt did represent a balanced and healthy diet – one that did not rely heavily on the process and convenient options that riddle ULI communities, it did paint a somewhat obscured picture of what we would consider development, poverty, and progress.

1. In terms of development, the receipt itself represents modernism's accuracy. We can accurately gather and access our shopping carts' contents. Historically, the nuances of handwritten receipts resulted in inefficiencies, some of which hindered production. The receipt's contents also indicated another aspect of development: globalization, consumerism, convenience, and comfort.
 - a. **Globalization**—Many of our foods are linked to developments in transportation. These developments allow us to purchase items that are not native to our region. In turn, our food systems are diversified, yet our connection to them is severed.
 - b. **Consumerism** – Our shopping behaviors affect the quantity of products we consume. These behaviors are backed by developments in American culture, such as our historical need for large food masses. We are drawn to this behavior due to America's foundation, which implies that stockpiling food was necessary to wade off early food insecurities.
 - c. **Convenience**—Our purchasing power's convenience also represented American development. We are able to purchase foods that take months for others (usually a Global South producer) to harvest. This added

luxury later transformed into complacency when it came to sustainable transitioning.

d. **Comfort**—The store receipt initiated comfort. Developments in American food systems, which rely on conveniently packaged goods, allot us comfortable lifestyles. We no longer have to worry about producing our food because of the conveniences within their system.

2. As I viewed my receipt from a poverty perspective, I realized why I felt shameful. It was because I was not used to splurging on groceries, which was, until my adulthood, considered taboo. It was instilled in us not to waste money on the luxuries of food but to purchase food with the mindset of getting the most for our dollar. The reality was that I had spent over \$120 for a week's worth of groceries that consisted of 21 products. It was unfathomable that a single person's weekly grocery content should cost that much. However, this actuality reinforced the notion that eating healthy was a luxury that lower-income residents would be hard-pressed to obtain.
3. Reflecting on my grocery store receipt, I wondered if progress was being made. Indeed, progression was seen amongst individuals such as myself, who had elevated above lower socio-economic circumstances. However, has progression been witnessed in society as a whole? Or has society been stalemated? In terms of our progression rate, we have seen technological advancements that lend to our society's comfortability, for example, not having to concern ourselves with growing our foods. Nevertheless, my receipt indicated that people within our society lack access to fundamental nutrition simply because they cannot afford to engage with these products. This did not resemble progression. In a truly progressive society, regardless of socio-economic status, everyone should have access to healthy and nutritious foods, leaving food-insecure households a thing of the past.

The object in question, my store receipt, had revealed to me a few important elements. First, it showed me that inequalities and disparities remained within our food systems. One of those is the lack of access to healthy/nutritious foods, both through geospatial and financial disadvantages. These disparities are encouraged by demographics, socioeconomics, and relative knowledge, all of which are entrenched within the constraints of the Unsustainable Matrix.

Second, the store receipt painted the illusion that development and progression had been made with the simplification of our food systems. The receipt reflected our harvesting and shopping experiences, a by-product of modernism and American development. Nevertheless, the introduction of technological prowess within our systems does not always yield positive results; we have learned this by observing many of our current systems, such as harvesting fossil fuels for energy. Developments within our food systems face the same conundrum. Despite our food system's simplification, i.e., the ease of receipt obtainment,

some within the system are victimized by food insecurities. Genuine progression and development would challenge the notion that simplifying our processes is not more essential than fighting hunger and malnutrition, but ridding our systems of these impurities takes precedence.

Finally, it is crucial to understand that communities with access to healthy and affordable foods are on course for self-sufficiency. The observed receipt mirrored my initial sentiments that decoupling health from wealth is not tangible within our current systems. So, had I not been fortunate enough to purchase the quality products reflected in my receipt, I would have to accept the risk of engaging in poor dietary behaviors. Many individuals in our society do not have the luxury of purchasing quality foods, meaning they unwillingly risk their longevity and developing generational wealth. With my receipt's observation and subsequent revelation, we could magnify the need to distribute healthy food-secured systems across all demographics and their respective communities.

Observations: Photographic Diary

Those who are cognizant of the Unsustainable Matrix/Paradox understand that imagery is paramount in relaying and perceiving information. There are those who will use this knowledge to their advantage and your demise. They recognize the difficulty in processing information without the subsequent visual representation. In addition to this revelation, they have considered our current media output, which would suggest that visual information is more valuable than its written counterparts. In turn, our attention spans are readjusted to fit the speed of visual perception – meaning our ability to sit through drawn-out events without adding imagery has shrunk alongside our attention spans.

Considering our current information era, backed by media, I chose to express my perceived observations through imagery. As mentioned in my initial observations, the surrounding NC A&T ULI communities suffered from the lack of access to healthy foods and an oversaturation of unhealthy, convenient options. According to the CDC and Chew et al. (2020), an area with four or more convenient options within 0.25 mi of a residence or where the ratio of unhealthy to healthy food establishments exceeds a Retail Food Environment Index (RFEI) of 3.89 that area could be considered a **food swamp**. Unfortunately, the communities in question fell under this definition, with the fast foods to healthy foods ratio of 4:1; for every four unhealthy food options, there was only one healthy food retailer.

I am sure some will think that having at least one healthy food option available within these communities is better than nothing. However, I will dispute this notion in the following section, which will explain why comparisons are necessary when considering quality. Those who would subscribe to the idea of “at least” have yet to break free from the Unsustainable Matrix, which still utilizes false imagery/mirages to trick those into believing in poor city development/planning. I developed an ensuing picture diary to put my observed reflections into context. In this diary, you can witness the magnitude of the ULI food environment.



Click Picture to Watch Photo Diary

Observations: Contrast and Comparisons

In our current era, the prevailing narrative warns us against comparing ourselves to others, insisting there could be potential harm to our mental well-being. These comparisons often breed discontentment and negativity as they highlight the disparities between our circumstances and those of others. Indeed, there is some truth to this perspective. When we measure ourselves

against others, it is easy to fall into one of two traps: 1) comparing yourself to others begins to make you feel inadequate in comparison, leading to feelings of failure. Alternatively, 2) comparing yourself to those who do not measure up to your current success creates a sense of superiority, which can foster arrogance and complacency.

Both outcomes can foster detrimental mental attitudes and, or ill philosophies. However, should we entirely forgo comparisons? Are there benefits to making comparisons? If wielded judiciously, comparisons can serve as valuable tools for meaningful assessment. They provide benchmarks by which we can gauge our progress, identify areas for improvement, and explore the boundaries of creation, fostering innovation. In this light, comparisons offered me indispensable support in substantiating my claims.

However, amidst this discourse lies the Unsustainable Matrix/Paradox. Much like the caution against comparison, the Unsustainable Matrix warned me against accepting the status quo without deeper examination. It cautioned me against the blind acceptance of circumstances, highlighting the danger of operating within a reality where underlying issues remain obscured by false imagery. Thus, while comparisons could be helpful, they must be approached with awareness, ensuring they do not inadvertently reinforce unsustainable conditions or perpetuate harmful narratives within ULI communities.

In pursuing meaningful assessment, I embarked on a comparative journey, visiting two stores in different parts of Greensboro to make observations. I aimed to challenge the prevalent narrative within the Unsustainable Matrix that "at least there is one healthy food choice located in the community." This idea, often accepted without question, can perpetuate a false sense of security and hinder ULI community redevelopment efforts. By conducting comparative observations, I could unveil the stark realities of disparities in market quality between affluent and lower-income communities. Comprehending this could shed light on areas that are in need of improvement.

To maintain objectivity, I evaluated my observations using the following criteria:

1. Employee engagement and customer service.
2. Types of products offered at each location.
3. Quality of the store's products.
4. Cleanliness of the storefront and the store.
5. Types of customers that frequent these locations.
6. Affordability of products.
7. Customer mood when shopping.
8. Proximity of the store to communities and other stores.

Publix

In my quest for insight, I ventured into Publix in West Greensboro (the affluent region of the city) with the high expectations that follow the chain's reputation of quality and excellence.

Keeping my observations impartial, I sought to uncover any shortcomings, yet, not to my surprise, I found little to no faults. However, this level of establishment quality is common within this region of Greensboro, where the quality is known to be exceptional. Despite this, I remained objective, evaluating my findings against the predetermined criteria. Here is what I discovered during my observation at Publix:

1. **Employee Engagement and Customer Service** - The staff exhibited friendliness and a genuine enthusiasm for their work. Despite being busy, they maintained a positive attitude and provided prompt service, ensuring a pleasant experience for customers.
2. **Types of Products Offered**—Upon entry, Publix offers a significant selection of diverse fresh produce. Additionally, they offer an extensive selection of health drinks, fresh meal kits that cater to a balanced diet, and a range of convenient and healthy frozen food options not found at other locations.
3. **Quality of Products**—Publix's products are impeccable in quality. From lush greens to fresh meats, the shelves are consistently stocked with high-quality items, which is reflected in their pricing (expensive). Still, efforts were being made to rotate expiring products to maintain freshness.
4. **Cleanliness**—Publix's storefront and interior were clean and orderly (one of the store's known qualities). The plaza's well-maintained and spotless storefront set the tone for the pristine store conditions, where shelves and items were impeccably

arranged.



Figure 3: Publix's Exterior 5. **Customer Demographics**—Publix's customer demographic was diverse. It included older couples, young people, and individuals driving mid-luxury vehicles, which indicated diverse socioeconomic backgrounds.

6. **Affordability**—While Publix's products may be pricier, reflecting its commitment to quality and health-conscious options, it does offer discounts through promotions like BOGO (Buy One, Get One free) sales. If budgeted correctly, shoppers could shop here with feasible costs. Otherwise, a visit here could quickly exceed grocery cost expectations, and shoppers could find themselves spending way more than anticipated.
7. **Customer Mood**—Despite the contrary, customer mood/atmosphere is exceedingly important. Customers' experiences dictate store operations, thus determining the store's quality. The customer atmosphere at this Publix location overall exuded positivity, with customers appearing content and engaging in friendly interactions with staff, contributing to a welcoming shopping environment.
8. **Proximity to Communities and Other Stores**— This Publix location is situated in an up-and-coming suburban area, serving as a cornerstone of convenience for nearby luxury apartments and suburban neighborhoods. It is complemented by other high-quality grocery stores like Harris Teeter that are within a short distance.

Walmart

Entering the beloved Walmart, a linchpin of American retail culture near NC A&T (about a 5-minute drive), I found myself at the bustling Supercenter in the heart of East

Greensboro. This location serves as a lifeline for many in the Urban Lower-Income communities, including myself, during my tenure in the area. Armed with the same objective lens as my Publix observation, I embarked on this journey to uncover the nuances of the shopping experience. Here is what I uncovered during my visit:

1. **Employee Engagement and Customer Service**—Walmart's customer service varied, from friendly greetings at the entrance to moments of reluctant attitudes among some staff. While these interactions were mixed, the atmosphere remained positive overall, with most employees striving to assist customers to the best of their ability despite the unorganized store conditions.
2. **Types of Products Offered**—Even during my tenure in East Greensboro, I frequented the Neighborhood Walmart on Friendly Avenue in West Greensboro over this location. There is a disparity in product offerings, particularly in health-conscious food options. Not to my surprise, the scarcity of such options persisted during my recent visit.
Unfortunately, there is still a noticeable difference in the amount of alternative/healthy food options compared to its affluent counterparts in the West.
3. **Quality of Products**—You must have a discerning eye when shopping at this location. While some items, such as meats and some dry goods, may meet expectations on the surface, others fall short. Some produce exhibited signs of expiration, with browning greens and nearly expired meats. In addition, dry goods sometimes showed signs of staleness, with opened bags/boxes sporadically placed on the shelves.
4. **Cleanliness**—The recently updated exterior presentation of the store left something to be desired. The parking lot showed signs of disrepair, such as potholes, disembodied speed bumps, and occasional litter. While not necessarily dirty, the interior was disorganized, with haphazardly arranged items and occasional product displacement, i.e., milk sitting in the dry goods aisle.



Figure 4: Walmart's Exterior



Figure 5: Walmart's Interior/Shelves

5. **Customer Demographics**—This Walmart location had a diverse customer demographic that reflected the surrounding communities, with the predominant presence of customers from ULI backgrounds. Unfortunately, this is mirrored in the store's security measures, which are heightened compared to its Western counterparts -this could be indicative of broader societal issues.
6. **Affordability**—Despite this location's shortcomings, Walmart remains a beacon of affordability, with its competitive prices and frequent Rollback sales catering to budget friendly shoppers. However, much like any store in today's climate, considering your budget is advised to avoid overspending.
7. **Customer Mood**—This location had a mixed customer attitude. While some patrons may have harbored discontent due to past and present experiences, the prevailing atmosphere during my visit was positivity and camaraderie. Some customers engaged in friendly conversations with employees, indicating a family-like atmosphere essential for community development.
8. **Proximity to Communities and Other Stores**—This Walmart location is accessible via various transportation modes and is situated near NC A&T's ULI communities. However, the abundance of nearby fast-food options starkly contrasts the limited healthy food choices, raising concerns about community development and the surrounding food landscape.

Observations: Conclusions

Overall, the observed investigations provided evidence to support my hypothesis, which suggested that food access and knowledge were affected by a myriad of unsustainable factors, assisting in constructing the paradox of the Unsustainable Matrix. The contradictory reality that the Unsustainable Matrix creates perpetuates the philosophy that community conditions are not as egregious as they seem despite poor community development. Instead, these subpar circumstances are credited to community engagement and demand – meaning these communities incited unsustainable conditions because of a desire and, or willingness to participate in deplorable planetary and health practices.

However, my observations post-Unsustainable Matrix granted me the insightfulness to discern that poor community factors are the work of inequalities. ULI communities are unaware of the root causes of conditions, thus allowing them to engage with vulnerability culture. The nuances that hinder clarification reside in community resourcefulness and access. Put simply, ULI residents are not recognized by solution drivers, resulting in a disconnected reality of resilient and self-sufficient practices and lending to their involvement in the Unsustainable Matrix.

Further implications for engagement choices can be found in Hough and Sosa's (2015) "Food choice in low-income populations – A review," which implies that lower-income food choices are constrained by income level and significant food budgeting that require unrealistic proportioning. They insist that multidimensional societal factors such as familiarity, convenience, comfort, satiation, and prioritization encourage lower-income food engagement. These factors align with my observations that lacking resourcefulness and relative knowledge ensnares ULI communities into confined conditions, leading to generational vulnerabilities.

Increasing Recognition & Polyvocality

Increasing Recognition

As mentioned in the Methodology and Results sections, improving recognition is at the forefront of ensuring ULI redevelopment and breaking out of the Unsustainable Matrix. When individuals are included in resilient practices, they can be instrumental in developing genuine solutions. These community-led solutions have proved successful because they empower ULI communities that are often underappreciated and overlooked (Chase, 2018). Conversely, solutions implemented without community involvement are short-lived because of a lack of knowledge of how solutions operate and engagement with practices, which ironically is the basis of American culture and capitalism.

Furthermore, these notions mislead those who imply that ULI communities intentionally perpetuate unsustainable conditions because of their willingness to engage or unwillingness to disengage in deleterious culture. ULI residents are often not involved in sustainable discussions and solution implementation; thus, they do not have a bone in the fight. Imagine being told that you are doing something wrong but are not given any explanation as to what this wrongdoing is, and to add insult, someone chooses to correct this behavior without your consent. Would these actions make you want to engage in the corrective practices? Or would you ignore these warnings and continue to live in cecity?

Before answering these questions, ask yourself what fundamental human rights look like. Are there any imputations towards free will in your version of human rights? If so, are there any justifications for untethered control? Perhaps this paradoxical form of justice may exist under the guise of the Unsustainable Matrix. However, in reality, these two implications are contrary elements, meaning they cannot exist within the same realm. The three forms of energy justice explain additional evidence to support the need for community recognition, which is requisite for human rights and development. This concept is further depicted by Christensen (2020): “What is Energy Justice and why should you care?” The work describes that three fundamental forms of justice are necessary to ensure the discouragement of injustices:

1. **Distributional Justice**—This form of justice focuses on systems' physical benefits and risks. It implies that the inequitable distribution of benefits or resources hinders planetary development and favors specific communities and individuals.
2. **Procedural Justice** – This justice calls for equal and fair procedures. It encourages equal opportunity regardless of socioeconomic factors and demographics, ensuring the decision-making process remains equitable and unbiased.
3. **Recognition Justice** – This justice is about recognizing the needs of others and addressing their concerns. It seeks to identify the parts of society that are affected by inequalities and injustices.

Christensen (2020) favors using these forms of justice to promote planetary welfare, happiness, freedom, and morality. They go on to state that a sustainable planet is tethered to stakeholders' (in this case, community members) rights to information and participation in decision-making processes. In terms of detaching ourselves from the Unsustainable Matrix, these three justices are an integral part of the awakening process. For example, distributional justice identifies the inequitable subtleties that encourage the Unsustainable Matrix. The unfair distribution of knowledge and resources only limits our society's ability to sustain systems due to the lack of relationships between the systems, which further explains poor food literacy amongst ULI communities.

The heterogeneity of our food systems requires promoting knowledge and competencies amongst diverse stakeholders/actors (Rosas et al., 2022); the increased distribution of knowledge and competencies, therefore, changes food behaviors and habits that lend to the Unsustainable Matrix. In addition, distributional and recognition justice relates to the development of ULI food swamps. The homogenous distribution of knowledge among actors within our food systems allows for increased participation in fast foods. However, those who control knowledge utilize people's lack of food literacy to their advantage, disguising unhealthy food demand under the banner of capitalism. If an item is in demand, there is potential profit, thus the need for fast food establishments.

This concept may support James P. et al.'s (2014) study using CBGs that showed increased access to fast foods in areas with higher concentrations of racial-ethnic minorities. It also links Jin et al.'s (2021) historical account of the development of food swamps, which implies these circumstances are accredited to the “urban crisis” that left ULI communities with a food security fiasco and the need for fast/convenient foods. Similarly, the recognition of

non-communicable diseases among stakeholders, like obesity and diabetes, should indicate poor food practices and malnutrition (Cooksey-Stowers K. et al., 2017).

The disregard for the above food swamp indicators assists in juxtaposing the hunger-obesity paradox, an outlier of the Unsustainable Matrix that animates obesity in the face of food insecurities (Wiig K. et al., 2009). Unfortunately, the marriage of hunger-obesity and the Unsustainable Paradox results from absentee recognition and complacency. Knowledge holders understand that fast food establishments convey a false sense of food security. Nevertheless, they are unwilling to shift narratives because they rely on capitalistic systems.

Increasing Polyvocality

Our answer to injustice deconstruction is found in the three forms of justice: distributional, procedural, and recognition justice. Still, comprehending the necessity for these elements is not enough to revise our liberation from the Unsustainable Matrix. There must be an indication to apply the three-justice methods, which would require stakeholders' engagement. As I mentioned previously, the idea of minuscule inflates unsustainable conditions by disregarding stakeholders who lack power (knowledge and resources). In turn, ULI communities are left with untethered control of their systems, suspending the probability of interacting with sustainable practices that would increase their resilience.

Acknowledging the need for community participation, we understand that resilience can be built on community experiences and knowledge. This not only ensures proper solution implementation but also incentivizes people to engage in sustainable transitioning. So, in that sense, highlighting community voices is paramount in the liberation of the Unsustainable Matrix and, ultimately, planetary health. Imagine how you feel when someone asks you for advice. There is a sense of respect that accompanies their consultation, and you feel more inclined to participate in the solution process. The same concept can be applied in encouraging sustainable transitioning; instead of asserting our solution to someone, ask them about their optimal solution. Again, coming to this understanding lessens the impact of the Unsustainable Matrix and increases a community's chances for liberation.

A genuine solution resembles the Mississippi River, where countless tributaries (in this case, community input) tie into the river, making it a substantial watershed (collective solution) (Weidinger, 2020). Comparably, within the Unsustainable Matrix is the concept of power in the numbers – this plays into the perpetuation and disassembling of the paradox. For example, the numbers game can be used as a tool of deception when advocating for fast-food demand. Agents of the Unsustainable Matrix (those in power) may misuse demand and numbers for capitalistic gains. Equally, highlighting much community knowledge and experiences could lead to dismantling the Unsustainable Matrix, revealing the community's discontent with their communities' vulnerabilities. Would that be farfetched to believe? No. However, the Matrix would have us believe that poor conditions are warranted.

Weidinger (2020) states that changing the narratives of destructive single-sided stories is required for sustainable transitioning and planetary health. They insist that through the concept of polyvocality, which is the idea of boasting many voices to paint a grander picture, we can see effective change and potentially foster a greater sense of global

understanding. I would add that polyvocality is opposition to control, which seeks to silence voices rather than highlight them – this becomes the American paradox that encourages free will and liberation yet allows for single sided narratives to ensue because of potential profits.

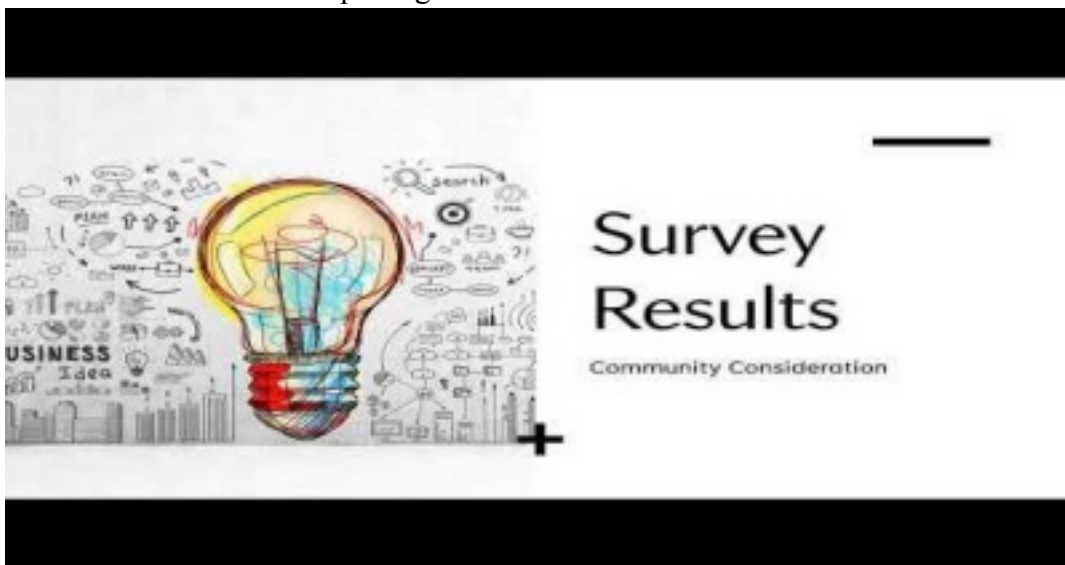
Survey Results

In light of pursuing polyvocality to ensure freedom and practical solutions, I sought to increase this concept within this study. I thought, ‘How can I highlight community experiences pertaining to food conditions while substantiating my observations and claims?’ ‘In addition, how do I ensure that results are unbiased?’ Jones et al. (2013) describe that surveys and questionnaires are vital tools to gather significant amounts of unbiased information across a broad spectrum. Conducting surveys rather than directly speaking to individuals allows for freedom of expression that you might otherwise lose because of your proximity to the inquiry. Still, surveys are not without fault. They are limited in the amount of information that could be extracted from participants, especially concerning the complexities of root causes within our food systems.

Nevertheless, using an electronic survey, I was able to gather invaluable information concerning the ULI community’s experiences with food conditions and their inputs on redevelopment. I asked a multitude of questions about community demographics, experiences, and potential solutions, in which participants were encouraged to explain and air their grievances, if any, about food conditions within the East Greensboro area. Here are a few key elements from the survey analysis:

1. The following demographics participated:
 - a. Age—The age ranged from 18 to 74, with the primary participant group within the 18-24 age group. Due to the electronic nature of the survey, I could not get any participants 75 or older.
 - b. Race/Ethnicity—The foremost race/ethnic group that participated in the survey was Black/African American. There were attempts to get Hispanic participants, but I found the language barrier an issue.
 - c. Gender—The gender participation was split, with only a slight advantage in male participation.
 - d. Martial Status—The majority of participants identified as single.
 - e. Children—The survey asked participants if they had any children. The responses were nearly split, with the advantage being that there were “no children.” I believe these numbers may reflect the age range demographic.
2. The survey asked participants if they were experiencing any health complications. A third of the participants answered with “no health complications,” while the others indicated they were experiencing issues with diabetes, high blood pressure, asthma, and cardiovascular disease.
3. Just under half of the participants reported having children, and just over a third of them stated they were in a co-parenting relationship.
4. Well over 80 percent of the participants stated that their primary means of transportation was a car. This is indicative of reasonable access to local markets and eateries.

5. The survey asked participants how they felt about the food choices available in the area. Over 50 percent of respondents claimed the choices were “bad,” and a third responded with “ok.”
6. The following question asked if they were satisfied with local food quality. Just under half of the responses said they were dissatisfied, while a third of them said they were satisfied.
7. Participants were asked to explain their previous answer; there were strong indications that the community was oversaturated with fast foods and undersaturated with healthier counterparts. One participant stated, ***“East Greensboro offers no healthy choice of foods in East GSO. Obviously, this area is not on the books of being cared for and being a good area to live in. I am so disappointed, being this is an area of a College town.”***
8. Respondents were asked if they could afford the foods they wanted and if they received government assistance. Forty-one percent of participants responded, “Yes, they can always afford the foods they want,” while 47 percent stated they could buy them on special occasions. No participants claimed they received government assistance.
9. Participants reported eating fast food a few times a week, thinking about eating healthy occasionally, and strongly agreeing that consuming healthy foods is expensive.
10. The survey asked what could be done to improve the area’s food quality. The consensus suggested healthy food access, pricing, and diversity improvements. One participant responded, ***“Stop concentrating poverty so a range of businesses can thrive here.”***
11. Lastly, the survey asks participants to select a few solutions that they would like to see implemented in the community. The top three responses were:
 - a. Create a community garden that provides access to healthy/fresh foods.
 - b. Include healthier restaurants in the area.
 - c. Introduce better pricing for healthier foods.



Click Picture to Review Survey Results

Survey Conclusion

The above survey painted an interesting story about ULI food conditions and community dynamics. It gave us a snapshot of the challenges and aspirations of the East Greensboro residents and underscored the complexities of the community's food systems. For example, participants had limited access to healthy foods despite their primary form of transportation being cars. This juxtaposition is one of many that riddle ULI communities, foreshadowing the need for further investigation into the Unsustainable Matrix.

In addition, the survey responses recalled my initial observations. Participants voiced dissatisfaction with community food conditions, such as the food choices offered and the oversaturation of poorly designed foods. Unfortunately, our observations reflect these communities' reality. The community conditions were further exacerbated by pricing/affordability, diversity in food choices, and low recognition by powerful actors (i.e., city government and city planners). Despite these challenges, community participants revealed their desire for resilience by boasting their opinions, an element that would have been overlooked without the addition of polyvocality.

Overall, the survey highlighted community voices and provided insight that could be the foundation for future ULI redevelopment and possibly a guide for the Unsustainable Matrix's liberation. The results of listening and amplifying community voices have paved the way for open dialogue addressing paradoxical nuances within ULI communities, like the desire for convenient meals despite discontent with unhealthy fast food. We discovered that ULI community members are not opposed to alternative food choices but are concerned with the pricing/affordability of these options; thus, convenience and financial accessibility must be considered in healthy establishments' introduction. Based on the findings of this survey and study, future ULI efforts should emphasize justice, polyvocality, and a departure from the Unsustainable Matrix.

Summary

Our current climate insists on the need for social reconstruction. It challenges the previous notion that decouples the environment from anthropogeny (the study of human nature). In light of this, we understand that humans are susceptible to decline without a healthy environment and vice versa. While each human should have a set of fundamental requirements concerning self-sufficiency, power distribution presents a challenge. On the one hand, there is a call for increased freedom. However, on the other hand, proclivity toward freedom is far and short. People only want freedom and liberation when it aligns with their beliefs, insisting that freedom is only granted when it can be controlled. This form of control results in unequal power distribution and is accompanied by surface-level nuances that develop complacency. Moreover, the lack of investigation into root causes paints a picture of the unknown and wades any efforts to disassemble systematic inequalities.

The Unsustainable Matrix assisted with forewarning individuals about accepting things at face value. Still, agents who understand sustainability are keen on the power of imagery or face value. They either use this trick to their advantage or disregard the issue

entirely, forgoing any connections to its deleterious behaviors. Unfortunately, those who suffer the greatest at the hands of the Unsustainable Matrix are the unaware ULI community members. However, this suffering is not accredited by willingness but because of their lack of funding, recognition, and resources. Like many other unsustainable issues that riddle low-income communities, these communities' food systems are paradoxical in nature. Further investigation into these systems is then warranted for planetary prosperity.

So, how does one go about setting the foundation for ULI redevelopment? It starts with observing; observations must spark discussion, and no observation or person should subscribe to minuscule. Here is where applying effective and judicious methodology excels. Initiate redevelopment discussions by personally observing conditions. Consider how these conditions may affect those living within them and yourself, drawing connections to the interdependence of our systems. After self-reflections are made, speak with the members of the community to compare and contrast observations. Were there any similarities in perception? Did you learn a possible solution implementation? You want to answer these questions to break the cycle of the Unsustainable Matrix.

Overall, this study has highlighted personal and community experiences with the unsustainable nature of the ULI food systems surrounding NC A&T. It applied the above methodology to uncover the nuances of the root causes of poor food conditions. The investigation revealed that personal observations of these communities' inequitable food conditions were not farfetched and that community members have witnessed similar trials and experiences. Still, the juxtaposing nature of the Unsustainable Matrix has allowed for the perpetuation of adverse elements, i.e., providing low-quality fresh markets to "quail food insecurities." We now understand that sinking our teeth into these nuances and bringing forth deeper reflections and discussions is required to unveil the mediocracy that supports the Unsustainable Matrix.

References

Jin, H., Lu, Y., (2021). SAR-Gi*: Taking a spatial approach to understanding food deserts and food swamps, *Applied Geography*, Volume 134,

<https://doi.org/10.1016/j.apgeog.2021.102529>

James, P., Arcaya, M. C., Parker, D. M., & Tucker-Seeley, R. (2014). Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States? *Health & Place*, pp. 29, 10. <https://doi.org/10.1016/j.healthplace.2014.04.011>

Cooksey-Stowers, K., Schwartz, M.B., Brownell, K.D. (2017). Food Swamps Predict Obesity Rates Better Than Food Deserts in the United States. *Int J Environ Res Public Health*, 14(11):1366. <https://doi.org/10.3390%2Fijerph14111366>

Wiig, K., & Smith, C. (2009). The art of grocery shopping on a food stamp budget: factors influencing the food choices of low-income women as they try to make ends meet. *Public Health Nutrition*, 12 (10), 1726–1734. <https://doi.org/10.1017/S1368980008004102>

Larson, N. I., Story, M. T., & Nelson, M. C. (2009). Neighborhood Environments: Disparities in Access to Healthy Foods in the U.S. *American Journal of Preventive Medicine*, 36(1), 74- 81.e10. <https://doi.org/10.1016/j.amepre.2008.09.025>

Darko, J., Eggett, D. L., & Richards, R. (2013). Shopping Behaviors of Low-income Families during a 1-Month Period of Time bring about. *Journal of Nutrition Education and Behavior*, 45(1), 20-29. <https://doi.org/10.1016/j.jneb.2012.05.016>

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (2022). FOODLIT-tool: Development and validation of the adaptable food literacy tool towards global sustainability within food systems. *Appetite*, 168, 105658. <https://doi.org/10.1016/j.appet.2021.105658>

Tapia, C., Randall, L., Wang, S., & Aguiar Borges, L. (2021). Monitoring the contribution of urban agriculture to urban sustainability: An indicator-based framework. *Sustainable Cities and Society*, 74, 103130. <https://doi.org/10.1016/j.scs.2021.103130>

Tonumaip'e'a, D., Cammock, R., Conn, C., Food havens not swamps: a strength-based approach to sustainable food environments, *Health Promotion International*, Volume 36,

Issue 6, December 2021, Pages 1795–1805, <https://doi.org/10.1093/heapro/daab021>.

Chase, R. (2018, April 14). *Community-led solutions: Building evidence that counts*. <https://www.mncompass.org/data-insights/articles/community-led-solutions-building-evidence-counts>

Weidinger, R. (2020, November 19). *Polyvocal narrative strategy: Turning many voices into durable change*.

<https://narrativeinitiative.org/blog/polyvocal-narrative-strategy-turning-many-voices-into-durable-change/>

Hough, G., & Sosa, M. (2015). Food choice in low-income populations – A review. *Food Quality and Preference*, Volume 40, Part B, March 2015, Pages 334–342. Volume 40, Part B. <https://doi.org/10.1016/j.foodqual.2014.05.003>

Christensen, M. (2020, April 28). What is Energy Justice, and why should you care? LinkedIn.

<https://www.linkedin.com/pulse/what-energy-justice-why-should-you-care-phd-physics/>

Farm Aid and Abet

Agriculture Subsidies in the United States

Christian Clarence
Department of Engineering, University of San Diego
ESH 540 Capstone Project
April 15, 2024

Abstract-

I have conducted research on the government assistance available to farmers in the United States by means of direct and indirect subsidy programs. I sought to understand the function of the programs and their goals. My inquiry into this topic arose from trying to gain a better understanding of the relationship our agriculture systems have with our natural resources, environment, and the local farming communities. Our agricultural industry has become notorious for the [negative externalities](#) as a result of the practices that allow unprecedented quantities of food and pollution to be produced. After gaining an understanding of the government programs, I explored agricultural practices and their negative externalities. The United States Department of Agriculture (USDA) does not share all the relevant information needed to draw connections between the support being provided through the various government programs and who is benefiting. However, we can draw some connections between the programs and the farming practices they encourage. From my research, I identified that the majority of direct subsidies are being provided to large industrial commodity crop and animal farming operations. Additionally, Confined Animal Farming Operations (CAFO) receive the most indirect subsidization via exemptions from regulations, the ability to avoid being responsible for all the costs associated with their practices, and lowered costs as a result of direct subsidies for commodity crops.

Introduction-

Agriculture has been part of human civilization since the start of human civilization. As a species, we know how to produce food sustainably. We were doing it thousands of years before the remarkable technological and engineering advances that are available to today's farmers. Modern technologies like GPS and Hydrogeophysics, in addition to ideas and practices from around the globe that have been used for millennia, can be shared with all corners of the planet. Whether it is using advanced technologies, introducing cover crops that protect soils between growing seasons, or the regenerative practices of the indigenous peoples who have thrived on this land longer than we may ever know, are all available for implementation within our current agriculture system. However, despite the treasure of knowledge available to us, somehow, we have gotten to a point where our agricultural practices are a threat to our very existence. We have a system where corporations own massive farming operations that are able to produce extraordinary quantities of food, but at the cost of environmental degradation, resource depletion, and a myriad of other alarming consequences. My project aims to draw attention to the need to transition away from the egregious agriculture practices that cause the most harm and towards practices that will give us the best chance of avoiding food and water shortages. The ability of farmers to produce food with the goal of human health for many years to come needs to be a priority and must take precedence over the short-term profits of corporations. We have thousands of years worth of knowledge and are continuing to learn more, but we are nonetheless destroying the environment and depleting resources to the point where many experts warn that the near future may very well be unrecognizable, "The forecast for 2050 is that Asia (the whole continent) will not be able to feed itself due to a lack of arable land, and WANA even less so, due to a lack of water. Sub-Saharan Africa could have enough water and soils to feed itself, but if and only if intensive agricultural development takes place, mostly by increasing rain-fed agriculture and its yields, and developing irrigation" ([de Marsily, 2020](#)).

Currently, the US government provides billions of dollars to the agricultural industry every year. Unfortunately, the vast majority of this support is being provided to large industrial farms growing monoculture crops and to factory farming operations, which are the two systems behind the majority of the harm being caused in the agricultural industry. This is unfortunate because even though these farming operations are detrimental to the health of local communities, the environment, and future generations, the

United States government encourages these types of practices with its subsidy programs. Spending billions of dollars solely to support industrial agriculture, and a fraction of that amount on supporting sustainable agriculture is a recipe for disaster. The well-being of farmers, the communities they live in, and the environment are all at risk unless serious changes are made to the current agricultural system. On a national scale, agriculture corporations have used their influence to sway the laws and regulations to increase their profits. On a local level, it can be seen by less than 15% of farmers in my home state, Washington, regularly receiving subsidies. ([2017 Census of Agriculture. USDA](#)). It is not a secret among farmers that the climate crisis continues to worsen and that transitioning to more sustainable practices is long overdue; farmers experience the devastating impacts firsthand. As water, soil, and air quality diminishes, we simply cannot continue to use the majority of our agriculture subsidies to encourage harmful farming practices.

Literature Review-

In my research, I aim to understand the intentions and results of agriculture subsidies in the United States. There are a multitude of programs available to farmers across the US through various government departments at the federal, state, and community levels. The [USDA](#) is, of course, the central hub for anything related to agriculture, but also the Department of Fish and Wildlife ([FWS](#)), Environmental Protection Agency ([EPA](#)), Department of Commerce ([DOC](#)), and more have an interest in some form or another in agriculture and offer programs for farmers. The government websites were my foundation for understanding the various aspects of the programs available to farmers. Many non-profit and cooperative groups are able to provide assistance and support to farmers, like the American Farm Bureau Federation ([AFBF](#)), which is a 501 with offices in every US state and Puerto Rico that lobbies on behalf of their member's interests. Most towns and counties have agriculture [committees](#) and [coalitions](#) that also offer support to one another, and the importance of community support for individual farmers is arguably just as important as government programs. I will not be focusing on the impacts of community, volunteer, and private assistance; my research here is only on the impacts of government assistance programs for farmers, though I do believe there is value in researching the [decentralization of agriculture support](#). Instead, the resources provided by the local groups provide many insights into the issues facing farmers and provide voices from different perspectives. Many of the non-government and local agriculture groups are often opposed to the policies and regulations imposed by the government agencies I listed above. An example of this misalignment between goals is often seen in environmental regulation, which was a significant focus in my project and can be seen in the American Farm Bureau Federation's article on the EPA's Clean Water Act, which they believe is still unfair to farmers and land developers even after recent rulings to diminish the EPA's regulatory power, "After the Supreme Court ruling in Sackett, EPA and the Corps had an opportunity to write a WOTUS Rule that's fair to farmers and stands the test of time, but instead they chose to revise only a slice of the rule that the Court rejected" ([Water of the United States, 2023](#)). Much of my research is centered around unraveling the competing interests that claim to, in fact, have similar goals.

The USDA website has a wealth of information about the various programs available to farmers since they are the department responsible for overseeing agriculture, including a page listing many resources for [small/mid-sized farms](#). However, you might notice they do not mention anything about subsidies on this page. In fact, I wasn't able to find a path to a source that had the word subsidy anywhere from the 'Resources for Small and Mid-Sized Farmer' page. Since the USDA's responsibilities are pretty expansive, from nutrition to forest services, another USDA website, [farmers.gov](#), provides even more resources specifically for farmers, though there is still no mention of subsidies. Instead, the USDA refers to the

assistance as ['protection and recovery'](#), ['conservation'](#), or simply ['insurance'](#) programs. There certainly is no lack of information on the USDA site. Actually, there are so many pages and links that it is a bit overwhelming, and finding information on agriculture subsidies is not straightforward.

In agriculture, what is and is not considered a subsidy or a subsidized program can be an area of disagreement. Therefore, I don't want to get hung up on defining what a subsidy is, though that conversation is important. Instead, in my research, I first wanted to be able to show what the purpose of agricultural subsidies is according to the USDA, and I saw any program, data, legislation, etc. that was offered by the government that assists in achieving those purposes as an agriculture subsidy. For the sake of this project, please consider the term 'subsidy' as being interchangeable with 'government assistance', and I intend no other meaning besides assistance in some form provided by the government. To gain an understanding of the purpose of the services and programs offered by the government, I utilized the many resources found on government websites, particularly the USDA websites. The Farm Service Agency ([FSA](#)) is a USDA sector that assists farmers on a local level. The FSA provides details on the various subsidized programs available to farmers, and they have numerous locations throughout every state, allowing them to assist farmers in person in addition to virtually.

After forming an understanding of why the government is providing support to farmers, what actions they want to encourage, and what they want to discourage, I next researched what agriculture practices are prevalent in farming operations that receive government assistance. What role do the subsidies and subsidized programs have in what is being grown in the US? A large portion of the direct financial incentives is provided towards encouraging the growth of commodity crops, such as corn, soy, and wheat. These are also the crops that are grown the most by US farmers. Factory and industrial farms have become the primary producers of the food we eat. While most types of agriculture operations are a testament to human ingenuity, they also have a laundry list of negative externalities. In my research, I try to understand what practices are being encouraged and the social, economic, and environmental consequences associated with those practices. While I want to provide a complete and well-rounded look at all the costs and benefits of the agriculture operations receiving subsidies, the lack of transparency in the available data regarding costs can lead to speculation and discrepancies among numbers. I have included sources for any statistics I present and have tried to use data that the USDA published. However, it is not hard to find differing numbers even within other government agency sources. I want to have straightforward numbers on agriculture and agriculture subsidies, as well as data and statistics, avoiding any speculation when providing a figure. These will be used to come up with the 'how much' and 'how many' figures, but a recurring issue I have found is the lack of transparency regarding the actual figures. The best source of data on agriculture subsidies allocation I was able to find was the [USDA's Payment Files Information](#), but the numbers do not line up with any reports I could find from the [USDA](#); they also do not match the figures provided by the agriculture research group [Environmental Working Group](#), or any of the dozen other articles and sources reporting on how much money is being distributed and to what parties. Many groups and organizations have dedicated countless hours to painting the picture of where subsidies are going. However, from what I can see, this is not information the government currently provides to the public. Even if they did, it is no easy task to calculate all the various accounts, making the array of calculations and summations regarding agriculture subsidies severely challenging to verify.

The calculations for my project were all done using data from [USDA's Payment Files Information](#). However, it took me months to clean up the over eight million subsidy payment records just from the last three years. I realize my calculations are no more meaningful than the multiple other reports available. So, if my project on agriculture subsidies seems to lack data on the allocation of subsidies, it is because there is a lack of

empirical data available regarding their allocation, and I want to avoid drawing conclusions from speculation when possible. Therefore, in my project, I aim to stick to statistics for the agriculture industry in the US that are readily shared and available, like how much food is being produced, how much that food contributes to the GDP, how many farms there are in the US, what those farms produce on how many acres, and other figures that can give us a complete picture of agriculture practices in the US, and are shared [annually by the USDA](#) and through the [USDA's Payment Files Information](#).

Much of the research I have done for this project regards the laws and regulations that are put into place to protect against environmental degradation. Focusing beyond financial factors, such as the devastating health impacts on local communities and the inefficiencies of industrial commodity farms and CAFOs in bettering food insecurity issues. Following the trail of where the government assistance is being allocated towards, instead of trying to make estimates on how much money the support equates to, I examined the practices within the US agriculture system that are commonplace and tried to connect what agriculture subsidy programs influence the practices. Risk plays a significant role in what farmers grow, and most of the subsidy programs are framed as risk mitigation programs. The risk mitigation offered by the government favors commodity crops, making it less risky for farmers to produce commodity crops. Corn is the star of the subsidy show, but only a tiny fraction of it is consumed as food. The most subsidized crop in the US is corn, but corn is not the most subsidized food. The crop that receives the second highest amount of support is soy, which also is predominantly not grown for human food consumption. The practices required to grow the quantity of commodity crops products that we do, the resources those crops require, the impacts on local ecosystems and communities, the industries farmers are reliant on like mining, oil, and natural gas that are all used to create fertilizers, and the tradeoffs we are making for our ceaseless pursuit for economic growth; all of this is tied in and interwoven into the billions of tax dollars being allocated to the agricultural industry.

Methodology-

The primary research questions I have focused on thus far are surrounding the publicly available information on where agriculture subsidies are currently being allocated to in the US, what are policymakers hoping to achieve with the subsidies, and finally, taking a step back to look at what practices are prevalent in the agriculture industry. The agricultural products receiving the most direct assistance from government funding are grains and soy; why is this, and what impact does this have on the practices and choices of farmers? The full extent to which the subsidies are being allocated is not transparent and is currently not publicly available. Many people and interest groups have calculated very precise accounts for where the support is going, but at the end of the day, there is still a degree of uncertainty. Another research question I focus on is: who is benefiting from the agriculture subsidies? From my understanding, government subsidies should be geared towards aiding the greater good of all citizens, or at least the government needs to pretend as though a subsidy will be for the greater good. Since 'greater good' is a subjective measure, it is not difficult to make an argument backing a subsidy's value, but it still needs to be done. In my research, I use resources from the USDA and the USDA's various sub-departments to try to gain an understanding of the intentions behind and allocation of government subsidies in the US. What I have found is that the largest amount of government assistance in the US is given toward operations that have adverse effects and do not seem to match the stated goals of the USDA. 20% of the apples consumed in the US are grown in WA, but apple farmers do not qualify for nearly as many government assistance programs as commodity crops are. This leads to more questions that I have focused on: why are the subsidies allocated how they are? What are they encouraging? This has ultimately gotten me to my final research question: How do the goals and intentions of agriculture subsidies align with the goals and intentions of farmers and

their communities? I am wanting to find out where the agricultural subsidies are aiding local farmers, and where they are not.

In my research, I sought to find the voices of farmers, people who engage in agriculture practices every day, to gain a better understanding of the impacts of government assistance on agriculture.

I wanted to explore the environments where different types of farming were present. In places where animal waste leaches into the surrounding waterways, what are the root causes? Is water pollution in the agriculture industry caused by farm flooding? Is this something the subsidies could assist with, or are there any oversights in regard to waste removal? Likewise, how are chemical fertilizers getting into waterways? Animal waste and fertilizer pollution will disrupt the nutrient balance of waterways not only in close proximity to these farms but also can have negative impacts miles downstream and contribute to extreme issues like the Gulf of Mexico Dead Zone. The contamination of the waterways due to agricultural runoff is harmful to the health of both the environment and the local communities. The environmental costs being externalized to communities and ecosystems that receive no benefit is indirect subsidization of the practices causing the harm. It may make agricultural products less expensive to produce, but the environmental, social, and tax costs are not being paid by those who are benefiting from the exploitation of resources.

Initially, I planned on conducting interviews with farmers within my community, but due to time constraints, I was not able to follow through. Instead, I found videos, blog posts, and news articles made by farmers about their experience with agriculture subsidies in order to get a sense of their ideas and views. Of course, farmers come from all walks of life, and their worldviews and stances on issues vary as much as any other profession. I also found multiple podcasts that not only interviewed folks in the agriculture industry but also hosted some by farmers. For most farmers, agriculture is a huge factor in their lives. Being a farmer requires a skill set and knowledge base far beyond most occupations. One of the many proficiencies they need is a solid understanding of the relationship their farm, just like any other business, has with the government. Understanding the rules and regulations in addition to the government resources that are available to them. It can take a lifetime to become an expert in farming, which is why the media made by farmers provides valuable insight into how these experts understand government assistance programs. Some farmers air [their grievances with the programs](#), while others provide [detailed explanations of programs](#) to help other farmers navigate the complexities. When planning out my project, I thought I would be pulling agricultural statistics from online databases regarding the allocation of subsidies. Then, I would be able to tell a story about how much support was going on here vs. there, but after fifteen months of research, it became clear that current data is not available to the public. I submitted a request to the USDA and never received a response. I found at least a dozen different statistical sources, including international entities like the Organisation for Economic Co-operation and Development (OECD) and the domestic Federal Reserve Economic Data ([FRED](#)), and numerous files provided in the depths of the USDA website.

Results and Discussion-

There are many intricacies to subsidies, but taking a step back, simply put, the US government provides incentives to encourage certain actions, values, and/or ideas that are thought to be beneficial to society as a whole. These incentives take many shapes and forms and are found across a multitude of industries and sectors in our society. Incentives where the government provides a monetary payment to an individual or group are considered direct subsidies, and incentives where the monetary value is not explicitly measurable. Agricultural subsidies have an immense impact on our society as they affect the food that feeds not only the US but also populations around the globe.

Understanding, qualifying, and ultimately being able to utilize subsidy programs is a tall task that is required in agriculture for many farmers to have financial stability. Similar to any other type of business, the ability to

understand the government tax breaks, grants, insurance, and the numerous other assistance programs meant to help farms succeed can play a definitive role in whether a farm is able to make ends meet. Additionally, the subsidized programs in the agriculture industry are of great interest to many people and groups outside of agriculture. Before digging into the various agriculture programs, the reasoning behind why the government provides support to farming is an important foundation. Sustainable agriculture is not only the preservation of the environment but also the health and longevity of the farmers themselves. If no one wants to be a farmer, then the agriculture industry is not sustainable. Farming requires a comprehensive set of skills, a mountain of work, long hours, a lot of responsibility, and a financial profit that is in no way guaranteed. If nothing else, I see subsidies in agriculture as a means to make sure farming is still a realistic career option.

The USDA website provides the following purposes in which agricultural subsidies serve, "While some subsidies are given to promote specific farming practices, others focus on research and development, conservation practices, disaster aid, marketing, nutrition assistance, risk mitigation, and more" ([USDA Subsidies, n.d.](#)). The USDA is providing a reasonably broad explanation here, which is fine since each program is unique in its function. However, I find it moderately misleading because the actual distribution of the subsidies is less broad in their priorities. According to the [USDA forecasts](#) for agriculture subsidy payments based on the current farm bill, about 30.7% of the money for direct agriculture subsidies is provided to support commodity crops through various price protections and revenue coverage programs, another 28.6% is used for conservation programs, and crop insurance receives the most support at about 37.4%. These three programs account for 96.6% of the USDA's estimates of spending. Looking at the payment records for government assistance for farmers, according to the [USDAs Payment Files](#), there were a total of 8,246,991 unique agricultural subsidy payments made between 2020 and 2023; all the payments totaled just over \$40.8 billion. These two numbers are simply summations of the [USDAs Payment Files](#). Unfortunately, there is limited information on how much support is being allocated to specific agriculture practices. What we can see are the program descriptions, and out of the 118 programs in which payments were made, twenty-seven were programs specifically to support livestock, dairy, and other animal agriculture, for a total distribution amount of \$9.86 billion paid under these programs between 2020 and 2023. Thirty-three of the programs were specifically for commodity crops, with total payments of \$20.8 billion during this period. The remaining fifty-eight programs are for conservation, insurance, and other programs where the type of farm is not clear. There are a handful; I counted six programs that specify in their description that they are for non-commodity crops or specialty crops. Finally, we can see that of the 1,189,457 total unique locations that received agricultural subsidy payments from 2020 to 2023, 81.8% of them received payment for either a commodity crop or for animal agriculture, and of the \$40.8 billion in direct agricultural subsidy payments, \$37.4 billion was provided to operations that participated in either commodity crop or animal agriculture government programs. ([USDA Payment Files, 2024](#)) I think it is safe to say that the USDA is accurate in their statement, "some subsidies are given to promote specific farming practices" ([USDA Subsidies, n.d.](#)), as the farming practices associated with commodity crop growers and animal agriculture farms are being heavily promoted.

There is no shortage of risks associated with farming, many of which are entirely out of the control of the farmers themselves. Farms are at risk due to fluctuations in markets caused by a natural disaster, an international conflict, or countless other events happening around the globe; even something as simple as a change in weather where it is warmer/colder during a season can have devastating impacts on crop yields. Droughts, floods, and extreme weather are all becoming more common across the US, which can destroy crops. Farmers invest not only financially to acquire seed, feed, equipment, labor, fertilizers, and many

other physical inputs, but they also are dedicating their time, energy, and often overall well-being in order to hopefully have a plentiful harvest and make a return on all their investments at the end of the season. Farmers are exposed to dangerous conditions working with various chemicals, waste materials, and large and sometimes industrial-sized machines. The point is that farming is risky, and subsidies help mitigate some of these risks. If one of the many things that can go wrong, then subsidies can act as a way for farmers to access the support they need in order to continue to operate.

Direct subsidies provided to farmers can be found in the US Farm Bill, which is a piece of legislation that is redrafted every five years or so and impacts not only farmers but everyone else, too. What types of crops farmers choose to grow, what is done with those crops upon harvest, and how much those crops cost at the grocery store for consumers are all heavily influenced by this bill. It includes provisions of consequence for environmental groups, the most influential oil and retail corporations around the world, international and domestic human rights and labor organizations, and many other parties that one might not intuitively think to have interest enough to spend copious amounts of resources on lobbying politicians and policymakers to add/remove a few sentences. The Agriculture Improvement Act of 2018, a five-hundred thirty-page document, is the current Farm Bill, signed into law by Donald Trump in 2018 and extended for an additional year by Joe Biden in 2023. The majority of the projected 100-150 billion dollars that will be spent annually for the next decade will be used for nutritional, energy, international trade, conservation, rural development, and multiple other related programs that might not come to mind when thinking of farming, but the farm bill pertains to food at all stages of the supply chain. The fact that the Farm Bill encapsulates such a broad scope of critical public programs makes the drafting of the bill a very complex ordeal of competing interests. The primary direct subsidies given to farmers by the federal government are outlined and enacted with the quinquennial legislation.

There are multiple unique programs for farmers and their families to receive assistance. However, the more impactful direct subsidy programs can be summed up within three of the Farm Bill's twelve chapters. Farmers may very well find their duties fall within many, and possibly all of the chapters, but in terms of agricultural direct subsidies, we will focus on Title 1: Commodities, Title 2: Conservation, and Title 11: Crop Insurance. After Title 4: Nutrition, which contains SNAP benefits, Title 1: Commodities receives the second most funding. Grains, oilseeds, and pulses are allocated the lion's share of the assistance through commodity supports with programs such as Price Loss Coverage (PLC), Agricultural Risk Coverage (ARC), and Marketing Assistance Loans (MAL).

The ARC and PLC programs are two separate programs that farmers can choose between in order to help mitigate some of the liabilities associated with farming. ARC has two options: ARC-CO, which designates the guaranteed prices based on county revenue averages, and ARC-IC, which bases price guarantees at the individual revenue level. While the ARC program considers revenue, which is the market price of crops and crop yields, the PLC is based only on the price of the crops. Only available for commodity crops, which include barley, canola, corn, crambe and sesame seed, dry peas, flaxseed, grain sorghum, large chickpeas, lentils, mustard seed, oats, peanuts, rapeseed, rice, safflower, seed cotton, small chickpeas, soybeans, sunflower seed, and wheat.

Many farmers may require the assistance of a lawyer or a Farm Service Agency (FSA) professional to organize, prepare, and adequately find eligibility. Furthermore, the calculation for payments in these programs is based on seasonal or yearly averages, and forecasting for farmers can become a guessing game in times of uncertainty, which can be an issue if budgets are tight, especially when prices or yields are low, which is when these programs are designed to be accessible. The ARC and PLC programs set the

price floors based on seasons and annual averages, so farmers have to wait for payments at times when they likely need them the most.

In stretches of unfortunate time spans with multiple seasons or years of low yields and prices, the averages will dip, and inversely, when prices and yields are high, the price floors will be higher. Perhaps creating risk mitigation and forecasting plans might be possible for a year or so out, but it makes preparation for the long term uncertain. While relieving some uncertainty, there is still a high level of risk to farms that do qualify for the programs and even more for those that do not. It is such a crucial program, yet farmers need to fully understand the complexities of them or hire an advisor/lawyer to make sure they are covered. One size does not fit all; some farms have been in families for over a century, and the longer a farm has been in production, the less likely it is to succumb to risks. This is for a variety of reasons: generations of knowledge about the farms, skills, and unique practices learned and passed down, and depending on the history of the land being farmed, the water sources, irrigation systems, and establishing field through logging and grading, could have been established decades ago, while other farms are prevented from doing these things due contemporary ecological policy and regulations, financial reasons, lack of experience with different weather conditions, lack of knowledge, etc. Some consider these programs to act as barriers to entry for smaller and newer farms. In order to overcome these barriers of entry, the government does offer other incentives and programs to support the next generation of farmers, but the PLC and ARC programs, where a large percent of agricultural direct subsidies are being allocated, are more favorable for larger commercial farms that are capable of producing high quantities of commodity crops.

The risk mitigation provided by the programs can make farms reckless, not fully report or harvest their yields, and employ unsustainable farming practices. The mixed nature of the US economy combines market trend influences or (supply and demand influences) and regulatory interventions like the ARC and PLC programs that can lead to those with enough market influence to have the protection of programs to make production choices they might otherwise not make without the protection of ARC and PLC. If there is any reason a farmer is not able to receive a base price for their commodity crops, then they can still receive payment. Through a calculation that is far from simple or transparent, the USDA creates a five-year average price floor for each of the two dozen or so crops and will issue an annual payment to landowners who have acreage of the commodity crops in the systems of the local farm service agency. From my understanding, if the land is enrolled under one of the commodity crops, then whoever owns that land will receive an annual payment for around 85% of the difference between the price floor established by the USDA and the market price of the crop.

An example of this would be if a farmer had 25 acres of corn enrolled in either of these programs and regardless of whether they grew corn during the previous year or not, if the market price was below the price floor established by the USDA, the land owner would receive a payment called an income support payment. MAL are loans that have more friendly terms than available outside of agriculture, where farmers can take a loan out and put the crops they are growing as collateral. There is minimal risk in taking these types of loans because if the price of their crop increases, they only have to pay back the price set by the loan, and if the price of their crop decreases, they do not have to pay the difference. The loan terms allow farmers to hold onto their harvest when prices are low, take out a loan to maintain their cash flow, and then sell when the market price increases, and they can sell their commodity for a more significant profit. As the title's name suggests, these programs only apply to commodities, so the safety of growing these crops is a huge incentive for farmers. Another safety net built into the Title One section is disaster relief for commodity

crops specifically, which, as we see in the separate Title 11 crop insurance, is quickly becoming very important with changing and more severe weather.

Insurance policies for farming serve the same purpose as any other insurance policy: to protect the policyholder from unforeseen damages. The only difference is that farming is vulnerable to a multitude of risks, including the conditions attributed to climate change. As droughts, flooding, extreme heat, and cold all become more observable to farmers whose professions are reliant on the weather, the attractiveness of having insurance to mitigate some of these risks increases. "Premium subsidies for policyholders. In addition to paying companies to deliver the program, USDA subsidizes the premiums that policyholders pay. In 2022, subsidies averaged about 62 percent of policyholders' premiums and totaled \$12 billion, comprising the largest portion of the program's total cost of \$17.3 billion" ([GAO, 2023](#)). The PLC and ARC from the Title One portion of the farm bill protect against market price risks, and Title 11 protects against yield risks. If the climate, fire, equipment failure, insects, or animal disease causes a lower yield than expected, then farmers are theoretically able to collect insurance on their losses. I say theoretically because there are many clauses and stipulations in the insurance policies that can impact payment eligibility. According to the US Government Accountability Office, "In addition to paying companies to deliver the program, USDA subsidizes the premiums that policyholders pay. In 2022, subsidies averaged about 62 percent of policyholders' premiums and totaled \$12 billion, comprising the largest portion of the program's total cost of \$17.3 billion" ([GAO, 2023](#)).

Many farms located in Northeastern states in the US have recently been experiencing heavy rainfall, warmer winters, flooding, and other extreme weather conditions that are negatively affecting crops. In July 2023, the state of Vermont suffered flooding that impacted folks all over, but especially farmers and their crops. Flood water is often contaminated with human and animal waste, in addition to various other contaminants from urban runoff, resulting in crop contamination and potentially the entirety of a farm's yields being ruined. I remember local and national news coverage calling the flooding a once-in-a-century event, but then they would say it was the worst flood damage since 2011. The problem with calling it a once-in-a-century event is that there have been between 15-20 extreme floods in the last century in Vermont. While it is suitable for headlines, it can potentially underrepresent how valuable assistance programs are for businesses like farms. The first thing I thought of when finding that there is a flooding disaster every decade or so is how vital the subsidized crop insurance programs are in Vermont. Disaster relief programs do assist farmers and other small businesses in times of need, but they lack the reliability needed for farms, furthering the importance of insurance. This need can be seen in Connecticut currently, as they recently experienced flooding in January 2024 that has had detrimental effects on their crops, though less intense than the flooding in Vermont; CT farms also had severe crop losses during floods in 2023, 2021, and 2019. When a farm floods, it often takes all the work a farm can afford simply to clean their fields and equipment, order new inputs like seeds and fertilizers, and prepare the fields for the next crop. With the frequency of flooding increasing dramatically, the insurance and risk mitigation programs do offer relief, but in many places, the programs do not support proactive solutions. The Environmental Protection Agency ([EPA](#)) states that "At more than half of the locations [Southern and Eastern US coastal regions], floods are now at least five times more common than they were in the 1950s" ([EPA, 2023](#)), and farms are too busy recovering from flooding for them to also be expected to apply for grants in order to build flood mitigation infrastructure. Two of the USDA's expressed purposes of agricultural subsidies are disaster aid and risk mitigation, but the various government programs are set up to provide aid after crops are lost; little support or encouragement is being provided for proactive safety practices. While the conservation programs have some inefficiencies, both preventative and restorative programs are available.

One program that is more proactive in its focus is the Conservation Reserve Program (CRP). It is a subsidy program that provides money to farmers who agree not to farm their land. The USDA says the goals of the various CRP programs are to improve and repair native ecosystems, in addition to protecting water and soil. The government allocates a large amount of resources towards CRP, but some argue that the results are unclear in terms of protecting the environment. On the surface, it makes sense as a way to conserve ecological health, but opponents say that in practice, the program is vulnerable to exploitation by program participants and is unproductive in improving environmental health. Rewarding landowners for taking the land out of production does not necessarily mean the land is any better off, and since the CRP contracts typically are for ten to fifteen years, the benefits are lost if the landowner tills the land after the contract to put it back into production. Any farmer is allowed to participate in the program. The landowner is the one choosing what acreage they take out of production, which can lead to areas that are vital to the local ecology, such as areas near waterways or native wilderness, still being farmed because they are typically better for growing crops and letting livestock graze. At the same time, perhaps less sensitive land is instead being set aside by farmers for the CRP. Some land is more worth protecting. This also benefits those who have more land, raising the price of farmland overall.

Agriculture has always been an integral part of our society, and the fact that it is so important makes it an easy place for groups with power and influence to focus their exploits. The people who have control over the production and distribution of food are in positions of power, which they can leverage to persuade the policies and laws put into place by governments at all levels. Agriculture is one of the largest industries in the US economy. Like all other industries within our capitalist system, businesses will employ any strategies at their disposal to get a leg up on the competition. Equally crucial to the conversation, once an entity is able to get an advantage, it will fight to keep it. This leads to great efforts being exerted to influence those who are responsible for the creation and enforcement of policies and laws. The policymakers are also part of the same capitalistic system that is ingrained into our society and will use their positions to protect their interests. Even when groups or individuals with honest intentions propose laws and regulations, the folks in charge of getting those proposals enacted and put into place are vulnerable to the influence of corporations, religious groups, wealthy individuals, and others who have the resources to either progress or protect their interests.

An example of seemingly neutral policies can be found within Washington State's [Climate Commitment Act](#), which, after many years of effort from environmental advocacy groups, was finally passed at the end of 2021 and went into effect on January 1, 2023. As a WA native, I have been following the progression of this plan. However, unfortunately, the original environmental plan proposal, which was published in 2014, not only differs in many areas but outright opposes what was actually approved because corporations were able to pervert the focus of the plan away from the environment to instead support economic and business interests. Similar to how those with economic power can blur the focus of environmental policy, the same issue can arise in the drafting of agriculture policy and allocating government assistance. Entities with interests outside of the longevity and safety of our food system can influence how government programs function. Many aspects of agriculture are counterproductive to the goals of climate action but are heavily subsidized by the government. The livelihood of farmers, the health of the citizens, and the environment are all in jeopardy unless changes are made to the current agricultural system. Farmers being affected by drought and flooding are aware of this, and environmental interest agencies and groups are aware of this, but there is a disconnect between these two parties. Many farmers are sustainably producing their crops, but since subsidy programs are primarily geared towards assisting commodity crop producers and the risk mitigation is lacking proactive measures, it makes it challenging to be able to form and carry out strategies

not only at the state but also at the federal level to make the necessary transitions to ensure we do not exhaust our limited resources any further.

Another practice we are seeing in the US is the consolidation of agriculture operations. Each year, there are fewer small and medium-sized farms and more large farms. The average number of animals per farm has increased across the board, yet the number of total animals and farms has decreased. Similar to how many other industries, such as banking, retail, oil, healthcare, etc., are consolidating into the hands of fewer people, the agriculture industry is no different. Smaller farms suffer when trying to compete with more extensive agriculture operations due to economies of scale (EOS). According to [Investopedia](#), there are internal and external EOS. Internal EOS provides financial advantages/disadvantages to farms in their ability to invest in more expensive equipment, make purchases and store materials in bulk quantities at lower prices, implement newer technologies, and more favorable interest and borrowing rates associated with the loans for larger farming operations. Internal EOS allows farms to gain a leg up on their competitors of similar size in their respective markets. External EOS provides advantages to larger farming operations through tax exemptions, subsidies, regional and federal laws, and other positive operant conditionings that are designed to be out of the control of any private entity.

"...certain industries may become so important that they can develop bargaining power with politicians and local governments. This, in turn, can lead to more favorable treatment in the form of subsidies or other concessions. The oil industry has a long history of subsidies in the United States, which were historically given to continue a steady flow of domestic supply", and since food is a necessity for our society, there are numerous incentives in place to ensure supply does not fall below demand. ([Ross, 2023](#)). EOS is seen where an inverse relationship between costs and production occurs, as opposed to diseconomies of scale (DOS), where the costs to the business increase as their production increases. At some point, the marginal cost will begin to outweigh the marginal benefit of producing more units, leading to DOS. Similar to EOS, there are internal and external DOS. As a farming operation grows, ceteris paribus, then the natural resources they require and the pollution they produce will also increase. Government restrictions, laws, and permissions impact the EOS and DOS for farms, and the agriculture subsidies play a vital role in shifting the point where a farm's costs become higher than the benefits, allowing farms to employ practices they otherwise would avoid without the subsidy programs. Connecting back to one of the primary purposes of agriculture subsidies per the USDA, to promote specific farming practices, the fact that the number of small/mid farms is shrinking, and the number of large farms is growing begs the question of whether larger operations employ practices that the USDA wants to promote.

If the goals of agriculture subsidies are supposed to protect farmers from income instability and improve food security, what items are farmers being encouraged to produce? The visible answer is commodity crops. Corn farmers receive the most direct subsidy payments, and corn is also the most produced product in the US. Soybeans, wheat, rice, and all the other commodity crops receive the most assistance from the PLC, ARC, crop insurance, and other direct subsidy programs. Upon further investigation, though, the US government indirectly subsidizes animal agriculture, more than any other food type, through a landslide. The USDA states that around 36% of the grains grown in the US are provided as animal feed. ([USDA ERS, 2023](#)) With the highest percent of the funds allocated through the various agriculture direct subsidy programs like PLC, ARC, and crop insurance going to commodity crop grain production, even though the animal agriculture industry only receives a small percentage of subsidy payments directly, primarily support for dairy, they benefit significantly from the direct payments made towards corn, soy, and the other commodity crops.

Additionally, around 40% of corn grown in the US is used for ethanol production, with corn used for animal feed accounting for about the same percentage, according to USDA; another 10-20% is exported, and the remainder is used for domestic human consumption. ([USDA ERS, 2023](#)) Consumers have to go out of their way now to find gasoline without ethanol, increasing the demand for corn and other crops needed for ethanol, like beets. The food vs. fuel debate will likely be a hot topic in the coming years, but the amount of water, fertilizer, and land that would otherwise not be tilled and farmed now is being used to grow crops should be a red flag. I was also not able to find any evidence that ethanol produced from corn is beneficial to carbon emissions, and a 2022 study actually claimed, "These changes [to increase corn production] increased annual nationwide fertilizer use by 3 to 8%, increased water quality degradants by 3 to 5%, and caused enough domestic land use change emissions such that the carbon intensity of corn ethanol produced under the RFS is no less than gasoline and likely at least 24% higher" ([Lark et al., 2022](#))

Intensive monocropping on an industrial scale is able to produce an unbelievable amount of foodstuff, but it also has detrimental impacts on global health. In addition to 40% of corn being used for animal feed, in the past decade, around 70-80% of soy grown in the US has been used for animal feed, and around 20% of wheat is used for animal feed, rounding out the three most directly subsidized crops, corn, soy, and wheat. ([USDA ERS, 2023](#)). Humans have greatly benefited from the consumption of animal products throughout our evolution, and the fact that meat, dairy, eggs, and other animal products contain many of the essential nutrients needed in a healthy diet is a clear advantage to the consumption of products derived from animals. Animal agriculture comes at a very high cost to the environment, local communities, and the economy, and it begs the question of whether the benefits can cover these costs.

A study done by Oxford University in 1989 ([Appleby Et al.](#)) took three thousand vegetarians and had each individual choose a meat-eating friend, and then took another three thousand meat-eaters and had each find a vegetarian friend. With a study group of six thousand vegetarians and five thousand meat eaters, Oxford monitored the individuals between 1980 and 1984. The study concluded that vegetarians were half as likely to be at risk of heart disease, appendicitis, or being prescribed long-term medication. The overall health of the vegetarians was much better than that of the meat eaters. Another study by the "Journal of American Diabetes Association" ([Turner-McGrievy Et al.](#)) in 2008 found that over 22 weeks, people with diabetes had twice as good of AHEI results if they maintained a vegan diet than if they maintained the ADA diet and medication guidelines. A [cancer study in 2011](#) found that vegetarians were 50% less likely to develop cancer, while a general estimate in the medical field that 10% of cancer is hereditary and 90% comes from diet and environment in the meat-eating group, only 35% of cancer in the vegetarian group was caused by diet and environment.

All of these studies showed no indication that animal products are necessary for a healthy diet. I do not have a deep understanding of nutrition, and I do not want to claim that diets that do not include animal products are in any way healthier when compared to carnivorous or vegetarian diets. Though the studies above state that excluding animal products improves health, I want to acknowledge that many factors contribute to a person's health. I did more research and found that vegetarians tend to have a higher level of education, are more likely to exercise, and, on average, smoke/drink less often than people who eat animal products. All of these things are strongly correlated with overall better health, so vegetarianism does not necessarily mean it is healthier than a meat-based diet. However, there are no grounds to state that a diet with little to no animal products is less healthy than a diet with more meat. In all the studies, vegetarians and meat eaters were equally likely to be deficient in any given nutrient when it came to nutrients like proteins, iron, vitamin D, and vitamin B12. Vegetarians, pescatarians, vegans, and meat eaters all had the same likelihood of needing some additional vitamins to supplement their diets. At the very

least, excluding animal products is equally healthy and potentially more healthy than a diet with animal products.

Again, animal products may be a rich source of protein, vitamins, and minerals, but it is difficult to argue that they are necessary. Even though meat contains nutrients, it does not offset the cost of meat. For every dollar we spend on meat production subsidies, we spend only 8 cents on vegetables and fruit for human consumption (EWG's Farm Subsidy, n.d.).

Another massive problem with animal agriculture is the enormous negative externalities on the health of our environment and natural resources. According to the 2009 Livestock's Longshadow Report, livestock produces a tremendous amount of greenhouse gasses and is arguably the biggest polluter of freshwater resources in the US. "The leading role of livestock in methane emissions has long been a well-established fact. Enteric fermentation and manure represent some 80 percent of agricultural methane emissions and about 35–40 percent of the total anthropogenic methane emissions" ([Steinfeld, 2016](#)). Steinfeld's emissions percentages are on the higher end of estimates; another study by IOPScience ([Hayek, Miller 2021](#)) echos the concerns of methane produced by animal agriculture, and another study states, "Animal agriculture has been reported to represent 15.6% of total annual greenhouse gas (GHG) emissions globally...Limiting GHGs from agriculture is urgent because business-as-usual agricultural growth is likely incompatible with limiting warming below 1.5 °C" ([Clark et al., 2020](#)). Somewhere between 24-40% of methane produced by human activities is from animal agriculture. Additionally, according to The IOPScience letter from Matthew N Hayek and Scot M Miller, 26% of the world's ice-free land is dedicated to meat production, and the CDC claims over 3 million Americans fall ill each year from antibiotic pathogens due to animal agriculture. The production of animal agriculture is also the leading cause of deforestation, and I cannot find any evidence that deforestation is beneficial to the health of our planet. "Expansion of livestock production is a key factor in deforestation, especially in Latin America where the greatest amount of deforestation is occurring – 70 percent of previously forested land in the Amazon is occupied by pastures and feed crops" ([Steinfeld, 2016](#)).

The United States spends billions of dollars to fix the health of our citizens; as the 2016 [CDC data brief](#) from Dr. Melonie Heron and Dr. Robert N. Anderson discusses, cancer and heart disease have been the two leading causes of death in the United States for decades, and an unhealthy diet is undoubtedly one of the most significant contributors to these, and many other, diseases. Instead of dedicating billions of dollars of food subsidies to animal agriculture production, we could focus on incentivizing farmers to produce a variety of food groups to support healthy, balanced diets. The current system allows selling animal products for a fraction of the true cost. At the same time, fruits and vegetables only receive 2% of the total food subsidies in the US. Then, the US also spends billions more to protect and repair engaged environments but also allocates great sums of money towards factory farming, which is detrimental to water, land, and air. On top of it all, the primary benefit citizens receive from animal agriculture is nutrients, which can easily be replaced with more responsible alternatives. According to J. Poore and T. Nemecek in their research article "[Reducing Food's Environmental Impacts Through Producers and Consumers](#)", they estimate the GHG emission to produce a gram of protein from beef is 17 times higher than producing a gram of tofu, or over 40 times higher than beans. Over 150 times the GHG compared to nuts. "Most strikingly, impacts of the lowest-impact animal products typically exceed those of vegetable substitutes, providing new evidence for the importance of dietary change" ([Poore & Nemecek, 2018](#)). Cows are always the focal point in comparisons because they require a large amount of food and water, and they produce the equivalent amount of waste. A vast majority of farms in Washington, and the world for that matter, are smaller farms that are conscientious of resources, and the cow's waste can be used as fertilizer for crops

and, if properly utilized, can potentially improve the health of soils and plants. Maintaining a balance is the key. Unfortunately, balance is not what the government incentivizes. Instead, we have corporations and large-scale farmers who only produce a single subsidized crop, such as corn, soy, wheat, meat, dairy, or eggs, and strip the soil of nutrients that have to be continuously replenished with chemical fertilizers. "Ranches in Washington are diverse in size and can be found in all 39 counties. Of the approximately 9,000 ranches and farms, about 6,000 have only ten head of cattle. Only 45 ranches have over 500 head but represent about 63% of the beef cattle inventory" ([WSBC, 2022](#)). The majority of cattle are held by a small fraction of the farming population, and according to the Environmental Working Group ([EWG](#)), of the top 20 recipients of state and federal farming subsidies in 2020, over 61% of the funds went towards the production of cows for meat and dairy products.

I am not claiming animal agriculture needs to be banned or even taxed. However, it does not seem to make sense for such a harmful industry to receive such a large percentage of funds that are supposed to be supporting the farmers and food security.

Washington is known as the evergreen state, and Seattle has the reputation of being a rainy city, but each year, this is becoming less and less true. According to States at Risk, an organization that analyzes the risk each US state is at in connection with extreme weather conditions, Washington needs to protect our freshwater resources, "Washington faces the third largest overall drought threat among states. By 2050, the state is projected to see a more than 300 percent increase in severity of widespread summer drought" ([States at Risk](#)). According to a 2019 article from the [Seattle Times](#), investors are spending millions of dollars to buy water rights from farmers and landowners because the investors believe the environmental scientists that water will become a scarce commodity within the near future, and controlling access to fresh water will become very profitable. Drought is becoming a severe problem in the Western United States, similar to how floods are a serious problem on the Eastern and Southern coasts.

Water conservation needs to be a top priority not only for Washington but across the nation. At the rate we are currently going, even if we were somehow able to meet our greenhouse and climate commitments, we will need water to survive and still need water in order to produce food. For the sake of all the farmers and everybody else, we need to be willing to make drastic and immediate changes to our agricultural practices that use such a large portion of our freshwater resources.

According to the US Department of the Interior's US Geological Survey ([USGS](#)), agriculture consumes more than twice as much fresh water than what is consumed for industrial, domestic, mining, and public use, all combined. The USGS shows that of all the water withdrawn from groundwater sources, 70% was used for agriculture irrigation purposes. Additionally, 30% of the water consumed from surface water sources was used for agricultural irrigation. ([USGS, 2018](#)) The amount of water used in agriculture would make it quite expensive if farmers had to pay the same prices for water as the public, but as explained by Dr. Baldocchi, who is currently a professor and associate dean for the Department of Environmental Science at UC Berkeley, irrigation water for agriculture is highly subsidized. Dr. Baldocchi says the average acre of lettuce farmed requires 3-acre feet of water, or around one million gallons of water; the water bill to grow an acre of lettuce would cost a nonfarmer around \$5k, but between 2010-2015, the average cost in central California was 120 dollars for a million gallons of water for irrigation, and some areas offer prices as low as \$15 for a million gallons. The purpose of Dr. Baldocchi's was to encourage urban farming and address the concerns about the expense of water to people without access to irrigation water prices; he concludes that traditional agriculture might use a million gallons of water to grow an acre of lettuce, but it is possible to cut that amount in half by using drip irrigation. It can potentially be reduced even further by employing other practices. ([Baldocchi, 2018](#)) Dr. Baldocchi's opinion piece tries to show that people should

not be dissuaded from urban farming because of the price of water and other inputs. If anything, it offers a chance to utilize and explore water-saving techniques in growing food. Having a food system that is very much reliant on being able to pull billions of gallons of water annually from sources that are being depleted at an alarming rate creates a juxtaposition of urgently needing to find ways to conserve our precious water resources and having an indispensable industry that is currently reliant on using water-intensive practices is an issue.

Agriculture has been around for thousands of years, and as a collective species, we know how to produce food sustainably. We were doing it thousands of years before the astounding technological and engineering advances we have today. By using the internet, finding answers to problems instantaneously through online searches, or learning how to fix something on YouTube, farmers can maintain a successful farming operation more easily. More complex advancements are just as readily available to farmers, like GPS or even hybrid cover crops that protect soils between growing seasons. Supporting the prosperity of farmers needs to take precedence over profits for large businesses. There is an urgent need to develop more sustainable agriculture, which needs to be a global effort. Spending billions of dollars to support industrial monocropping and animal agriculture and a fraction of that on supporting sustainable agriculture practices seems like a recipe for disaster.

The group [R-CALF](#) put together multiple charts and data points to demonstrate how it has become financially unfeasible to continue farming. The number of beef farm operations decreased by 42% between 1980 and 2010, dairy farms decreased by 81%, and pigs/swine had 91% fewer operations. [R-CALF](#) claims these decreases are not because of a fall in demand for animal meat, but rather large industrial farms have come in and taken over the market. They claim 85% of the meat production comes from four corporate beef slaughter facilities. Farmers struggle to profit, while industrial farming corporations bring in billions of dollars. For example, the [Rieckmann family farm in WI](#), which is \$300k in debt, is just a part of the \$416 billion total farm debt in the United States and shows how ineffective the billions of dollars of subsidies are at providing financial support to smaller farms.

It seems strange that the government would need to convince our farmers that they need to move towards more sustainable practices while farmers are already making these changes out of necessity and the desire to keep their land healthy. As water becomes ever more scarce, farmers like Jay Gordon from Elma, WA, are adapting and changing their farming practices. Jay Gordon, in an interview on the Real Food Real People Podcast, talks about how he has had to learn new techniques to produce crops with less water and fossil fuels, joking that he had to remember all the things from his "...crops and soils classes that [he] fell asleep in 40 years ago" ([Gordon, 2021](#)). Jay Gordon was actually on the advisory board for the Washington climate goals in [2014](#), and farmers like him and his family are prime examples of what needs to be supported. Current subsidy programs are dictating what farmers should and should not be doing by providing little support for practices outside of growing commodities and farming animals. Modern-day agriculture practices are reliant on reactive agriculture subsidies and subsidies that externalize the costs of resource depletion and pollution.

Summary-

Change is inevitable; as clean water and other resources diminish, there will not be enough to keep doing what we are doing. The current subsidy programs have helped farmers across the country face the risks associated with farming, and the programs, without a doubt, have saved countless farming operations from going out of business, but support for farmers big and small to find and implement sustainable practices is needed in order to be proactive in the face of consequences from resource depletion and climate change. I would like to see agriculture subsidies used to aid in the health and longevity of farming communities and

our food systems as a whole, especially as the agriculture industry will need to adapt to variable weather conditions, clean water scarcity, soil degradation, and the countless other impacts of climate change in the coming years. Farming is labor intensive, requiring farmers to work long hours virtually year-round. It also requires many of the same skills needed to run any other type of small business, including accounting, market trends, supply chain management, and a hundred other hats that business owners have to wear. At the same time, it is an integral part of our society, and our society would cease to exist if we did not have an agricultural system that could provide food. The next farm bill is set to be drafted this year, and I plan to follow its progression closely. Currently, the [forecasted government assistance programs](#) will be even more focused on crop insurance and promoting the same farming practices that are presently being promoted. The agricultural practices that the government subsidy programs promote are predominantly industrial and factory farming, and assuming this is intentional on the government's part, a question that has developed during my research that I want to explore is the logic behind the decisions to promote these choices.

Bibliography-

de Marsily G: Will We Soon Run Out of Water? *Ann Nutr Metab* 2020;76(suppl 1):10-16. doi: 10.1159/000515019.

Climate Commitment Act RCW 70A.15.2200 WA State Senate, (2021). WA State Senate Bills. <https://lawfilesexternal.wa.gov/biennium/2021-22/Pdf/Bills/Senate%20Passed%20Legislature/5126-S2.PL.pdf?f?q=20230807173150>

CERT. (2014). Carbon Emissions Reduction Taskforce: Report to the Washington State Governor's Office. WA State Governor's Office . https://www.c2es.org/wp-content/uploads/2018/11/WA_2014_Action_Plan.pdf

Appleby P, Thorogood M, Mann J, Key T, The Oxford Vegetarian Study: an overview, *The American Journal of Clinical Nutrition*, Volume 70, Issue 3, September 1999, Pages 525s–531s, <https://doi.org/10.1093/ajcn/70.3.525s>

Turner-McGrievy G, Barnard N, Cohen J, Jenkins D, Gloede L, Green A, Changes in Nutrient Intake and Dietary Quality among Participants with Type 2 Diabetes Following a Low-Fat Vegan Diet or a Conventional Diabetes Diet for 22 Weeks, *Journal of the American Dietetic Association*, Volume 108, Issue 10, 2008, Pages 1636-1645

Zimmer J, Lange B, Frick JS, Sauer H, Zimmermann K, Schwartz A, Rusch K, Klosterhalfen S, Enck P. A vegan or vegetarian diet substantially alters the human colonic fecal microbiota. *Eur J Clin Nutr*. 2012 Jan;66(1):53-60. doi: 10.1038/ejcn.2011.141. Epub 2011 Aug 3. P.M.I.D.: 21811294.

USDA Payment Files. (2024). <https://www.fsa.usda.gov/news-room/efoia/electronic-reading-room/frequently-requested-information/payment-files-information/index>

Steinfeld H. Food and Agriculture Organization of the United Nations & Livestock Environment and Development (Firm). (2006). *Livestock's long shadow: environmental issues and options*. Food and Agriculture Organization of the United Nations.

Clark MA, Domingo NGG, Colgan K, Thakrar SK, Tilman D, Lynch J, Azevedo IL, Hill JD. Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science*. 2020 Nov 6;370(6517):705-708. doi: 10.1126/science.aba7357. P.M.I.D.: 33154139.

Heron, Melonie Ph.D. and Anderson, Robert N. Ph.D. 2016, Changes in the leading cause of death: Recent patterns in heart disease ... (n.d.). Retrieved from <https://www.cdc.gov/nchs/data/databriefs/db254.pdf>

2017 Census of Agriculture, (U.S.D.A.) United States Department of Agriculture. 2017 Census by State | USDA/NASS.(n.d.).Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/index.php

Poore, J., & Nemecek, T. (2018). We are reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987-992.

R-Calf. (2011). R-calfusa.

<https://www.r-calfusa.com/wp-content/uploads/competition/110502StateUSCattleIndustry.pdf>

Gordon J, Farmer Jay Gordon: #055. Real Food Real People. (2021, April 27). Retrieved from <https://realfoodrealpeople.org/jay-gordon-055/>

Baldocchi, D. (2018). The cost of irrigation water and urban farming. Berkeley.

<https://news.berkeley.edu/2018/01/26/the-cost-of-irrigation-water-and-urban-farming>

USGS. (2018). Surface water use in the United States . Surface Water Use in the United States | U.S. Geological Survey.

<https://www.usgs.gov/special-topics/water-science-school/science/surface-water-use-united-states>

Ross, S. (2023, September 13). Internal vs. external economies of scale: What's the difference? Investopedia.

<https://www.investopedia.com/ask/answers/013015/what-are-differences-between-internal-and-external-economies-scale.asp#:~:text=Key%20Takeaways,average%20costs%20of%20business%20drop.>

GAO (Dec. 2023). Crop insurance: Update on opportunities to reduce program costs. Crop Insurance: Update on Opportunities to Reduce Program Costs | U.S. GAO.

<https://www.gao.gov/products/gao-24-106086#:~:text=Premium%20subsidies%20for%20policyholders.,total%20cost%20of%20%2417.3%20billion.>

W.S.B.C. (2022). Industry stats. Washington State Beef Commission.

<https://www.wabeef.org/about-us/Industry-Stats>

Lark, T., Hendricks, N., Smith, A., Gibbs, H., Pates, N., & Spawn-Lee, S. (2022, February). Environmental outcomes of the US renewable fuel ... <https://www.pnas.org/doi/abs/10.1073/pnas.2101084119>

EPA. (2023). <https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding>

USDA ERS. (2023). Feed grains sector at a glance. Feed Grains Sector at a Glance.

<https://www.ers.usda.gov/topics/crops/corn-and-other-feed-grains/feed-grains-sector-at-a-glance/>

Waters of the United States. American Farm Bureau Federation. (2023).

<https://www.fb.org/issue/regulatory-reform/waters-of-the-united-states>

Beyond the Packaging: Engineering Sustainable Solutions to Plastic Pollution in Tijuana

Case Study Final Paper

David Garcia, B.S. Packaging Engineering

MESH 540 – Capstone Project Course

Willy Oppenheim, Ph.D

April 14, 2024

Abstract

This paper provides a comprehensive examination of my efforts to combat plastic pollution in the Tijuana River Basin with the non-profit organization, Waste For Life, focusing on community engagement, sustainability, and environmental justice. Drawing from lessons learned throughout the MESH program and influential environmental writers, the study delves into the multifaceted challenges posed by plastic waste and explores innovative solutions implemented by local citizens of impacted communities. With support from Waste For Life and myself, locals in Tijuana have found a way to turn plastic packaging waste into recycled composite sheets using a heat press. These sheets are then skillfully crafted into artistic products that are then sold with 100% of the profits going to the local community members. 450 samples of these plastics were sent to me for testing where I revealed quantifiable physical properties, such as flexural strength, which can be used to optimize the manufacturing process and identify potential use cases for the recycled products. Through a combination of fieldwork, laboratory testing, and community outreach, the paper uncovers the various dimensions of the problem, highlighting the importance of cross-border collaboration in mitigating the impact of plastic pollution in the Tijuana River. Utilizing empirical data, sociological perspectives, and environmental philosophy, the paper highlights the complex dynamics underlying plastic pollution in the Tijuana region. It proposes practical strategies for fostering sustainable practices and community resilience. By integrating insights from diverse disciplines and amplifying the voices of local stakeholders, this research contributes to ongoing efforts to combat plastic pollution in the Tijuana River Basin and beyond, aiming to catalyze meaningful change in environmental conservation practices and both community and global health.

Introduction

Plastic pollution in the Tijuana River Basin poses a complex challenge, influenced by factors such as industrialization, rapid urbanization, and inadequate waste management practices. Particularly evident at Imperial Beach, San Diego, plastic debris carried downstream by the 120-mile Tijuana River accumulates, negatively impacting coastal ecosystems and communities. Stormwater runoff worsens the problem during intense rainfall by washing plastic garbage from mountainous urban areas, garbage dumps, and spontaneous dumpsites to the river's mouth and out to the ocean. Addressing this complex problem demands collaborative efforts across governmental, non-governmental, and community stakeholders on both sides of the border to implement comprehensive waste management strategies and enhance stormwater management infrastructure.

To fully grasp the magnitude of the plastic pollution crisis in the Tijuana River basin, it is imperative to delve into the historical roots of the issue. The evolution of Tijuana from a small border town to a bustling metropolis has been marked by waves of industrialization and urban development, driven by various economic and social forces. The rapid growth of manufacturing industries, coupled with lax environmental regulations in past decades, has fostered a culture of unchecked production and disposal of plastic materials. Moreover, the historical dynamics of the US-Mexico border region, characterized by disparities in wealth, resources, and governance, have played a significant role in shaping patterns of waste generation and management.

Beyond historical context, the current crisis of plastic pollution in the Tijuana River cannot be separated from its socio-political dimensions. Tijuana, like many urban centers in developing countries, grapples with a multitude of challenges ranging from poverty and inequality to corruption and institutional

weaknesses. These factors intersect with environmental issues in complex ways, influencing everything from waste management practices to community resilience in the face of environmental hazards. Moreover, the transboundary nature of the Tijuana River basin implicates not only local stakeholders but also regional and international actors in efforts to address plastic pollution and its impacts on both sides of the border.



As a packaging engineer deeply committed to sustainability, my involvement in tackling plastic pollution in the Tijuana area has been guided by a sense of responsibility to confront this pressing issue inadvertently created by the packaging engineers before me. Through rigorous testing protocols aimed at optimizing the manufacturing process for reclaimed composite plastics, I have endeavored to mitigate plastic pollution while fostering sustainable development in the Tijuana River Basin. Drawing upon technical expertise in material science and packaging engineering, I have collected and analyzed numerous samples, providing valuable insights into the physical properties and recyclability of plastic materials used in the region. By leveraging empirical data and engineering ingenuity, I have sought to unlock innovative solutions that contribute to environmental conservation by helping to optimize the manufacturing process carried about by Waste For Life in Tijuana.

My 1,000-mile journey into the heart of Tijuana provided firsthand insight into the realities of plastic pollution and the transformative potential of community-led initiatives. Immersed in the vibrant tapestry of local life, I witnessed the tangible impacts of my scientific endeavors and the resilience of communities grappling with environmental challenges. From attending the educational workshops of organizations like

Waste For Life to the conversations with the key women involved in reducing plastics in the area, each encounter deepened my understanding of the socio-economic dynamics shaping plastic pollution in the region. Through dialogue, collaboration, and shared vision, I forged meaningful connections with local stakeholders, laying the groundwork for collaborative action towards a more sustainable future.

Environmental authors like Rachel Carson and Wangari Maathai have profoundly influenced my approach to addressing plastic pollution, underscoring the interconnectedness of human and environmental well-being. Embracing their values of environmental stewardship and social justice, I have anchored my initial work within a broader ethical framework that transcends disciplinary boundaries. Furthermore, by drawing upon sociological perspectives from scholars like Ian Angus and Gareth Evans, I have navigated the socio-economic dimensions of plastic pollution, shedding light on the power dynamics and systemic injustices that perpetuate environmental degradation. Through this interdisciplinary lens, I hope to amplify the voices of marginalized communities and advocate for inclusive, community-driven solutions to plastic pollution in the Tijuana area.

In charting a course towards a sustainable future, my endeavors underscore the critical importance of interdisciplinary collaboration, community empowerment, and ethical stewardship. By implementing scientific processes, community engagement, and environmental philosophy, I am optimistic about the transformative potential of collective action in addressing plastic pollution in the Tijuana River Basin. In my time in Tijuana, I experienced firsthand the lives of locals like Adela Bonilla and Ana Aguiarte who are actively making a positive effort to manage the issue of plastic pollution in their own community. Moreover, I was able to witness the local children learn about sustainability and create works of art of their own using the reclaimed composite plastics and manufacturing techniques that I contributed to. Through inclusive decision-making processes and participatory engagement, I believe we can pave the way for a brighter and more sustainable future for generations to come.

Literature Review

Application of Classical Sociological Thinkers

My case study focuses on the Tijuana River, where I'm actively engaged with Waste For Life to extract plastic from the river and transform it into marketable goods, benefiting the local community. Utilizing my expertise as a Packaging Engineer, I will offer insights to optimize the manufacturing of these new materials, enhancing their final physical attributes. However, beyond the physical aspect of sustainability, I believe it is important to dive deeper into new perspectives based on the lessons I've learned throughout the MESH program.

The plastic pollution crisis in the Tijuana River presents an urgent ecological challenge that demands comprehensive solutions. Drawing inspiration from the wisdom of environmental pioneers Rachel Carson and Wangari Maathai, we can draw guidance to effectively address this issue and uplift the Tijuana community. However, it is essential to recognize both the captivating aspects of the problem and the limitations in their insights.

One crucial facet that demands attention is the profound environmental and health consequences of plastic pollution in the Tijuana River. American marine biologist Rachel Carson, in her seminal work "Silent Spring," highlighted the intricate interplay between human activity and nature, underscoring how pollutants can disrupt ecosystems. Similarly, Kenyan environmentalist Wangari Maathai's emphasis on the importance of trees and biodiversity in "The Green Belt Movement" echoes the significance of preserving the river's

ecosystem. Plastic pollution imperils aquatic life and jeopardizes the ecological well-being of the region through habitat destruction and microplastic consumption (Carson, 1962; Maathai, 2004). Carson also warned of the interconnectedness of environmental issues, emphasizing that "the balance of nature is not a status quo; it is fluid, ever shifting, in a constant state of adjustment" (Carson, 1951). This highlights the constant need to find adaptable, long-lasting solutions towards sustainability in regions like the Tijuana River.

Moreover, the contamination of water sources and ingestion of plastic particles by marine organisms have dire implications for human health (Carson, 1962). A comprehensive strategy is imperative, encompassing both environmental well-being and the health of the local population. Maathai's call for grassroots action and community engagement, as seen in her assertion that "when people are empowered, they take control," aligns with the need to raise awareness, provide education, and involve the Tijuana community in decision-making processes (Maathai, 2004).

Cross-border collaboration emerges as another significant facet, considering the Tijuana River's transboundary nature. Carson's advocacy for international cooperation in "The Sea Around Us" resonates with the requirement for joint efforts between Mexico and the United States to combat plastic pollution (Carson, 1951). Collaborative financial, resource, and implementation endeavors from both sides of the border are the most vital aspects to effectively address the issue of pollution in the river.

Engaging and empowering the local community is paramount, given the disproportionate impact of pollution on Tijuana's inhabitants. Maathai's emphasis on empowerment and education finds relevance in the context of the Tijuana community's struggle with untreated wastewater and trash contamination (Maathai, 2004). Empowering the community through education and involvement fosters a collective sense of responsibility and promotes sustainable practices. Furthermore, embracing a circular economy and eco-conscious entrepreneurship can offer practical avenues to combat plastic pollution and support the local community. Initiatives that transform plastic waste into marketable products, just like Waste For Life's endeavors, align with this circular economic model (Carson, 1962). These initiatives not only reduce waste but also create economic opportunities, resonating with Maathai's vision of environmental conservation intertwined with economic prosperity.

However, it is important to acknowledge the limitations in Carson's and Maathai's contributions. While their work on pesticides and reforestation remains pertinent, they do not directly address plastic pollution. A broader spectrum of perspectives is necessary to comprehensively grasp the complexities of plastic waste management (Carson, 1962; Maathai, 2004). Additionally, ensuring social justice in cleanup and recycling initiatives, as Maathai advocated for marginalized communities, is crucial in not just Tijuana, but all communities. (Maathai, 2004).

Ultimately, integrating the foundational principles of Carson and Maathai provides valuable insights for tackling plastic pollution in the Tijuana River. However, it is essential to recognize the multifaceted nature of the issue, encompassing environmental consequences, cross-border collaboration, community engagement, and circular economy principles. Acknowledging the gaps in these visionaries' perspectives and embracing diverse viewpoints is vital for a comprehensive and effective approach to addressing plastic pollution and benefiting the Tijuana community.

Application of Sociological Perspectives

As is the case with most issues with global engineering, the microscopic roots of the issues can be better examined through a sociological lens. The scholarly contributions of Ian Angus, Gareth Evans, Gloria

Flora, and Tatiana Schlossberg Pierre-Louis have significantly deepened my comprehension of sustainability and shed light on its relevance to my analysis of Waste For Life's initiatives aimed at eradicating plastic pollution from the Tijuana River.

In his thought-provoking essay titled "The Myth of the Tragedy of the Commons," Ian Angus challenges the conventional belief that the depletion of resources is solely a consequence of innate human behavior. Angus's perspective urges us to consider a broader spectrum of societal, economic, and political factors when tackling sustainability challenges (Angus, 2008). This prompts Waste For Life to acknowledge and address the systemic underpinnings of plastic pollution, transcending mere individual actions. The organization's proactive engagement with local authorities, businesses, and civil society groups – such as the Tijuana River National Estuarine Research Reserve - exemplifies their commitment to formulating holistic strategies that target the fundamental origins of plastic waste (Angus, 2008).

Gareth Evans' meticulous research on environmental governance underscores the critical importance of inclusive decision-making and active community involvement (Evans, 2001). I believe Waste For Life's approach of involving local community members in plastic collection mirrors Evans's emphasis on community engagement. By empowering the community and respecting their local knowledge, Waste For Life ensures the appropriateness and sustainability of their interventions (Evans, 2001). This empowerment approach nurtures a sense of ownership and dedication within the community, fostering lasting and transformative change.

The integration of Angus and Evans' theoretical frameworks significantly expands the understanding of this case study and revolutionizes the conceptualization of interventions and solutions. Waste For Life is poised to adopt a comprehensive strategy that takes into account the broader societal, economic, and political dimensions of plastic pollution (Angus, 2008; Evans, 2001). This involves advocating for policy reforms, engaging in educational initiatives, and forging partnerships with a diverse range of stakeholders to address the underlying drivers of plastic waste. Such an all-encompassing strategy enhances the efficacy and enduring impact of Waste For Life's endeavors (Angus, 2008; Evans, 2001).

Through the assimilation of these innovative concepts, my comprehension of the case study has matured significantly. I now recognize the imperative to transcend individual behaviors and delve into the systemic catalysts of plastic pollution. Waste For Life's strategy of involving the local community underscores the importance of inclusive decision-making and community empowerment (Evans, 2001). This realization paves the way for a more comprehensive and adoptable approach to mitigating plastic pollution in the Tijuana River.

All-in-all, the insights gained from Angus, Evans, Flora, and Pierre-Louis's writing have enriched my understanding of sustainability in the context of my cooperation with Waste For Life case study. By embracing a multifaceted approach that considers broader societal, economic, and political influences, collaborating with stakeholders, and empowering the local community, Waste For Life can formulate comprehensive strategies that address the root causes of plastic waste (Angus, 2008; Evans, 2001). This approach not only expands our comprehension of the case study but also reimagines the conception of interventions and solutions, fostering a more sustainable future for the Tijuana River region.

Application of the Feminist Method

In the exploration of my collaborative venture with the non-profit organization Waste For Life, focused on combatting plastic pollution in the Tijuana River through plastic recycling, a feminist lens

provides invaluable insights into the plight of women and marginalized groups grappling with the environmental injustices stemming from plastic contamination in the Tijuana River. As written by Robert Verchick's *In a Greener Voice: Feminist Theory and Environmental Justice*, a feminist methodology encompasses three essential components: the revelation of concealed dynamics, contextual reasoning, and the elevation of collective consciousness (Verchick, 1996). By diligently applying these tenets, we can shed light on intricate societal power dynamics and ensure the inclusion of marginalized voices in the decision-making process.

The first aspect, the unveiling of hidden dynamics, involves a rigorous analysis of seemingly impartial environmental regulations, policies, and decisions to expose underlying social power dynamics (Verchick, 1996). In the context of the Waste For Life project, this requires a thorough exploration of the historical evolution and implementation of waste management policies in Tijuana. Scrutinizing past policies and practices allows us to comprehend their impact on waste management and to identify any biases or inequities disproportionately affecting different communities. This approach assists in uncovering the foundational causes of environmental injustices linked to plastic pollution and informs efforts to promote more equitable waste management strategies (Verchick, 1996).

An integral facet is the spatial distribution of waste processing facilities, which may reveal an unjust concentration of these sites in low-income or marginalized mountainous communities (Verchick, 1996). A crucial question is whether the geographical arrangement perpetuates environmental disparities by disproportionately burdening these communities. Additionally, delving into the gendered dimension of decision-making processes and policy implementation could reveal the potential marginalization of women in the formulation and execution of waste management strategies (Verchick, 1996).

The second principle, contextual reasoning, urges us to grasp social and environmental concerns by engaging directly with the experiences of those most affected (Verchick, 1996). Conducting interviews or orchestrating focus group discussions with community members offers invaluable insights into the daily challenges they confront due to plastic pollution in the Tijuana River. In my time spent in Mexico, I made it a mission of mine to interview the key women involved and I made my best attempt at speaking in their native language. From that I learned that women, particularly those like Ana Aguiarte and Adela Bonilla Armenta, play crucial roles in addressing these challenges.

Ana Aguiarte, a dedicated environmental advocate, serves as a pivotal figure at the Tijuana River National Estuarine Research Reserve. With over 20 years of experience in the region, Ana works tirelessly to bridge gaps between communities and promote sustainable practices. As a liaison between projects on both the American and Mexican sides, Ana emphasizes the importance of cross-border collaboration in tackling environmental issues. Through her work, Ana sheds light on the interconnected nature of environmental challenges and the need for collaborative solutions. In line with Verchick's principles of addressing environmental inequalities, Ana's efforts highlight the importance of considering marginalized communities' perspectives and engaging in cross-border cooperation to ensure equitable environmental outcomes (Verchick, 1996).

On the other hand, Adela Bonilla Armenta stands out as a visionary artist and youth educator, deeply committed to transforming reusable materials into usable, sellable, works of art. With 17 years of experience in working with recycled materials, Adela's innovative approach exemplifies the fusion of creativity and sustainability. Her work with Waste For Life not only empowers communities to repurpose waste materials

but also fosters economic opportunities and environmental stewardship. Adela's dedication to sustainability initiatives highlights the transformative potential of grassroots efforts in combating plastic pollution and fostering community resilience. Through her actions, Adela embodies Verchick's principles of grassroots empowerment, as she enables community members to advocate for their rights and needs in environmental decision-making processes (Verchick, 1996).

Together, Ana and Adela offer unique perspectives and insights into the complexities of environmental sustainability and the transformative power of community-driven initiatives. Through their interviews, we gain valuable insights into the challenges faced by communities affected by plastic pollution and the importance of grassroots empowerment in driving sustainable change. By amplifying their voices and incorporating their perspectives into environmental initiatives, we can work towards more equitable and sustainable outcomes for all, in line with Verchick's principles of consciousness-raising and community engagement (Verchick, 1996).

Literature Review Conclusion

In conclusion, this paper has traversed diverse theoretical landscapes, drawing from classical sociological perspectives, environmental governance frameworks, and feminist methodologies to illuminate the multifaceted nature of plastic pollution in the Tijuana River and the initiatives spearheaded by Waste For Life. Through the lens of environmental pioneers like Rachel Carson and Wangari Maathai, we've explored the intricate interplay between human activity and ecological systems, underscoring the urgent need for comprehensive solutions to address plastic pollution and uplift communities. Additionally, insights from scholars such as Ian Angus and Gareth Evans have broadened our understanding of sustainability challenges, emphasizing the importance of inclusive decision-making and community empowerment in tackling systemic issues. Moreover, the feminist lens has brought to light the gendered dimensions of environmental injustices and highlighted the pivotal roles played by women like Ana Aguiarte and Adela Bonilla Armenta in driving grassroots initiatives for change. By synthesizing these theoretical perspectives and integrating empirical evidence from interviews with key stakeholders, this paper not only deepens our comprehension of the Waste For Life project but also contributes to broader conversations surrounding environmental sustainability and social justice. It underscores the imperative for collaborative, holistic approaches that consider ecological, social, and economic dimensions to foster meaningful and lasting change in the Tijuana River region and beyond.

Methodology:

Literature Review: The methodology of this paper is grounded in a thorough review of existing literature on plastic pollution, drawing from a diverse range of sources to comprehensively understand the multifaceted nature of the issue. Central to this review is an exploration of the environmental, social, and economic implications of plastic pollution, informed by the works of environmental philosophers such as Rachel Carson and Wangari Maathai. By delving into their philosophical perspectives, the study seeks to highlight the underlying values and principles that shape environmental conservation efforts, providing a foundational framework for further inquiry.

Data Collection: A critical aspect of the methodology involves primary data collection, facilitated through my active involvement in testing plastic composite samples as a packaging engineer. This hands-on approach allows for the gathering of empirical data on the physical properties and manufacturing processes of plastic composites, offering valuable insights into the technical aspects of plastic recycling and product

development. Through systematic testing and analysis, the study aims to generate evidence-based findings that contribute to a deeper understanding of the challenges and opportunities associated with plastic waste management while simultaneously offering data to optimize the manufacturing process of the recycled plastic materials.



Above: Here we see samples of the composite plastics that were sent to me from the University of San Diego

Below: 25 samples were sent to me and prepared into 450 strips that underwent different environmental conditions through state of the art lab equipment simulating different damaging factors (see appendix) before being tested individual for their flexural strength.



Here we can see the final testing process I performed in my packaging lab in Westpak – San Jose, CA. 450 prepared samples were tested, and their flexural properties recorded according to American Society for Testing and Materials ASTM D790-17. This data provided insights to optimize each individual plastic composite sheet and identify potential use cases for the products made from the recycled materials.

Ethnography: The methodology includes fieldwork in Tijuana, where firsthand observation and documentation of the plastic recycling process are conducted. This immersive experience provided an invaluable opportunity to engage with local communities, environmental organizations, and stakeholders, gaining insights into the socio-economic and environmental dimensions of plastic pollution in the region. By directly interacting with individuals affected by plastic pollution and witnessing the intricacies of recycling efforts, the study aims to contextualize theoretical knowledge within the real-world context, enriching its analytical framework.

Interviews: Key stakeholders, including Ana Aguiarte from the Tijuana River National Estuarine Research Reserve and Adela Bonilla Armenta, an artisan and educator specializing in reusable materials, are interviewed with consent to gather qualitative data to supplement my quantitative data as well as firsthand perspectives on plastic pollution mitigation efforts. These interviews serve as a crucial component of the methodology, offering deeper insights into community perspectives, challenges, and potential solutions. Through in-depth conversations and dialogue, the study seeks to capture the diverse range of experiences and perspectives shaping plastic waste management practices.

Analysis and Synthesis: Following data collection, the study employs rigorous analysis and synthesis techniques to distill key findings and identify emerging themes related to plastic pollution, community engagement, and sustainable practices. By combining data from literature reviews, empirical research, field observations, and interviews, the study aims to uncover patterns, trends, and underlying dynamics influencing plastic waste management strategies. Through systematic analysis, the study seeks to generate actionable insights and recommendations for addressing the complex challenges posed by plastic pollution.

Epistemological Stance: This methodology adopts a dual approach, blending experiential and participatory epistemological stances, to explore plastic pollution in Tijuana. Initially, we engage in direct activities within the community, experiencing and learning about plastic pollution firsthand. Transitioning to a participatory stance, we prioritize collaboration with the community, valuing their unique perspectives and knowledge. By physically being present in Tijuana, we engage in collaborative efforts with community members, leveraging their expertise derived from lived experiences. Our methodology challenges environmental disruption through grassroots involvement and redirects profits from recycled plastic products back to the community, empowering local residents economically. Through direct engagement and collaboration, we foster transformative experiences that transcend traditional research endeavors.

Reflection and Recommendations: The methodology concludes with a process of reflection and synthesis, where personal experiences, observations, and interview findings are critically analyzed to inform recommendations for future action and research. Drawing upon the insights generated through the study, the research proposes actionable steps towards fostering greater collaboration between stakeholders, empowering communities, and implementing innovative solutions to plastic pollution. By reflecting on the implications of the study's findings and offering practical recommendations, the methodology seeks to contribute to ongoing efforts aimed at mitigating the adverse effects of plastic packaging pollution and advancing sustainable development goals.

Results and Discussion

Extent of Plastic Pollution in the Tijuana Region:

Plastic pollution in the Tijuana region represents a multifaceted environmental challenge with far-reaching implications for both ecosystems and human communities. Extensive field research and data analysis have revealed the pervasive presence of plastic waste along the Tijuana River basin, encompassing not only the river itself but also adjacent coastal areas and urban centers. This pollution is attributable to various factors, including inadequate waste management infrastructure, population growth, industrial activities, and transboundary pollution from both sides of the Mexico-U.S. border. Moreover, the rugged mountainous topography of the region exacerbates the problem by creating inaccessible areas where plastic waste accumulates unchecked.

The consequences of plastic pollution in the Tijuana region are ever growing and reach beyond just the borders or the shore. Plastic debris poses significant threats to terrestrial and aquatic ecosystems, endangering wildlife, degrading habitat quality, and disrupting ecological processes. In addition, plastic pollution contributes to the contamination of soil and water resources, with potential implications for human health and food security. Moreover, plastic waste intensifies flooding and drainage issues, particularly in informal settlements and marginalized communities located in flood-prone areas along the Tijuana River. These communities often lack adequate infrastructure and resources to address the impacts of plastic pollution, perpetuating a cycle of environmental degradation and socio-economic vulnerability.

The root causes of plastic pollution in the Tijuana region are deeply intertwined with broader socio-economic and environmental dynamics. Rapid urbanization, population growth, and industrialization have led to increased plastic consumption and waste generation, placing immense strain on existing waste management systems. Inadequate waste collection and disposal infrastructure, coupled with limited regulatory enforcement, elevate the problem by allowing plastic waste to accumulate in natural ecosystems and urban areas. Furthermore, the socio-economic disparities prevalent in the region contribute to unequal distributional impacts, with marginalized communities bearing a disproportionate burden of plastic pollution-related risks and hazards.

Addressing the extent of plastic pollution in the Tijuana region requires a comprehensive and multifaceted approach that addresses both the symptoms and underlying drivers of the problem. Efforts to mitigate plastic pollution must encompass strategies for waste reduction, improved waste management infrastructure, environmental education, policy advocacy, and community engagement. By adopting a holistic perspective and implementing collective action across multiple disciplines and stakeholders, I believe it is possible to achieve meaningful progress towards a cleaner, healthier, and more sustainable environment for current and future generations in the Tijuana region.

Reclaimed Plastic Composite material testing:

Each of the plastic composite sheets that are representative of the materials produced in Tijuana went through a series of tests to simulate different conditions. 75 samples were placed in an environmental chamber that would simulate cold/wet/dry environments that are typically seen by products in the transit environment. 75 samples were placed in a UV exposure chamber to simulate the effects of the sun on the plastic such as in an outdoor use. 75 samples were placed in an accelerated aging chamber to simulate the degrading effect of time on the product through a lab-controlled setting. 75 samples were placed in salt fog exposure chamber to simulate the effects of salty-humid air such as in a seaside environment. 75 samples were placed in a low pressure/high altitude chamber to simulate the effect on the products that would be seen via plane travel or shipment.

450 recycled plastic composite sheets were tested by myself in a packaging lab to determine their flexural modulus and their flexural strength (see appendix for data). Flexural modulus can be described as a material's resistance to bending while flexural strength describes the material's maximum stress before breaking. The overall results of the collective testing, found in the Appendix of Data at the end of the paper, are as follows:

The atmospheric conditioning or cold/wet/dry test resulted in an increase in both flexural modulus and strength compared to the control group. This could be attributed to the fact that exposure to low temperatures, high humidity, and extreme temperatures may have induced some changes in the plastic

composite material's microstructure, which could have led to increased strength. UV exposure resulted in a decrease in both flexural modulus and strength compared to the control group. This could be due to the fact that UV radiation can lead to the degradation of plastic polymers. Accelerated aging resulted in an increase in flexural modulus but a decrease in flexural strength compared to the control group. The increase in flexural modulus could be due to the fact that the aging process caused the material to become stiffer. The decrease in flexural strength could be attributed to the fact that aging may have caused some weakening in the material's structure. Salt Fog exposure caused a decrease in flexural modulus but an increase in flexural strength compared to the control group. The reduction in flexural modulus could be due to the salt fog exposure causing corrosion and moisture absorption, leading to a decrease in stiffness. Additionally, the increase in flexural strength could be attributed to the salt fog exposure causing a buildup of salt on the materials surface. It is important to note that composites containing tamale husk began to grow mold so it would be ill-advised to use this product in moist environments. Exposure to low pressure and high altitude resulted in an increase in flexural modulus but a decrease in flexural strength compared to the control group. The increase in flexural modulus could be due to the reduction in air pressure causing the material to become compacted, leading to an increase in stiffness. However, the decrease in flexural strength could be attributed to the fact that exposure to low pressure and high altitude may have caused microcracks, leading to a reduction in strength.

These findings provide a quantitative insight into the potential uses of each reclaimed plastic composite and help further shape the creativity involved in turning the plastic waste into a variety of beautiful, usable, sustainable products.



Pictured: A green notepad made from chip bags, a beautiful brown coin purse made from recycled cloth and plastics, and other recycled plastic products produced by students in the workshop I attended in Tecolote, Tijuana, Mexico.

Epistemological Stance

In formulating this case study with Waste For Life, my methodology is supported by a dual approach, combining experiential and participatory epistemological stances. Embarking on an experiential epistemological stance, my work immerses itself in direct engagement with the local community members of Tijuana. Through hands-on involvement in activities addressing plastic pollution, I actively sought to acquire practical knowledge and gain insights into the challenges and potential solutions associated with plastic waste in the Tijuana River.

Transitioning to a participatory epistemological stance, collaboration with the local community is a fundamental pillar of my project. In February 2024, I drove down for 10 hours to Tijuana to have first-hand collaborative experience with the community I had done my lab testing for. Recognizing and valuing the unique knowledge and perspectives of the community members themselves, this participatory approach ensures that the community is not reduced to a passive role but are active contributors, leveraging their expertise derived from their lived experiences.



Here we can see a window into the lives of the locals in Tijuana as I captured a photo looking out of the second story of a community center where the local youths gathered to learn about sustainability.

In the realm of environmental disruption, my project challenges traditional top-down approaches by actively involving the local community. This grassroots approach not only acknowledges but centers on the significance of local knowledge in shaping meaningful and sustainable solutions to the pervasive issue of plastic pollution.

Shifting focus to economic disruption, the innovative model of transforming plastic waste into composite plastic products, with all profits reverting back to the community, stands as a departure from conventional economic paradigms. This approach intentionally reconfigures power dynamics, directing tangible benefits to the community and challenging established economic hierarchies. Zooming in on community empowerment, my project seeks to disrupt the passive role often assigned to communities in environmental initiatives. Instead, it empowers the community to actively participate in decision-making processes and ensures that they directly reap the benefits of the outcomes. This deliberate approach challenges preconceived notions that communities are mere recipients of interventions.

All-in-all, my case study falls within a methodological framework that seamlessly integrates experiential and participatory epistemologies. Through this combination, the project not only addresses environmental and economic challenges but also disrupts prevailing norms, empowering local communities to play a central and active role in shaping their own sustainable future.

In crafting this case study with Waste For Life, I feel a strong sense of pride with our dual approach of experiential and participatory epistemologies. Engaging directly with the Tijuana community, I find a

profound connection to the hands-on, experiential epistemological stance. It goes beyond just gathering knowledge; it's about immersing myself in the community's efforts to tackle plastic pollution at its source in the Tijuana River. I think this direct involvement not only informs the study but also cultivates a genuine understanding of the challenges the community faces in dealing with plastic waste.

Transitioning to a participatory epistemological stance, I have a newfound appreciation for the collaborative nature of the project. I like that it values and integrates the perspectives of the local community members, acknowledging their agency and expertise in shaping sustainable solutions. This resonates deeply with me as it goes beyond a mere research endeavor; it actively involves the community, making them partners in the process. Shaking hands and sharing food and speaking Spanish with the locals was a transformative experience that taught me more than any book I could have read. I now feel a personal connection to the idea of empowering communities as active participants, not just recipients.

Moreover, when considering the disruption of hegemonic ways of knowing and being, I think the environmental disruption, rooted in a grassroots approach, is particularly compelling. I have great appreciation for the fact that the project challenges traditional top-down environmental interventions, emphasizing a community-driven model. Similarly, the economic disruption, redirecting 100% of the profits from the sale of the recycled plastic products back to the community, makes me a proud collaborator. I feel it challenges established economic hierarchies in a way that aligns with the project's transformative goals. In essence, the theme of community empowerment resonates deeply with my personal values, and I have great respect for the project's commitment to fostering sustainability and challenging established norms for a more equitable and environmentally conscious future.

Impact of Community Engagement and Empowerment:

Community engagement and empowerment are pivotal in addressing the pervasive issue of plastic pollution in the Tijuana region, fostering a sense of ownership and responsibility among local residents. Ana Aguiarte and Adela Bonilla Armenta, through their involvement with Waste For Life, highlight the power of community-led initiatives in tackling environmental challenges. Ana's role as a liaison between communities on both sides of the border highlights the importance of cross-border collaboration, rooted in local knowledge and priorities. On the other hand, Adela's innovative work in transforming recycled materials into artistry showcases how individuals can contribute to sustainable development projects at the grassroots level.

One of the key impacts of community engagement in combating plastic pollution is the promotion of environmental awareness and behavioral change among residents, as highlighted in Ana and Adela's interviews. Through educational programs and workshops I attended, local community members and youth gained a deeper understanding of the environmental impacts of plastic pollution and the importance of adopting sustainable practices. In my interview with Adela Bonilla, she spoke on empowering her community through education saying, "You teach them to separate economically, they can learn to make some bag, some utensil that they think can be used in their own house." Ana emphasizes the significance of raising awareness about the consequences of plastic waste, while Adela's work in repurposing waste materials provides practical examples of sustainable living.

Moreover, community engagement initiatives foster human resources and networks of cooperation within and among communities affected by plastic pollution. Ana and Adela's experiences underscore the importance of collaboration, solidarity, and collective action in addressing shared environmental challenges.

By prioritizing inclusivity and equity, these initiatives ensure that the voices and needs of marginalized populations are heard and addressed, contributing to greater social equity and environmental justice.

Furthermore, community engagement and empowerment initiatives have tangible socio-economic benefits for participating communities, as evidenced by Ana and Adela's interviews. In my interview with Ana Aguiarte she discusses the potential for waste repurposing projects to provide economic opportunities for migrant communities stating, “In this region we have a migrant community...if this is an opportunity for them to have a business.. it would be excellent.” Through training programs and technical support, community members are equipped with the skills and resources to repurpose plastic waste into valuable products, creating economic opportunities and sustainable businesses. Ana's emphasis on empowering communities to generate income and support their families aligns with Adela's dedication to fostering economic opportunities through creativity and innovation.

Pictured: Here we see the Bonilla, standing next to the combine recycled plastics with create beautiful, waste-reducing



Tijuana artist, Adela heat press machine used to recycled fibers in order to products.

Ultimately, the impact of community engagement and empowerment in combating plastic pollution extends beyond immediate environmental outcomes to encompass broader socio-economic and cultural transformations. Ana and Adela's stories illustrate how communities can become agents of change, driving sustainable development and environmental conservation efforts in the Tijuana region and beyond. Through collaboration, cooperation, and collective action, communities can work together to build a cleaner, healthier, and more resilient future for themselves and future generations.

Significance of Cross-Sector Collaboration:

Cross-sector collaboration is paramount in addressing the multifaceted challenges posed by plastic pollution in the Tijuana region, as it brings together diverse stakeholders from government, civil society, academia, and more to collectively tackle environmental issues. By leveraging the expertise, resources, and networks of multiple sectors, collaborative efforts can create innovative solutions, scale up impact, and foster greater cooperation in addressing plastic pollution. Through partnerships and alliances that transcend

organizational boundaries, cross-sector collaboration enables stakeholders to combine their strengths, share knowledge, and coordinate action for more effective and sustainable outcomes.

One of the key benefits of cross-sector collaboration is its ability to mobilize a wide range of people and resources to address complex environmental challenges holistically. This project brings together government agencies, non-governmental organizations, academic institutions, businesses, and community groups as a collaborative initiatives that can tap into diverse perspectives, skills, and resources to develop comprehensive strategies and interventions for plastic pollution management. Through collective action and shared responsibility, cross-sector collaborations can overcome barriers, bridge gaps, and achieve greater impact than individual efforts alone.

Moreover, cross-sector collaboration facilitates the alignment of interests, priorities, and objectives among stakeholders, fostering greater coherence and coordination in plastic pollution management efforts. By facilitating dialogue, negotiation, and consensus-building processes, collaborative initiatives can reconcile competing interests, resolve conflicts, and build consensus around common goals and action plans. Through inclusive decision-making and participatory governance structures, cross-sector collaborations ensure that all stakeholders have a voice in shaping policies, programs, and projects related to plastic pollution management, thereby enhancing transparency, accountability, and legitimacy in decision-making processes.

Furthermore, cross-sector collaboration enhances the sustainability and scalability of interventions aimed at addressing plastic pollution by promoting shared learning, innovation, and capacity-building across sectors. By fostering knowledge exchange, technology transfer, and best practice sharing, collaborative initiatives enable stakeholders to learn from each other's experiences, experiment with new approaches, and adapt successful strategies to local contexts. Through capacity-building programs, training workshops, and technical assistance, cross-sector collaborations strengthen the institutional and human capacities of stakeholders to implement effective and sustainable solutions for plastic pollution management.

Ultimately, the significance of cross-sector collaboration lies in its potential to catalyze transformative change, build resilience, and foster collective ownership of plastic pollution management efforts in the Tijuana region. By harnessing the collective power of diverse stakeholders, collaborative initiatives can drive systemic change, promote innovation, and create a more sustainable future for communities and ecosystems affected by plastic pollution. Through sustained collaboration and cooperation, stakeholders can work together to address the root causes of plastic pollution, build adaptive capacity, and create a shared vision for a cleaner, healthier, and more resilient environment for present and future generations.

Role of Policy Advocacy and Legislative Action:

Policy advocacy and legislative action play a pivotal role in addressing plastic pollution in the Tijuana region by providing the regulatory framework, incentives, and enforcement mechanisms necessary to drive behavior change, promote sustainable practices, and mitigate environmental risks associated with plastic waste. Effective policy advocacy efforts aim to influence decision-makers, policymakers, and legislators to prioritize plastic pollution as a pressing environmental issue and take proactive measures to address it through the development and implementation of evidence-based policies and regulations.

One of the key functions of policy advocacy is to raise awareness and mobilize public support for legislative action on plastic pollution by highlighting its adverse impacts on human health, ecosystems, and biodiversity. By engaging stakeholders, communities, and civil society organizations in advocacy campaigns, awareness-raising activities, and public outreach initiatives, advocates can build momentum, generate public pressure, and galvanize grassroots support for policy reforms aimed at reducing plastic pollution, promoting recycling, and transitioning to a circular economy.

Moreover, policy advocacy efforts aim to promote the adoption of comprehensive and integrated policy frameworks that address the root causes of plastic pollution across the entire value chain, from production and consumption to disposal and recycling. By advocating for policies that incorporate principles of extended producer responsibility, product stewardship, and waste management hierarchy, advocates can incentivize producers, manufacturers, retailers, and consumers to adopt more sustainable practices, reduce plastic waste generation, and promote the use of alternative materials and packaging designs that are less harmful to the environment.

Furthermore, policy advocacy plays a crucial role in strengthening regulatory enforcement mechanisms, monitoring compliance with existing laws and regulations, and holding polluters accountable for their actions. By advocating for stricter enforcement of environmental laws, regulations, and standards, advocates can deter illegal dumping, littering, and other forms of environmental degradation associated with plastic pollution, and ensure that perpetrators face appropriate penalties, fines, and sanctions for non-compliance.

Ultimately, the role of policy advocacy and legislative action is to drive systemic change, catalyze political action, and create an enabling environment for sustainable solutions to plastic pollution in the Tijuana region. This project and collaboration with Waste For Life does just that by raising awareness of the issue while simultaneously growing the methodology among neighboring communities who can become advocates themselves. By advocating for evidence-based policies, regulatory reforms, and legislative measures that prioritize environmental protection, advocates can help create a more resilient, equitable, and sustainable future for communities and ecosystems affected by plastic pollution and contribute to the achievement of broader environmental and development goals at local, national, and global levels.

Implications for Environmental Conservation and Social Equity:

The implications of addressing plastic pollution in the Tijuana region extend beyond environmental conservation to encompass broader social, economic, and equity considerations. By addressing plastic pollution at its source and implementing sustainable waste management practices, communities - like the Tijuana community - can mitigate the adverse impacts of plastic waste on local ecosystems, wildlife, and biodiversity. Strategies such as plastic waste collection, recycling, and upcycling not only reduce the volume of plastic entering rivers and oceans but also contribute to the preservation and restoration of natural habitats, water quality, and ecosystem services essential for human well-being.

Furthermore, efforts to address plastic pollution have significant implications for social equity and community well-being by empowering marginalized communities, enhancing livelihoods, and promoting social inclusion. By engaging local residents, community organizations, and civil society groups in plastic waste management initiatives, communities can create economic opportunities, generate employment, and improve access to resources and services, particularly for vulnerable populations disproportionately affected by plastic pollution, such as informal waste pickers, low-income households, and marginalized communities residing in areas prone to environmental degradation and pollution.

Moreover, addressing plastic pollution can help foster social unity and collective action by bringing together diverse stakeholders, fostering collaboration, and building partnerships across sectors, disciplines, and jurisdictions. By promoting community-led initiatives, participatory decision-making processes, and inclusive governance structures, communities can strengthen social capital, build resilience, and foster a sense of ownership, pride, and stewardship among residents, thereby promoting social cohesion, solidarity, and mutual support networks essential for addressing complex environmental challenges.

Additionally, efforts to address plastic pollution can contribute to the achievement of broader social justice and equity goals by promoting environmental justice, human rights, and equitable access to resources and opportunities. By advocating for policies and interventions that prioritize the needs and interests of marginalized communities, address underlying social determinants of health and well-being, and promote equitable distribution of environmental benefits and burdens, communities can advance social justice, equity, and human rights principles, and ensure that all individuals have the opportunity to live in healthy, sustainable, and resilient communities.

Overall, addressing plastic pollution in the Tijuana region has far-reaching implications for environmental conservation, social equity, and community well-being, highlighting the interconnectedness of environmental, social, and economic dimensions of sustainable development. By adopting a holistic, integrated approach that addresses the root causes of plastic pollution while promoting social equity, justice, and inclusion, communities can create a more sustainable, resilient, and equitable future for all, where people and nature thrive in harmony.

Pathways to a Sustainable Future:

Community-led initiatives serve as foundational pillars in driving sustainable solutions to plastic pollution in the Tijuana region. These initiatives empower local communities to take proactive steps in waste management, including plastic collection, sorting, and recycling. By instilling a sense of responsibility and stewardship towards the environment, community-led efforts foster collaboration between stakeholders and provide training and capacity-building opportunities to develop innovative, context-specific solutions. Mobilizing community members, as seen in the actions in Tijuana, becomes paramount in addressing the unique challenges posed by plastic pollution in their area.

Embracing innovative technologies and practices becomes essential in steering towards a sustainable future free from plastic pollution. From advanced recycling technologies to eco-friendly packaging alternatives, investing in research, development, and implementation of innovative solutions significantly reduces the environmental impact of plastic waste. Such measures promote resource efficiency, circularity, and sustainability, guiding communities towards a circular economy model where waste is minimized, and resources are conserved.

Policy and regulatory measures are crucial in creating an enabling environment for sustainable waste management practices. Governments can enact robust policies, including bans on single-use plastics and extended producer responsibility (EPR) schemes, to incentivize responsible production, consumption, and disposal of plastic products. Such measures hold producers and packaging engineers like myself accountable for the environmental impact of their products throughout their lifecycle, driving businesses, industries, and consumers towards more sustainable practices and behaviors.

Education and awareness campaigns play a vital role in fostering behavioral change and promoting sustainable lifestyles. By raising awareness about the impacts of plastic pollution, communities can mobilize public support and inspire individuals to adopt more sustainable behaviors, such as reducing plastic consumption and supporting local initiatives. Engaging schools, universities, media, and civil society organizations empowers individuals with the knowledge, skills, and motivation to become agents of change in their communities.

Cross-sector collaboration and partnerships are essential for achieving lasting impact and creating a sustainable future. By forging partnerships between government agencies, businesses, academia, non-profit organizations, and communities, stakeholders can leverage their expertise, resources, and networks to develop comprehensive, multi-stakeholder solutions. This project embodies this by unifying the United States, Mexico, Waste For Life, the Tijuana River National Estuarine Research Reserve, The University of San Diego, my packaging lab Westpak, and ultimately the local community of Tijuana. This collection of change seekers has been instrumental in fostering dialogue, cooperation, and knowledge-sharing innovations that drive this collective action towards a shared vision of a plastic-free, sustainable future for the Tijuana River and more.

Personal Reflection:

Reflecting on my journey through the intricate landscape of plastic pollution, I'm acutely aware of the unique perspective I bring to the table as a packaging engineer. My career, once solely focused on the technical aspects of packaging design and innovation, has taken on a deeper meaning in the context of the packaging pollution crisis. Like a legacy to uphold or perhaps even atoning for the sins of my father, I feel a profound responsibility to reconcile the unintended consequences of the packaging engineers before me and chart a course towards sustainable solutions.

As a packaging engineer, I've been intricately involved in the creation of materials that, while initially serving practical purposes, have contributed to the pervasive issue of plastic pollution. This realization has been both humbling and motivating, propelling me to explore avenues for redemption through research, innovation, and advocacy.

Through my involvement in testing plastic composite samples and conducting rigorous analyses, I've come to recognize the pivotal role that technical expertise plays in shaping the future of packaging. The methodologies employed, whether in the controlled environment of a laboratory or the dynamic context of fieldwork in Tijuana, have provided me with valuable insights into the complexities of plastic waste management and the potential for transformative change. Yet, beyond the technical aspects, my journey has been characterized by a deepening sense of empathy and responsibility towards the communities affected by plastic pollution. Engaging with stakeholders, listening to their stories, and witnessing the environmental degradation firsthand have served as powerful reminders of the human dimensions of this crisis.

As I reflect on my career trajectory, I am compelled to harness my skills and expertise not only to mitigate the harms of packaging pollution but also to actively contribute to sustainable solutions. Whether through advocating for policy reforms, fostering cross-sector collaboration, or championing community-led

initiatives, I am committed to leveraging my position as a packaging engineer to drive positive change and pave the way towards a more sustainable future.

In this journey of redemption, I find solace in the belief that every action, no matter how small, has the potential to make a difference. As I navigate the complexities of plastic pollution, I am guided by a sense of purpose and a commitment to leaving behind a legacy that prioritizes environmental stewardship, social equity, and responsible innovation for the generations after me.

Summary

In conclusion, the journey through the exploration of plastic pollution in the Tijuana region has been a multifaceted experience, one that has not only broadened my understanding of the intricate web of environmental, social, and economic challenges but also instilled in us a profound sense of duty towards crafting a more sustainable future. As we delve deeper into the complexities of this issue, it becomes increasingly evident that quantifiable data and scientific analysis, while invaluable, only scratch the surface of the pervasive and interconnected nature of pollution and sustainability.

Throughout the course of this study, the paramount importance of community engagement, cross-sector collaboration, and proactive policy advocacy has been emphasized time and again as indispensable cornerstones in the ongoing battle against plastic pollution. By peeling back the layers to examine the root causes of this environmental crisis and assessing its profound ramifications on local communities, this paper has illuminated the pressing urgency of the matter and underscored the imperative for holistic solutions grounded in both environmental stewardship and social equity.

Drawing inspiration from the pioneering work of environmental luminaries such as Rachel Carson and Wangari Maathai, and amplifying the voices of grassroots advocates like Ana Aguiarte and Adela Bonilla, this study has underscored the transformative potential inherent in individual and collective action. From Ana's tireless efforts to bridge communities across borders to Adela's innovative endeavors in transforming recycled materials into expressions of artistry, the catalytic power of community-led initiatives has been unmistakable in propelling sustainable development initiatives from the ground up.

Moreover, the integration of experiential and participatory epistemologies, coupled with a deeper appreciation for the pivotal role of packaging engineers in devising innovative solutions, serves to enrich our collective understanding and approach to combatting plastic pollution. By embracing a holistic framework that acknowledges the interplay between human behavior, technological innovation, and policy interventions, we can forge a path towards lasting change, where the principles of environmental integrity, social justice, and economic prosperity converge synergistically to usher in a brighter tomorrow for all.

Looking forward, the insights gleaned and recommendations outlined in this paper serve as a roadmap for charting the course of future endeavors aimed at mitigating plastic pollution, not only within the confines of the Tijuana region but also on a broader, global scale. By fostering heightened awareness, nurturing community empowerment, and advocating for systemic policy reforms, stakeholders stand poised to forge collaborative pathways towards a more resilient and equitable society. It is through the ongoing pursuit of research, innovation, and collective action that we can build upon the foundational insights derived from this study to have humanity reevaluate our relationship with plastic packaging and willingly steer itself towards a cleaner, healthier, and more sustainable trajectory for generations to come.



Pictured: Dr. Caroline Baillie, co-founder of Waste For Life, working with local youth in Tijuana to turn plastic packaging waste into usable works of art. A special thanks to her and her team for inviting me to collaborate with their organization and be a part of something greater than myself.

WORKS CITED

Carson, Rachel. "The Sea Around Us." Oxford University Press, 1951.

Carson, Rachel. "Silent Spring." Houghton Mifflin, 1962.

Maathai, Wangari. "The Green Belt Movement: Sharing the Approach and the Experience." Lantern Books, 2004.

Angus, Ian. 2008. "The Myth of the Tragedy of the Commons." *Monthly Review*, 28 August 2008, <https://mronline.org/2008/08/25/the-myth-of-the-tragedy-of-the-commons/>

Evans, J. (2011). *Environmental Governance* (1st ed.). Routledge.
<https://doi.org/10.4324/9780203155677>

Robert R. M. Verchick, *In a Greener Voice: Feminist Theory and Environmental Justice*, 19 HARV. WOMEN's L.J. 23 (1996).

Are Cattle or Bison More Effective at Mitigating the Climate Crisis Using Holistic Management?

Jack Joslin
April 16th, 2024
ESH 540

I was a vegan in college. I had decided that for environmental reasons, it was not right to eat meat. Countless news articles and social media posts told me that cows, and animal products in general, emitted outside amounts of greenhouse gasses into the atmosphere, and the data backed up the story. On top of all of this, I began to hear that the Amazon rainforest is being burned down to raise cattle on. As an environmental studies student, the very same information was shown to me in my classes. I was fully onboard, convinced that meat was the enemy. I learned to cook vegan food and I was perfectly content. The spring of my third year at school, I signed up for a class called Holistic Management. I thought this class was simply going to be looking at how we can manage ecosystems and the environment in a holistic way. I was right for the most part, but what I didn't know was that the class was actually geared towards agriculture students. As we got into the class, we had a guest speaker one day. He was a rancher from eastern Montana who raised cattle. As soon as I found out what he did, I was confused as to why the professors would bring someone in who did something I perceived to be terrible for the environment. He gave a brief talk about his operations and what he does to allow his cows to support the health of the land. I was intrigued, but still unsure. Greenhouse gas emissions seemed to me the most important part of the environmental crisis. Without reducing emissions, nothing else really seemed to matter in my mind. He opened it up for questions at the end, and I raised my hand. I asked "Are you concerned about the greenhouse gas emissions that raising cows creates?" He responded by explaining how when cows are living on healthy, grassy land methane gas is absorbed by the vegetation almost instantly after emitted. I was shocked to be honest. I couldn't believe that this could be true. I started doing research online about all of the things he had talked about from rotating his cows between pastures, to the science behind emissions from cows and how cows interact with the land. I quickly became passionate about the idea that cows could be a climate solution rather than a travesty. I may have also indulged in a burger or two. The reason I am writing this is to share what I have learned about how cows and other grazing animals can help the environment and restore grassland ecosystems.

Before we can understand how these animals can help the environment, we must understand how they are harming it. Yes, they are harming it. There is great truth to the news articles, social media posts, and scientific papers that talk about cattle as an environmental travesty. Cattle raised on feedlots and in factory farm settings emit huge amounts of methane into the atmosphere, a highly potent greenhouse gas. In South America, the Amazon rainforest is being cut down at alarming rates, oftentimes for the purpose of raising cattle. The Amazon is the lungs of the Earth and one of the most important centers of biodiversity that remain intact. It is abundantly clear that beef production can have significant adverse effects on our environment. However, those who are calling for a reduction in beef production are not considering that there are other, better ways to produce beef. They are throwing the baby out with the bathwater. They are neglecting to look at the issues holistically and consider the true root of the problem. To understand how cattle and bison can have positive environmental effects, and how factory farming production methods are the cause of the environmental issues with cattle, we must go back in time. Modern domesticated cattle are not a natural species. They have been domesticated and bred for thousands of years from aurochs, a wild bovine species native to the Turkey region that is similar to an ox. Over the past ten thousand years, cows have slowly become the animal we know today. Historically, species like aurochs in Europe and Asia and bison in North America have had enormous population numbers and occupied huge swaths of land. Here is an image of the historical range of bison in North America, with depictions of how their range and population has been decimated. When Europeans arrived in North America, there were tens of millions of bison roaming the great plains region of the continent. Most studies estimate around sixty five million bison occupied the plains of North America prior to the European's arrival. However, some estimate the number

of bison could be in the billions. Regardless of the exact numbers, it is clear that bison occupied and had a significant impact on a huge portion of North America. These animals were a big part of the ecosystem and balance existed in that ecosystem with tons of ruminant herbivores on the plains. A ruminant animal, like a cow or bison, has a unique digestive system that allows it to digest plant matter, grass in particular. The ecosystem balance formed by bison and other ruminant animals by their impact on the land and ability to eat grass is now nonexistent in many areas due to many factors from farming to urban sprawl. However, the main reason for the ecosystem imbalance is the lack of ruminant animals, namely bison, in our grasslands.

Currently, the majority of cattle production and general existence of ruminant animals is fighting nature and removing the animals from the natural environment. We don't need to get rid of the livestock, we need to reintegrate them with nature. The goal of reintegrating these ruminant animals back into the fabric of the ecosystem is to achieve biomimicry where grassland ecosystems and the balance of the carbon cycle are restored. As such, this paper aims to answer questions about how biomimicry can best be accomplished. My questions also aim to meet a key need today in the context of the climate crisis: carbon sequestration. First, I will lay out how this can be done by outlining the biological, ecological, and climatic processes which occur when cattle and other animals graze on grass in herds, providing ecosystem services and sequestering carbon dioxide from the atmosphere. These ideas are based on biomimicry. I will use the example of bison populations of the past to help us understand the role that cattle, and bison once again, could have today by mimicking historical behaviors of bison and other ruminant animals. I will specifically explore these concepts in the American context where factory farming is extremely prevalent and there is huge opportunity for the use of herd grazing practices in the northern great plains region of the country. Then, I will state my research questions and answer them, in addition to explaining my methods for drawing these conclusions and explaining what researchers already know about the questions I am seeking answers to.

As discussed, cows do create a lot of greenhouse gas emissions, including methane which is one of the most potent of the greenhouse gasses. The reason that cows and other grass eating animals like bison produce methane has to do with their digestive system. The Environmental Protection Agency gives a good explanation of this process. "When ruminant animals such as goats, sheep, and especially cattle digest their food, it gets processed in their systems by way of fermentation. This process breaks the food down over time and produces methane, a powerful greenhouse gas that contributes to our rapidly warming planet when expelled to the atmosphere in the traditional biologic routes; i.e., flatulence or burps. Researchers have found that 37% of methane emissions from human activity are the direct result of our livestock and agricultural practices." Clearly methane emissions are nothing to scoff at. It is a highly potent greenhouse gas that is having profound effects on our climate. While these emissions are always going to occur to an extent from livestock, they can be mitigated in a natural, grass-grazing setting with rotating pastures. Furthermore, this practice can actually negate part of the methane emissions and improve the soil health to the point where the soil becomes a carbon sink. The same New York Times article previously mentioned cites that "Some research has suggested that widespread implementation of regenerative practices worldwide could have a significant effect, storing as much as 8 billion metric tons of carbon per year over the long term, or nearly as much as current annual emissions from burning of fossil fuels." This means that if we were to implement widespread use of regenerative grazing practices using livestock we could sequester almost as much carbon into the ground as we are producing each year, a staggering statistic. At this point, I will explain how these ruminant animals can regenerate the land into the carbon sink that we need it to be in the context of the climate crisis. Bison, like cattle, are herbivores, eating exclusively grass

and other grass like plants. These animals move in herds, and when they move together, they heavily graze on an area, significantly impacting the land they are on. They are eating the grass, their hooves are churning the soil as they move, and they are defecating and urinating. This sort of impact fosters the growth of the microbiology in the soil. This microbiology is critical to the health of the soil. It helps the soil retain water and slows the erosion process. Sustainable food expert and dietitian Diana Rodgers says this, "...the hoof stomping of the large animals allows for better water penetration when the rains come. Their manure inoculates the soil with microbes, and their grazing (just enough, not too much) stimulates new growth in the grasses. After they move on, the land has a chance to rest and this is when the "regeneration" happens." Intense impact on a relatively small area, followed by rest, is a critical part of making herbivores an effective way to regenerate land and sequester carbon from the atmosphere. A study out of Michigan State University found that "Emissions from the grazing system were offset completely by soil C(carbon) sequestration." The same study goes even further, saying that "Soil C sequestration from well-managed grazing may help to mitigate climate change."

Historically, bison moved from one area to another after they made their impact on the land, allowing it to rest and regenerate after they have grazed on it. This process can be mimicked with cows to achieve the same results of soil regeneration and carbon sequestration. An article in the New York Times describes this process well, "Regenerative grazing means closely managing where and for how long animals forage, unlike a more conventional approach in which animals are left to graze the same pasture more or less continuously." Thus, regenerative grazing is mimicking the patterns of bison and other ruminant animals in nature. It is implementing the same practices which nature created on its own to keep soil and land healthy. The goal of regenerative grazing is just that, to mimic the way that nature has operated in the past. In North America, bison are the example to look to for how to implement such practices, and where to do it. Because of their similar characteristics and impact on land, we can use a number of ruminant animals to accomplish this biomimicry from cattle to bison to sheep. Regenerative grazing can also be referred to as intensive rotational grazing and holistic management.

One of the amazing things about regenerative grazing is that it doesn't require much work on the part of a rancher. Cows, bison, and even sheep and goats do the work for us naturally. The part that we need to do is simulating the rotational and herding patterns that bison did naturally in the past. When Europeans arrived in North America, land was controlled and occupied by native tribes. Today, land is managed differently. Lots of land is privately owned and there are also large swaths of Bureau of Land Management land in the United States. Therefore, we cannot simply breed millions of bison or cows and unleash them on the plains. This would not accommodate all of the farms and private property, nor would it allow us to easily cultivate the animals for meat and other products. In order to mimic nature, we must herd livestock into relatively small areas, rotating them between pastures. This accomplishes the desired impact that the animals have on the land by eating the grass, churning the soil with their hooves, and adding their manure to the soil. They can then be rotated to another pasture to do the same thing while the last pasture rests. A TED Talk with a cattle farmer named Joel Salatin from the Shenandoah Valley in Virginia suggests that this rotation can and is being done using electric fencing. This eliminates the need for actual fences and therefore is a very efficient way to rotate cattle between pastures.

In terms of factory farming, we must understand the difference between these factory farms and regenerative grazing systems. Why is factory farming so harmful and how does regenerative grazing rectify these problems? Currently seventy percent of cows in the United States are living in factory farms. Setting aside the ethical aspect of factory farms for the sake of focusing on the environmental side of things, factory farming is a big part of the reason that cows have the environmental impact that they do. Without the

beautiful cycle of grass eating, soil impact, and rest, the soil becomes dead and the methane the cows excrete goes straight into the atmosphere without any offset.

Many cattle are raised on grass, however, without the intentional rotation of pastures and containing them in tight herds for periods of time, the benefits of regenerative grazing are not reaped. Overgrazing becomes the main issue because the land does not get the rest it needs after a large impact. Overgrazing depletes soil nutrients and disallows the regeneration we are seeking so that the soil can be strong and sequester carbon dioxide. This depletion affects the whole grassland ecosystem, making it much more challenging for other species to persist in the environment as it becomes barren. "According to the United Nations Framework Convention on Climate Change (UNFCCC), over 50% of grasslands worldwide are currently degraded. This alarming statistic highlights the urgent need for rehabilitation efforts." It is clear that our grasslands are in trouble from an ecosystemic perspective, and livestock can help.

It is important to mention that in places like the Amazon rainforest, the forest is being destroyed for the purpose of raising cattle. This is the last thing I would do in order to raise cattle. Forests are critical ecosystems, centers of biodiversity, and huge carbon sinks. Maintaining an intact Amazon rainforest ecosystem in particular is one of the key issues of our time ecologically speaking. I am advocating for using regenerative grazing practices on natural grassland regions, where historically, millions of ruminant animals lived and grazed. The goal is to mimic nature, not destroy it as is so unfortunately occurring in the Amazon. With an understanding of how ruminant herbivores like bison and cows can help sequester carbon from the atmosphere and regenerate grassland ecosystems, my curiosity piqued when I wondered about how bison and cattle might differ in their ability to accomplish these things. Bison are obviously the native species, but does this make a difference in the capacity of the carbon sink they can provide in the soil or the quality of ecosystem diversity that they foster? As such, the research questions I am focusing my project around are: Which ruminant animals, bison or cattle, create the most optimal conditions for carbon sequestration into the soil and ecosystem regenerative through human-managed intensive rotational grazing practices? Furthermore, would bison be more beneficial to health for those eating the meat than beef? What other social benefits might exist? I am interested in the comparison of health and social benefits because holistic management strategies always take into account all aspects of solving a problem in order to find the best solutions without significant and unforeseen side effects.

The epistemological structure of my project is based on data from peer-reviewed journals that allows me to believe in ruminant animals' ability to impact land and sequester soil carbon. Admittedly, this is a belief that many people do not share. There is an abundance of data that shows that cattle in particular have a hugely negative impact on the greenhouse gas content of our atmosphere. My project relies on data that suggests that the animals are not the problem, the method of management is. Which leads me to another epistemological structure of my project: the belief that nature is a balanced, harmonious system that is to be protected and restored. My project is largely based on biomimicry. Specifically, that the ruminant animals that roamed the North American plains in millions were a critical part of the grassland ecosystem. Data on intensive rotational grazing management practices today supports this idea based on what we know about how bison behaved and persisted on this land in the past, which is how I have come to believe in this idea.

My methodology for collecting data and finding results is simple. As my research is focused around complex data about how ruminant animals impact the environment both negatively and positively, the majority of my project is focused around peer-reviewed scientific papers which I have synthesized, compared, and contrasted to draw my conclusions. The number of factors which go into answering my complex question, if cattle or bison are able to sequester more soil carbon through intensive rotational

grazing than the other, are numbered. Admittedly, this makes my results based on correlation rather than causation. In order to find adequate research to support my paper, I have looked for data that speaks to bison or cattle individually that I can then collate and analyze. Furthermore, to account for a lack of data specific to carbon sequestration and intensive rotational grazing that compares between species, my results are to an extent based on inferences from studies analyzing the difference between bison and cattle behavior.

My research on this project has been focused around carbon sequestration data that is specific to bison and cattle in intensive rotational grazing management. In order to supplement the data, compare the animals, and come up with original ideas, I have also focused my research on bison and cattle behavior. The main points of interest in terms of behavior have been eating, herding, and movement habits. These behaviors form key understandings about the differences between the species and how they interact with the land and ecosystem. They are also the elemental components of how bison and cattle can sequester carbon into the soil. Forming an understanding of their behaviors and the differences has been key to understanding the difference between bison and cattle and their ability to sequester soil carbon. Due to the lack of specific scientific data to answer my research questions directly, I will use conceptual and explanatory frameworks to analyze the data. I have to come to my hypothesis through deductive reasoning of the data that is available to me on bison and cattle grazing as it relates to soil carbon sequestration as well as the things that are known about cattle and bison behavior. For instance, ruminant animals need to be packed into relatively small areas for a short period of time in intensive rotational grazing management methods. For the purpose of explaining my deductive framework, I'll give an example from my results. Bison tend to graze for a smaller percentage of their time than cattle, and the grass and land must be impacted for a certain period of time in order to maximize soil carbon absorption. Therefore, bison will need to have longer grazing periods in order to sequester carbon to the same degree as cattle. This method of data analysis will allow me to speak to the differences between bison and cattle in intensive rotational grazing systems and draw conclusions about management practices and differences in the species' ability to sequester soil carbon.

In addition to all of this knowledge about regenerative grazing referred to above, the existing literature also draws comparisons between bison and cattle, focusing on their ecological synonymity. Many studies have compared their behavior and the resulting impact on the land including the diversity of plant species and typical forage consumption by each species. These studies have found that there is a great deal of similarity between the species in terms of their impact on the land. However, they have also found significant differences in their behavior. In addition to the comparison between the species, the literature also has lots of information about the health of beef and bison meat. The studies show that bison meat is healthier, however, it does not draw direct comparison between similarly produced meat. This paper attempts to fill these gaps in the literature to beg the question: how can we optimize biomimicry using ruminant animals in grassland ecosystems?

As mentioned, there are significant differences in behavior between bison and cattle. These differences in behavior can help us to distinguish how bison and cattle might differ in terms of their ability to sequester carbon in the soil. Furthermore, they can give us ideas about how they need to be managed differently to maximize carbon sequestration, though one species may be superior in the ecosystem services and carbon sequestration it provides.

First, I will lay out some of the things that are known about how intensive rotational grazing leads to soil carbon sequestration and ecological restoration. As discussed, intensive rotational grazing relies on a few key tenets: ruminant animals eating grass, churning the soil with their hooves, defecating and urinating

on the soil, and finally the resting of the ground for the grass to regrow stronger as well as the microbiology to flourish in the ground. These things are what prime the soil for absorbing carbon. Therefore one of the keys to the success of intensive rotational grazing is getting the grass eaten down to a certain level prior to letting the land rest. This reduction of the plant biomass combined with the impact the animals make on the land gives the grass, microbiology, and other types of plants the opportunity to regrow. The growth of plant biomass is what allows carbon to be absorbed because as the plants grow and perform photosynthesis they consume carbon dioxide and release oxygen. Beyond just the grass, the animals impact on the land with their hooves also helps other seeds of native plants that may be in the soil to sprout by potentially breaking open seeds, aerating the soil, and allowing for water to permeate the soil more deeply. This can lead to increased native plant growth and biodiversity, critical parts of ecosystem restoration for grasslands. Understanding how bison and cattle can lead to carbon sequestration and ecosystem regeneration, we can bring in what we know from the data to draw conclusions about the differences between bison and cattle in terms of carbon sequestration and ecosystem regeneration. We can also look at the social and health benefits associated with ranching bison and cattle, critical parts of the holistic management puzzle.

A 2013 study on the ecological synonymy of bison and cattle looks directly at the behavior differences between the animals. From this we can glean a lot about how cattle and bison differ in carbon sequestration. First, bison moved much faster than cattle while grazing and covered much larger areas than cattle, approximately nineteen times larger areas than cattle in fact. This tells us that in intensive rotational grazing management, bison can either be given much larger areas to graze or given smaller areas for shorter grazing periods. Due to their natural range being larger, it seems wise to give them a larger area. However, one of the key components of intensive rotational grazing is getting the animals to forage the grass down to a certain level, ideally quite homogeneously, for optimal regrowth of the grass and therefore carbon sequestration. With this in mind, grazing bison in smaller areas than their range may lead to more homogeneous grazing. On the other hand, cattle will need longer grazing periods in smaller areas than bison to provide the same impact. This leads me to believe that bison may be more efficient in sequestering carbon than cattle.

Another study from 2005 looks at the difference between how bison and cattle affected plant communities while grazing on similar natural grassland prairies. The study shows that bison increased the biodiversity of grasses at a much higher rate than cattle over a ten year period. Bison also were more thorough in their grazing in this period, leaving less left over grass biomass than cattle. Furthermore, the land bison grazed on also had more diversity and quantity of flowering plants than the land cattle were on. In simple terms, more plant biomass growth equals more carbon sequestration. So, the diversity of species and quantity of them is a good sign of more carbon sequestration. The fact that bison left less left over grass than cattle after grazing is also a benefit to carbon sequestration because the combination of their impact on the land and consumption of the grass will lead to more biomass growth, which again will lead to more sequestered soil carbon.

Although this study did find these differences, the plant communities between the areas where the two species lived were eighty five percent similar after the ten years. This similarity shows that although bison do lead to more diversity of plants and stronger ecosystem over time than cattle, the key is the management. Factory farming and feedlots are what lead to the worst methane and carbon dioxide emissions from cows, along with deforestation of course. On the other hand, holistic intensive rotational grazing practices are what lead to the best results of ecosystem restoration and carbon sequestration. This evidence is backed up in other studies. A 2019 study looked at the difference in soil carbon stocks between continuous grazing with cattle and adaptive multi-paddock grazing, which is synonymous with

intensive rotational grazing, with bison. The study found that the multi-paddock grazing had significantly higher soil carbon levels than the continuous grazing. Furthermore, the study found that intensive rotational grazing led to higher levels of plant species diversity and increased plant matter with less bare ground. Both of these facts back up the soil carbon levels and show a strengthening of the grassland ecosystem.

Although this study did compare bison and cattle, the other evidence I have presented leads me to believe that similar results would have occurred if the study had compared cattle to cattle.

Increases in soil carbon and biodiversity of the grassland ecosystems seem to be most correlated with management methodology rather than species. Although, there does seem to be a slight advantage for bison in terms of biodiversity of plants after grazing is practiced for extended periods of time. This is clearly an important measure and one of the key reasons for practicing holistic management. However, in terms of implementation, similar results can be achieved using cattle or bison. This might allow for cattle who have been raised in a factory farm to transition to a holistically managed ranch where they can contribute right away to restoring the ecology of the land and soil carbon sequestration as well as improving their quality of life immensely.

You may not know much about bison other than having seen them in pictures of Yellowstone National Park. These animals are native herbivores native to North America and have been a source of food to Native Americans for thousands of years. Besides carbon sequestration and ecological management, it is also very important to take into account the human aspect of any environmentally related decisions that we make. You also may have never eaten bison before, but it is becoming more and more common. Some name brand grocery stores including Costco have begun selling bison in recent years. Studies have shown that bison can have less risk to your cardiovascular system than beef. This makes eating bison a great option for those looking to eat healthy meat, in addition to the ecosystem services and carbon sequestration that bison can provide. I went to school in Bozeman, Montana for three years and it is common to have bison on the menu in many restaurants. This shows that not only is it healthy, it also is marketable as a common meat for people to eat. Not to mention that in my personal opinion, it is delicious. Now, many people are concerned with animal welfare when it comes to eating meat. There is a lot of reality to animal welfare issues with factory farming today, and a lack of care for the lifestyles of animals that we eat. Intensive rotational grazing methods provide a much better alternative to factory farming when it comes to animal welfare. Although intensive rotational grazing does require animals to be put in a relatively small space, that space still always provides plenty of space for the animals to roam, nothing like the stalls animals are packed into on a factory farm. They are also, of course, able to eat their natural food, grass, which is healthier for them.

Not only has factory farming been a travesty to animal welfare and health, it has also turned out to be a travesty for the health of the meat that we are eating. The poor treatment of animals contributes to their poor health which trickles down to us who eat it. Doctors have shown time and time again that factory farmed beef is drastically nutritionally inferior to grass-fed beef. The same I'm sure would occur in bison if they were produced in a factory setting. Plus, we already understand that bison meat has less cardiovascular risk than beef. According to WebMD, bison meat is among the healthiest we can eat and includes many critical vitamins and minerals for our health.

Furthermore, Native Americans have been eating bison for thousands of years. Not only have they been eating it, they also have relied on it for so much more from clothing to shelter to tools. Of course, we typically use different materials for these purposes today. However, bison do still have a lot of usefulness for us besides their environmental and health benefits, just like cattle. Bison make beautiful leather products that we can use for boots, belts, and more. Bison and cattle can be utilized sustainably to provide a myriad

of benefits from ecological restoration to carbon sequestration to food to quality products. If we are looking to mimic the past in order to get back to a more sustainable lifestyle where we can be in harmony with nature, eating animals like bison seem to be a big part of the natural order in my opinion.

In addition to the health aspects of grass-fed meat, bison in particular, ranchers who practice intensive rotational grazing and holistic management can take advantage of another social benefit: the carbon credit market. The United States Department of Agriculture verifies and reports carbon sequestration that occurs through agriculture. These records can then be used to sell carbon credits, a new source of revenue for ranchers. For an industry that is notoriously difficult to get by in, this can help ranchers to overcome the difficulty of competing with the efficiency and volume of factory farming.

Besides these carbon credits that make ranching more financially viable, ranching can provide quality of life for people. The Minnesota Natural Resources Conservation Service interviewed Ken Hess, a retiree, who has owned a bison ranch in Minnesota for eight years with his family. Ken and his family practice intensive rotational grazing on their ranch. Ken talks about his love for the animals and the joy he gets from raising them and problem solving how to best manage and care for them. Furthermore, Ken describes the assistance he has been given by the U.S. Department of Agriculture with managing his bison. The department has been very helpful to him in learning about grazing management and been available to him to answer his questions. This makes ranching and managing animals holistically not only enjoyable but also more accessible to people who may not be familiar with intensive rotational grazing. The implementation of such systems is possible and fulfilling to those ranchers who decide to manage their animals this way.

In summary, although bison and cattle do have a great deal of ecological synonymy, bison do seem to provide the ecosystem with its match. They provide more species diversity than cattle. They move faster and graze more thoroughly than cows which allows them to be more efficient at impacting the land and therefore sequestering carbon. However, due to their high rate of ecological similarity, adjustments to management for cows could allow them to provide similar levels of ecosystem regeneration and carbon sequestration. If the goal is implementation of these practices in a timely manner in this country, using cattle may be more efficient to begin this type of management without sacrificing much of the results. In terms of health, bison meat is a very healthy meat in the eyes of well respected doctors. Beef has mixed reviews in terms of its nutritional value and many doctors advocate for avoiding it. The social benefits of implementing regenerative grazing are great for people and animals. It provides people with healthy meat and pulls animals out of factory farm settings that are certainly questionable in terms of the meat quality and animal welfare.

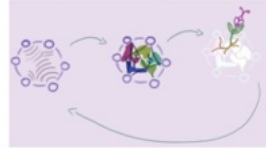
Implementing regenerative grazing techniques has so many benefits. It returns grasslands to their natural state, where ruminant animals are the integral part of the ecosystem. This balance builds strong soil that sequesters carbon from the atmosphere and negates the negative effects cows and other grazing animals can have when separated from nature in factory farms. This makes cows a powerful tool in the fight against climate change and ecological crisis. They can help us reduce our carbon emissions and reinvigorate dying ecosystems.

Cows are not the demons they have been made out to be. It isn't the cow, it is the way it is raised that decides how they impact the planet. We as humans are no different, it is not simply that we exist that creates environmental issues, it is the way we decide to live. My passion for this topic emerged from a revelation in my holistic management class in college. As I have dug into this topic and explored it, my passion has only grown. I believe that regenerative grazing is one of the most powerful tools we have to

mitigate the climate and ecological crises and provide people with healthy, nutrient rich food. It is an elegant design that nature has provided for us. All we have to do is put it into action.

Re-learning how to tend to our garden of communication

How do we nurture caring and cooperative social fields to heal our planet as globally distributed change-makers?



Leon Santen (they/any)

([website](#))

*In close collaboration for
design concepts & technical development:*

Odalys Benitez (she/her)

([website](#))

Advisors:

Caroline Baillie (she/her) - University of San Diego

Willy Oppenheim (he/him) - Omprakash ([website](#))

Laura Ballerini (she/her) - University of Oxford

April 2024

Thesis for Master of Science in Engineering, Sustainability, and Health (MESH)

([program's website](#))

University of San Diego, California, USA

ABSTRACT

Within communities of social justice focused engineers and globally distributed trans-disciplinary change makers, the desire to care for each other, collaborate, and build new regenerative, sustainable systems is high. Re-renewed forms of “managing our home” (also called economy) are needed. This thesis proposes a community practice to reflect on and sense the collective system and build systemic support networks, supported through a visual digital communication platform. This digital tool requires a surrounding community practice and is intended to serve as a medium that is conducive to the emergence of humanizing communication, community-sensing, collective vision-building, and trans-disciplinary collaboration.

The human-centered design process used in this thesis was primarily informed by 16 one-hour long ethnographic interviews with students from the master’s program “Engineering, Sustainability, and Health” (MESH), social-justice oriented engineering peers, organizers, and experts in the fields of knowledge building, cooperation, and liberatory design. Furthermore, this thesis upholds the value and validity of auto-ethnographic research as the lived experience of the authors cannot be separated from their motivation to embark on a research journey.

Insights from interviews suggest that all young professionals in our sphere aspire to work toward a community-focused world with harmonious forms of work and collaboration. As the amount of work needed to heal our social-ecological systems is inconceivably large, sustaining authentic and intrinsic motivation and care for action is necessary while staying aware of systemic relationships. Simultaneously, we observe a lack of cultural practice or skill to connect with each other across borders and disciplines. As communication is the central connector within social systems, this thesis offers a variety of interface designs, communication structures, and practices to co-create new systems from a place of empathetic connection and systemic awareness. The modular prototype developed in this thesis can be used to visualize community states in interactive animations for movement-building, sharing project ideas, contemplating collectively, or co-designing for the future. The prototype is modular and is intended to be adjusted according to particular community needs and frameworks of engagement such as conferences, re-connecting with this master’s community once a year or sensing local community networks.

Keywords: cooperation, care, regenerative economies, movement-building, engineering for social justice, trans-disciplinary collaboration, liberatory design, complex systems thinking, user interface design, intrinsic creativity, offers and needs market

Values embedded in this work: care, cooperation, consent, ease, health



introduction & literature sections are pretty long

if you want to see concrete designs,
you may enjoy jumping to the results section

otherwise, the introduction gives you personal context and the literature review presents some
core ideas very close to my heart

Table of Contents

I invite you to explore this section to gain an understanding of my work

ABSTRACT

INTRODUCTION AND CONTEXT

A brief overview of the work in this thesis

Deeper personal context: how this work emerged from my life

PIECES OF LITERATURE AND THOUGHT THAT INFORM MY RESEARCH AND DESIGN

Pieces for building a liberatory practice

What is the nature of reality?

Bringing adaptive cycles into the design practice

Liberation through re-connecting and sensing

Community development in action

Re-claiming the meaning of economy for regeneration

Building a digital communication medium

Creating a medium to build movement together

Design inspirations: visualizing projects and sharings

Design inspirations: visualizing communication

METHODOLOGY

Personal context: how this methodology arose from my life experience

Methodology and data

RESULTS: INSIGHTS ON PRACTICE AND INTERFACE DESIGNS

The big themes: building human relationships in context

Garden metaphors for describing interconnected, complex systems

Time-space (or a practice) is a prerequisite for coming together in a physical space

Why it matters to have a physical place for something

The bandwidth of interfaces: communication structures

Map to display the communication ecosystem in relationship

(A) Bulletin board communication ecosystem

(B) Bottling up project work as a medium for movement-building media

(C) Prototype design: Visualizing networks of people and projects spatially to elicit group sensing and collaboration

(D) Twitter but with questions

The prototype for systemic sensing and co-creating

Interface design: dreaming big

(I) The first step of engagement: the community responds to a question

(II) The second step of engagement: the community co-thinks about their system

(III) Infinitely more steps: emergent communication

(IV) Reflection on the communication structure

First steps toward a prototype

SUMMARY

REFERENCES



dedicated to all the wonderful humans
who have cared for me and taught me
to honor our intrinsic right to and desire for
the wellbeing of all beings

INTRODUCTION AND CONTEXT

While this thesis paper presents a large array of interface designs and conceptual solutions, the core of this work is not a technical solution, it is the attempt to grow into communication practices conducive to healing our systems. System means relationships. This thesis embodies the detailed research and reasoning behind the intentional development of a collective practice that is supported by a visually structured space that helps to facilitate complex forms of communication with the intention to let emerge cooperation and care among people. With the designs developed, I do not claim to have created a fully generalizable solution. They are concrete approaches to the authors' communities of change makers embarking on new journeys together. Let me help you understand from what place they emerged:

Almost all my friends and cohort members from this master's program "Engineering, Sustainability, and Health" (MESH) seek to build new systems together and support each other on a personal and change-oriented level. To enable effective cooperation and the emergence of caring support networks, we see the need to sense collectively emerging visions, think together, design, collaborate, and connect in humanizing ways; ultimately moving toward aspirations of justice and wellbeing. Doing this in person can be quite challenging as western educational systems do not aim to teach us these skills. However, engaging in this form of communication across time-zones, nations, organizational boundaries, so to speak - online, asks for new forms of communication. This thesis is a continued expression of efforts from fellow students and myself to build spaces for connecting over personal as well as professional needs, share our ideas, and stay connected to build new (anti-colonial & non-extractive) systems together.

I use the pronoun I to refer to my work always in relation to many other people. When I use the term "we," I refer to close collaborators such as my co-designer friend Odalys Benitized and collaborators that emerged during interviews.

I am part of the first cohort to graduate from this quite radical, trans-disciplinary, and globally distributed online master's program. With respect to environmental justice issues, we need global inter-group cooperation. At the same time, we need local community development. Interestingly, this online program allows for both to emerge as students are not forced to relocate to an arbitrary place to study and disconnect themselves from their carefully grown roots. It is worth contemplating the importance of such online containers with respect to local community building and international cooperation needed in the face of climate injustice. How else could I be friends and collaborate with a circular economy educator in Kenya who tries to introduce sustainable recycling systems in impoverished neighborhoods? Yet, I argue that our online world, digital tools, social media platforms, and cultural wisdom with respect to online collaboration & group thinking are still in their infancy. Just consider the fact that several years after the start of the COVID-19 pandemic, our online video chat platforms still do not allow us to virtually *sit in circles* or share an image with everyone easily (without having to screen share). Yet, many of us think visually and almost

every community communication book underlines the value of sitting in circles to foster meaningful collaboration and exchange.

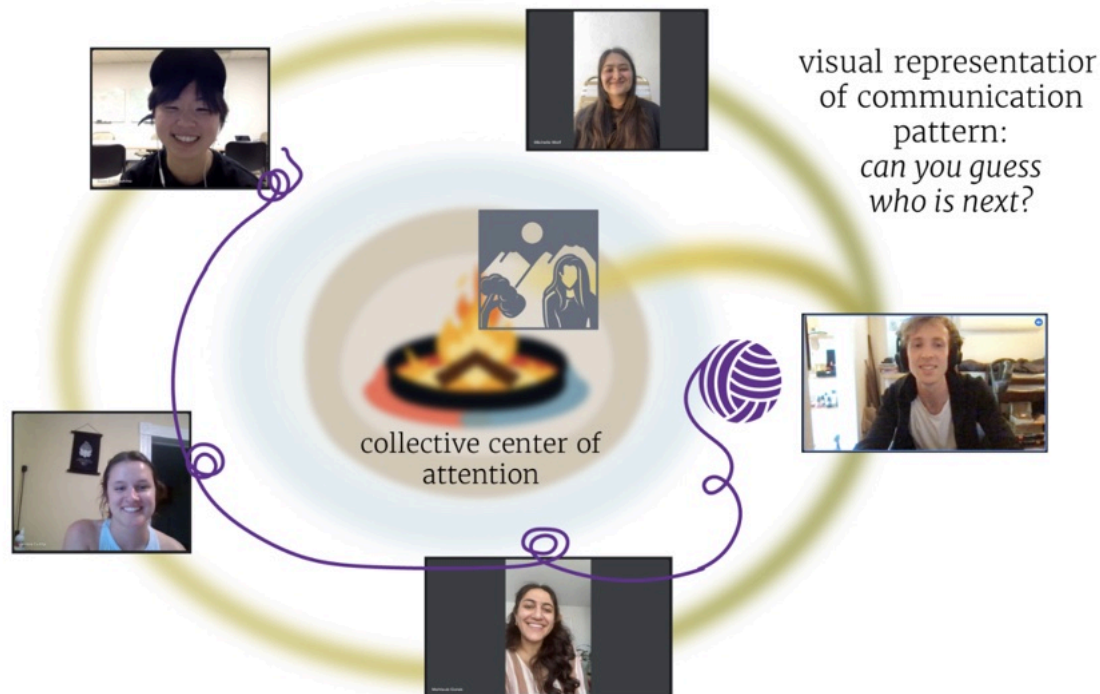


Figure 1: How long will it take for our basic communication interfaces to reflect the structure of desired communication patterns?

Secondly, I invite you to contemplate how the current landscape of academic publications is devoid of any space to respond to a published paper. You cannot respond to a paper, or see how many papers were submitted to disprove it. Monologue after monologue. Nor are papers written in a visual format that allows for intuitive understanding of side thoughts, tangents, and engagement with the reader because our current tools and frameworks for sharing communication are not dialogue oriented to walk a path together (if you are interested in these thoughts, my paper on [Spirituality and Ecological Justice](#) is a fun experiment where I attempt to communicate side thoughts and be in dialogue with the reader). I hope these few examples illustrate quite clearly that our current systems are not yet well-designed to engage with each other on complex topics.

With this thesis, we have crafted a response to the lack of community-conducive online communication, global inter-group cooperation, and local community vision-building.

A brief overview of the work in this thesis

Design ideas and the digital interface tool developed as part of this thesis are meant to be used in fusion with an intentional practice. A tool can never be the solution to a human web of relationships and likely needs to be adapted. The visualization tool is meant to be modular and requires tuning for the respective web of people.

We investigated communication as the central connector between humans with the aspiration to manifest visions, humanize relationships, learn together, dream big, collaborate, and support each other. Put simply, we try to be the organizers of our immediate, most-relevant social world to connect our creative powers and contribute to meaningful change. We seek to stretch the meaning of the term *direct action* to include radical envisioning, thinking together, planning, and building support networks with our local friends, mentors, and trans-disciplinary collaborators.

Below you can see a few overarching concepts that arose out 16-20 interviews and collaborative calls, depending on the time frame you choose. Creating time and intention to come together (practice) is just as important as the space where communication occurs (interface). Therefore, some designs focus on building communication structures, other creations focus on building a practice to adapt over time and *communicate about communication*.



Figure 2: An overview of design concepts and interface designs developed in response to interviews and research.

For design insights and concrete creations, you may jump to the results section. In the literature review section, you may join me on a walk to contemplate from what angle all of this work can be seen to stay connected to our values and reality as whole human beings (instead of just developing a technical interface tool). Right below, I go on a personal tangent, describing why I have been so driven to focus on learning how to *organize my closest communities*.

Deeper personal context: how this work emerged from my life

For the last six years, I have sought out spaces that allowed me to express myself fully and stay connected to my needs as a critically thinking engineer, friend to many, and human in a physical body..

During the last year of my college experience, I lived an academic life free from most common constraints in the middle of a forest at a permaculture farm in North Carolina. I experienced a low hierarchy environment around me as the farm owners gave us young adults freedom to shape the buildings we built, the food we cooked, the times we chose to work (we archived our experiences on this website [over here](#)). During the same time, I worked on my Bachelor's thesis that drew nutrients from the farm experience to explore a renewed engineering practice & science of holism (thesis link [over here](#)). I explored this topic with tender mentorship from someone called Linda Vanasupa (they/any) and all the inspiring people around me. Linda showed me that I could learn even more by bringing together my real experience in my physical body, chopping wood, and installing solar panels while checking in to write a thesis paper on complex systems! They granted me massive freedom to be present with my collaborative and intentional community in the forest while offering me emotional and intellectual guidance and inspiration.

I started to understand how being present in my life and body was a catalyst for meaningful creation not a hindrance to being productive, yet typical assignment structures would never endorse tending to our bodily and community needs. The experience at this farm has shaped my understanding of co-creating change as an engineer. It shifted from a largely intellectually disconnected process into a practice centered around integration of my values into my life with a focus on building human relationships and community. This process is complicated and not straightforward, as one of my fellow students expressed during an interview:

"There are way more intricacies being a change maker and not just another engineer" said a MESH student explaining their work to an outsider.

I wanted to stay connected to both, my values and community, moving into my master's program, and I luckily found this program, Master's in Engineering Sustainability and Health, as I stumbled upon the group *Engineering, Social Justice, and Peace* (ESJP website [here](#)) and connected with the co-founder of this program Caroline Baillie (she/her) over the phone. As soon as we talked, I knew that I had finally met someone who cared about me as a human with complex creative flows while staying connected to the aspiration to build new systems together. When I attended a retreat with members of the group ESJP from above, I experienced how Caroline and everyone else present created a space for relationship oriented contemplation, co-creating, caring for each other, and driving change in a peaceful manner.

I have experienced this master's program as an extension of my journey to create collaborative environments, holding space to listen to each other, sometimes challenge each other, and eventually grow into critically thinking, change-oriented activists. The academic freedom of this program granted me the emergent opportunity to collaborate with students from my former college, Olin College of Engineering, creating a renewable energy solutions portfolio for energy sovereignty, and it felt empowering and insightful to work with students from Cal Poly San Luis Obispo to plan out a ethical supply chain for a wind turbine donated to the Just Energy Hub at Olin College of Engineering. In short, we continued to learn how to collaborate across institutional boundaries on topics that were important to everyone involved, striving for social and ecological justice.

I had always perceived the challenge of an online-program (disconnected, distributed across the globe) as a deep opportunity to learn how to hold inclusive, caring space for relationship-building in a world full of climate injustice that deeply requires transnational collaboration. Almost all my college friends live in different cities. Yet we aspire to build new systems, support each other, and collaborate. Now, I find myself in the position of being the secretary for the above-mentioned organization *Engineering, Social Justice, and Peace* with similar aspirations to help this engineering community collaborate and care for each other.

During the design process of this thesis, I shared ideas with many of my local friends and collaborated with my college friend Odalys Benitez. And again, what I learned was that my ability to tune into my own creative source was amplified by the engagement with people around me. Collaboration with others gave life energy to this project. If anything, we need massive amounts of energy to rebuild our systems to fight systemic injustice and climate destruction. In response to this challenge, I invite you to explore with me how we can tune into our creativity to bring forth the change so many of us desire so deeply. During many interviews, I continued to hear the notion that we want to work together yet we feel depressed by the structures surrounding us. Therefore, this thesis is an unexpected continued journey of a path shown to me by Caroline, Linda and many other inspiring (and caring!) people I met along the way. It has grown out of a collective desire of my classmates and course facilitators to stay connected after graduation and tune into an emerging future.

PIECES OF LITERATURE AND THOUGHT THAT INFORM MY RESEARCH AND DESIGN

My intention for this section is to share pieces of theory and thought that I consider meaningful enough for an ongoing conversation with you - the reader -, my future self, and future collaborators. First, I describe macro-scale concepts such as metaphysical observations and holistic science. Then, I go into concrete theories of change to reconnect our systems and tune into deeper intelligence, closed by design concepts and practices that informed my work.

Before we explore theories and concepts, I want to help you, the reader, understand why I chose to highlight the specific pieces below and not others. This thesis is rather expansive as I explore re-building health-conducive systems from the ground up (yet for a particular community). We could spend much time breaking down how communication works. What I share here are pieces that have impacted my life as a critically thinking change-maker coming from an engineering background that created hidden mental models I needed to recognize before moving into a direction of healing. The pieces below are concrete forms of guidance for my life in a human body trying to bring about social, systemic change. Therefore, contemplating the nature of our reality, how our systems work, and how we may change them through a holistic lens that pays attention to all aspects of life is my approach below.

In the end, I don't change the world by writing a paper. I change the world by bringing this work into all parts of my life. Fighting climate change and oppression is not an academic pursuit, it's a pursuit for life, for my whole life. And because I am alive, the systems we work with are alive, and the systems we seek to build may hopefully portray characteristics of healthy living ecosystems, it makes much sense to contemplate what it means to be alive as beings on this earth. While the result of this thesis is a tangible design prototype & practice for a particular community, the essence it contains is a reconnection to parts of us that are already present. We don't need to change the people, we need to give them space to manifest the love and care that already resides in them.

I want to bring to your attention the following:

- Science of holism and how building a practice that pays attention to all aspects of life relates to this framework
- A garden metaphor for giving stewardship to our systems and building systems that can maintain themselves
- Re-connecting to our body, source, emotions, and stories for liberating ourselves
- Building a regenerative economy that can maintain itself through care & cooperation

I will introduce to you a few interface designs and ongoing practices that informed my work, including *Offers and Needs Markets*, *The City of 1 Million Experiments*, non-linear interfaces, the *Innovator's Compass* and my personal exploration of sharing through my (slowly evolving) space called *Mostly.Mutual.Studio* or *My Marble Sharings* (website [here](#)).

Pieces for building a liberatory practice

What is the nature of reality?

This question might seem quite far out but is of deep relevance. As we study the fundamental nature of reality (meta physics) we naturally look through a holistic all-embracing lens. How else would we try to study the nature of reality anyway? We can observe certain natural phenomena which we could describe as the *nature of nature*: We can see that our deeply connected natural systems already have everything they need to be balanced and thrive, and have been doing the work of finding a state of steady chemical, physical, and biological conditions for thousands or millions of years ([Lovelock & Margulis 1974](#)). Complex feedback loops are present in most healthy ecosystems to adapt to changes ([Holling 2001](#)). While creativity and emergence of new patterns may be necessary for continued balance through adaptation to challenges, our living systems contain everything they need within themselves. Our systems are whole to begin with and naturally contain the functions that let emerge patterns toward health.

This holistic perspective on the nature of reality deeply shapes my work because the realization that we are whole to begin with, equipped with all tools we need, moves the focus away from the prevalent mentality in engineering to “fix an imperfect state of being.” Instead, my actions are guided by the understanding that we might have been artificially fragmented due to social structures but can regain desired states of health, wellbeing, and wholeness by reconnecting with already existing systems, humans, and life overall. With this thesis project, I seek to hold space for exactly this type of re-connection to let emerge forms of collaboration and communication that naturally emerge within a social field of connected humans experiencing challenges.

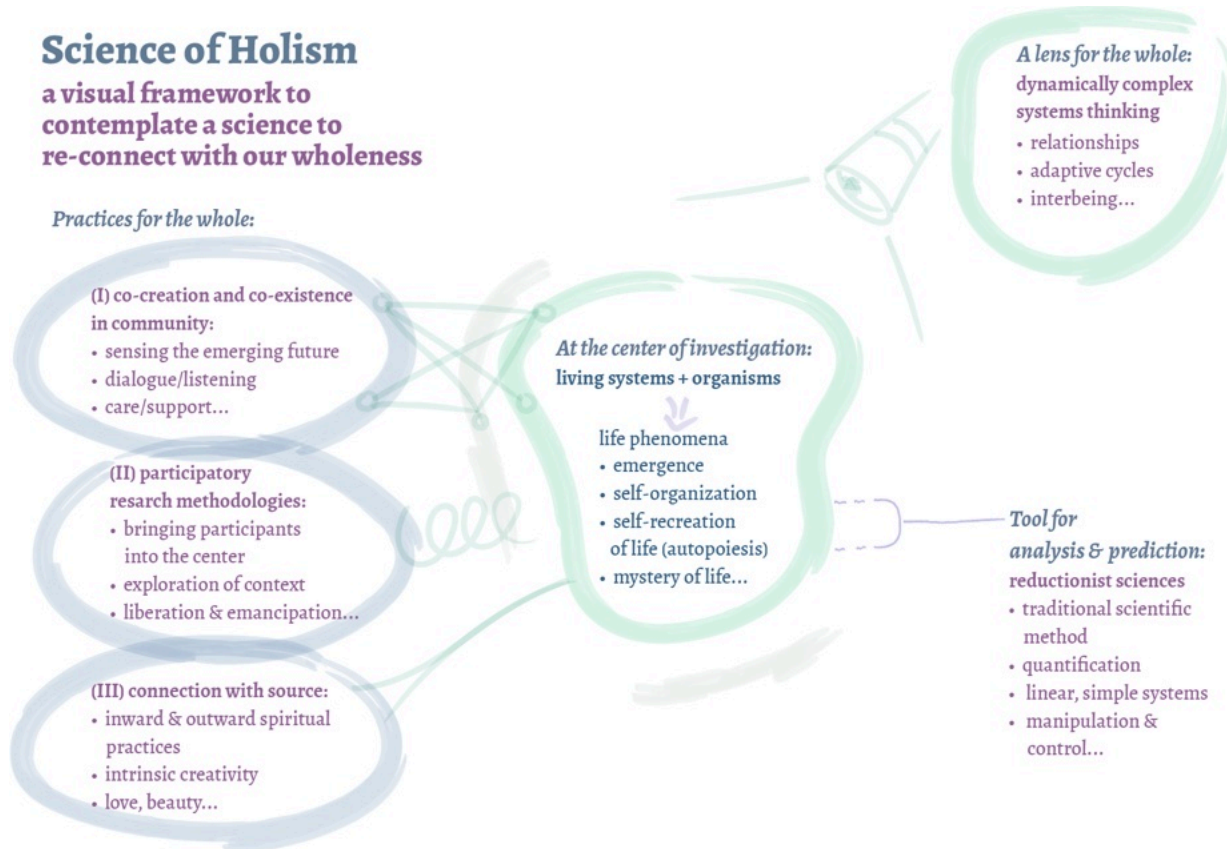


Figure 3: Practices for the whole differ from the traditional scientific method which disregards values and reduces complex systems to numbers for the sake of prediction. Complex systems thinking serves as an overarching lens for the whole. (adopted from my bachelor's thesis - [Santen 2021](#)).

I may summarize the overarching aspiration to build systems that re-create conditions conducive to life, where all beings can thrive. Such systems are often called regenerative systems as they regenerative their condition for thriving. They maintain themselves through a variety of processes without depleting other areas of life. The characteristic of a system to maintain itself and reproduce the conditions for its emergence is one way to define life. We give this characteristic the name *Autopoiesis*. While this term was introduced by Chilean biologists Humberto Maturana and Francisco Varela to describe natural systems in 1972 with the title “Autopoiesis and Cognition - The Realization of the Living” (link [here](#)), Niklas Luhmann transferred this theory to the social realm, showing that social systems portray characteristics of living systems as they are self-organizing and self-reproducing ([Albert 2016](#)). This theory is very relevant to this work because the underlying goal of our designs for community communication is the emergence of our social ability to self-regulate and maintain a semi-closed system of communication relationships and emergent project structures. The communication system can be seen as a living system itself and the ability of this system to maintain itself is needed to ensure sustainability. Luhmann's theory is quite extensive. While it serves as an inspirational reference for conceptualizing building social systems, I will not attempt to unpack the complexity of this (controversial) theory.

Since social systems can be perceived as living systems, it makes sense to turn to nature and become nature's apprentice. How does nature keep natural systems in a steady state of innovation and adaptation? Adaptive cycles are present in most healthy ecosystems. Within these cycles, the ecosystems go through stages of release of energy or capital, exploration of opportunities, growth, and sustaining existing structures. The cycle then starts over at release of energy which means to break down preexistent structures to free up new creative potential. Holling (2001) describes these adaptive cycles in his paper on "Understanding the Complexity of Economic, Ecological, and Social Systems" which I can highly recommend. Our designs keep this cycle of adaptation and innovation in mind.

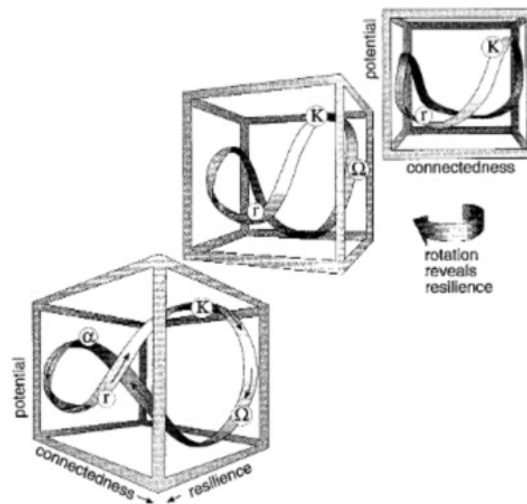


Figure 4: Living systems move through adaptive cycles during which the levels of resiliency, connectedness, and available energetic potential change. They can also get stuck in rigidity traps if resiliency overthrows creative expression (Holling 2001, p.394).

Bringing adaptive cycles into the design practice

Similarly, the two design frameworks that have inspired my work, the *Innovator's Compass* by Ela Ben-Ur and *liberatory design principles* (website [here](#)) try to keep alive this recurring loop of innovation. These two design tools are a manifestation of an attempt to keep adaptive loops alive within a community or group of people. For instance, The Innovator's compass asks five questions to get unstuck during a design process or community gathering. The questions asked are:

- (I) People: Who is involved?
- (II) Observation: What's happening?
- (III) Principles: What matters most?
- (IV) Ideas: What ways are there?
- (V) Experiments: What's a step to try?

These questions show many parallels to the liberatory design principles (website [here](#)) which offer us terms for moving through a pattern of seeing, engaging, and acting with equity in mind. In the end, the design concept developed in this thesis seeks to bring about emergent action arising from collective empathizing, sensing and co-creating. Therefore, both of these design tools are directly embedded in the practice & digital space we developed.

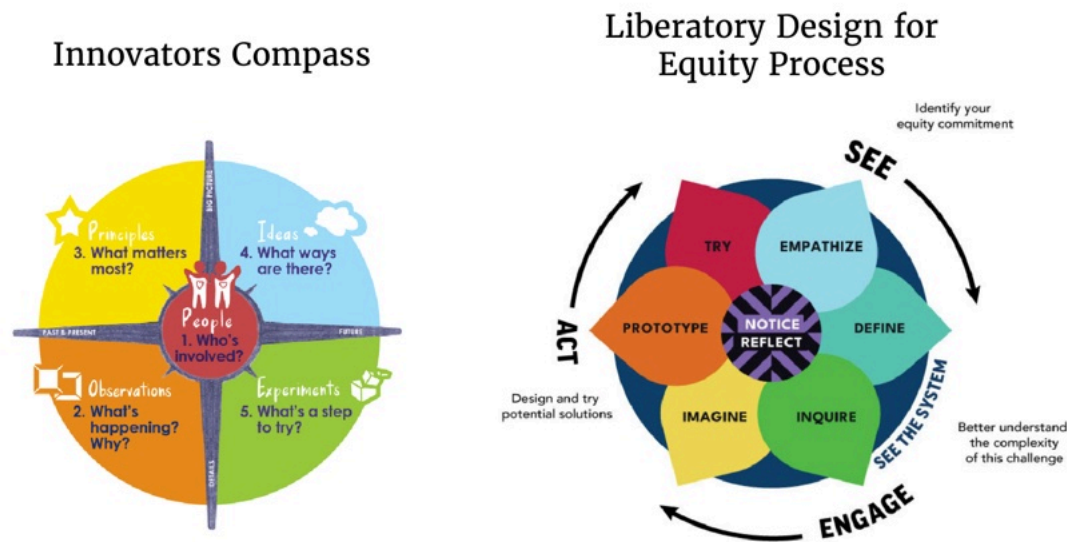


Figure 5: A design tool that asks five key questions to get unstuck and grow through challenges collectively or personally(left). Design principles that foster collective liberation (right) embedded in the compass.

Liberation through re-connecting and sensing

Staying close to the intention to liberate ourselves from old oppressive or divisive systems moving toward whole ways of being, Monica Dennis's framework below describes how this practice is largely related to reconnecting to source, body, stories, and emotions. As we re-connect, we literally rebuild pathways of communication and therefore gain access to a deeper source of embodied intelligence within our individual human bodies and our collective human body of ancestral wisdom, stories, emotional and spiritual intelligence.

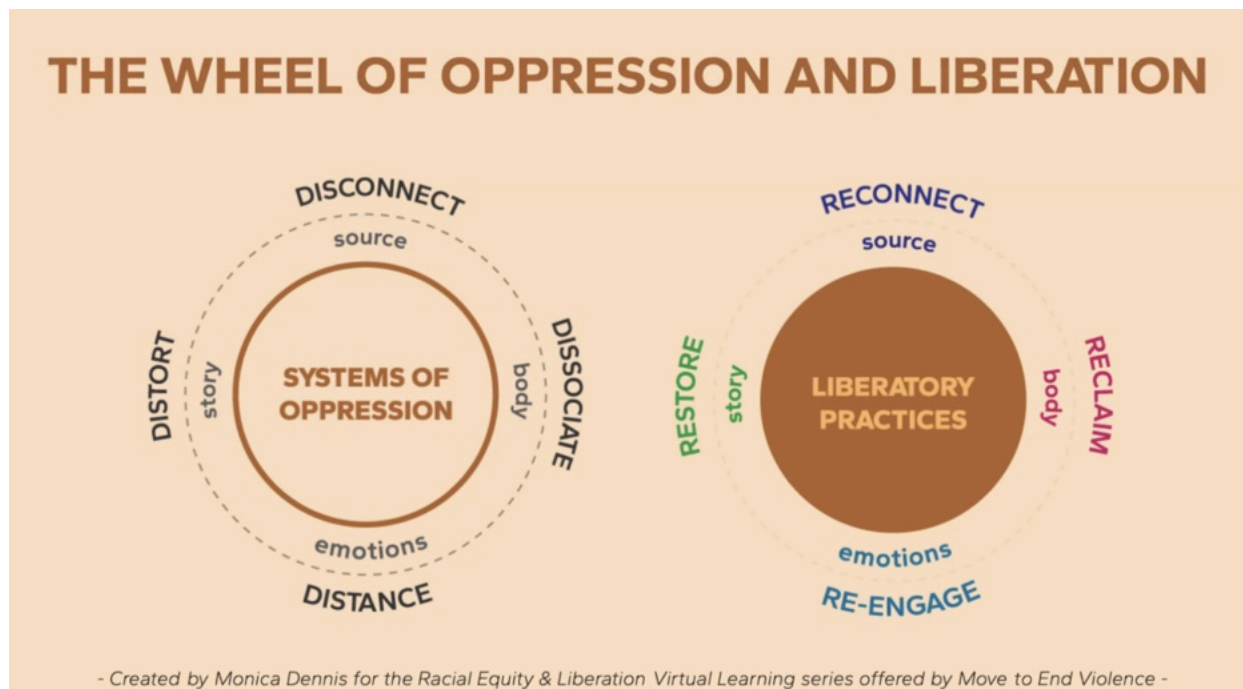
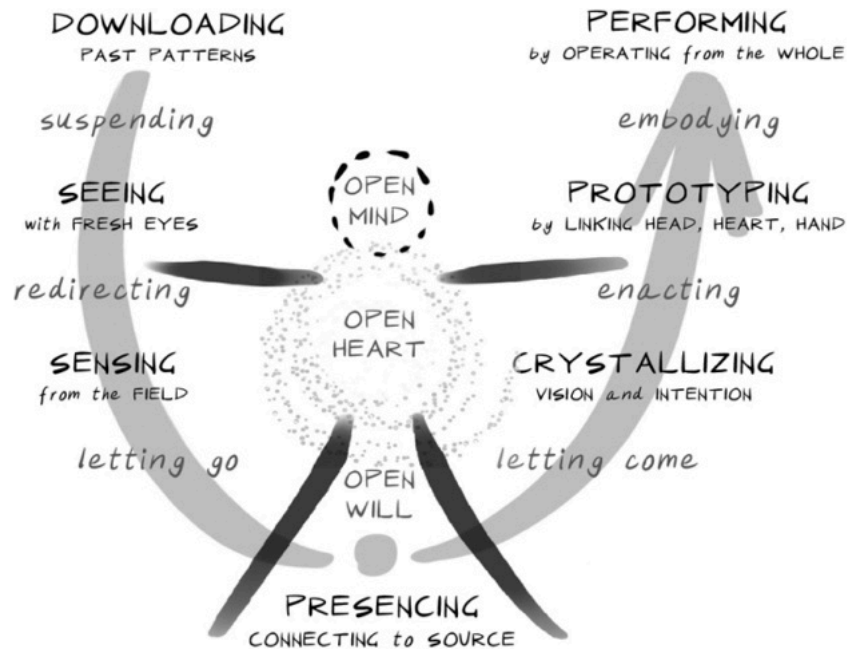


Figure 6: We hope to nurture an environment where re-connection to source, body, emotions, and story arises. Taken from AORTA presentation by Autumn Brown - A Breath Away from Freedom, February 2023.

Monica Denni's framework suggests that we need to build some social practice (a friend of mine called it a "cultural tool") of coming together that embodies these liberatory practices. For instance, the power of simple practices of re-connecting with each other shows that raising social and emotional awareness can largely increase interaction in online containers and deepen learning ([Lambropoulos et al. 2012](#)).

Liberatory practices can be found in the design framework mentioned above (*Innovator's Compass* and *liberatory design principles*) and have been concisely summarized by a process called Theory U established by Otto Scharmer and Katrin Käufer to address our systemic disconnects and "lead from the emerging future" (Scharmer & Käufer 2015). Their term to "lead from the emerging future" encapsulates the notion behind meshing together our current alumni, student and instructor community of my program *Master's in Engineering, Sustainability, and Health* (MESH). They describe this shift as a transformation from an ego-system awareness to an ecosystem awareness. "While someone with an ego-system awareness mainly cares about their own wellbeing, someone with an ecosystem awareness is driven by concerns that are informed by the well-being of the whole" ([Santen 2021](#), p. 31). "Pioneering the principles and personal practices that help us to perform this shift may well be one of the most important undertakings of our time" ([Scharmer & Käufer 2013](#), p. 2). Zastavker & Venkatesh ([2022](#)) demonstrate bringing these principles into engineering education by creating compassionate and empathetic spaces where students can contemplate together and practice democratic engagement.

We take the idea to sense the system from within (through a human, empathetic lens) quite literally as design concepts presented in this thesis provide space to co-sense the system. Out of this sensing process, action



may arise.

Figure 7: The path through the *Theory U* frameworks starts on the top left. While this illustration depicts a single person, the same approach applies to groups.

All the aforementioned frameworks synthesize very similar insights about the process of coming together, sensing each other as human beings, and bringing forth change. I share all of them to provide a variety of tools to you, the reader, as every tool focuses on slightly different aspects.

Community development in action

It has become clear that the process of connecting with each other and ourselves is dynamic in nature. It operates in loops. The dynamism behind the transformation of growing into new forms of being is the central component of this work we seek to bring alive in our communities. While working together to build new systems is important, we take the stance that this work arises from caring human connections without an ulterior motive in mind. Therefore, tending to our needs is of utmost importance and has to be integrated into the spaces we seek to nurture. The concepts of community development and *emancipatory action research* (EAR) lend us a useful lens to see the involved humans as equals, including actively deconstructing power relationships to create “critical spaces for dialogue [...], involving all co-participants in co-creating knowledge for our times. These are counter-hegemonic critical spaces where power relationships are

investigated and deconstructed in order to act to reconstruct democratic relations with new possibilities for a world that is fair and just. This concept of a democratic public space is a vital context for social justice as a site for critical dialogue and participation in the process of participatory democracy (Habermas, 1989)” ([Ledwith 2017](#), p. 56).

A direct manifestation of such forms of relating to each other are community gatherings called *Offers and Needs Markets*. Offers and needs markets ([website here](#)) are gatherings of people in real life or online where a new form of economy is built by connecting to the depth at which humans can support each other ([Post Growth Institute 2011](#)). People break up into small groups and share their offers. Later on, they regroup again and share their needs. Throughout this process, participants can reach out to each other, share with the large group. Toward the end of the gathering, all participants share their offers and needs publicly. Our designs take inspiration from this form of coming together that is driven by human connection and collective sensing of opportunities to support each other.

Re-claiming the meaning of economy for regeneration

If you were to translate *management of home* into old Greek, you would receive the word *economy*. For this reason, my work can be framed as the attempt to contribute to building a new economy based on different values than our current economy. The path from a life-destructive economy rooted in exploiting resources such as land and labor moving toward a new economy rooted in cooperation, consent, and care is depicted in the valuable framework of the Climate Justice Alliance ([link here](#)). My project seeks to transform the individualized, hierarchical communication spaces of our current systems by creating spaces for communication and collaboration among changemakers committed to building a regenerative economy.

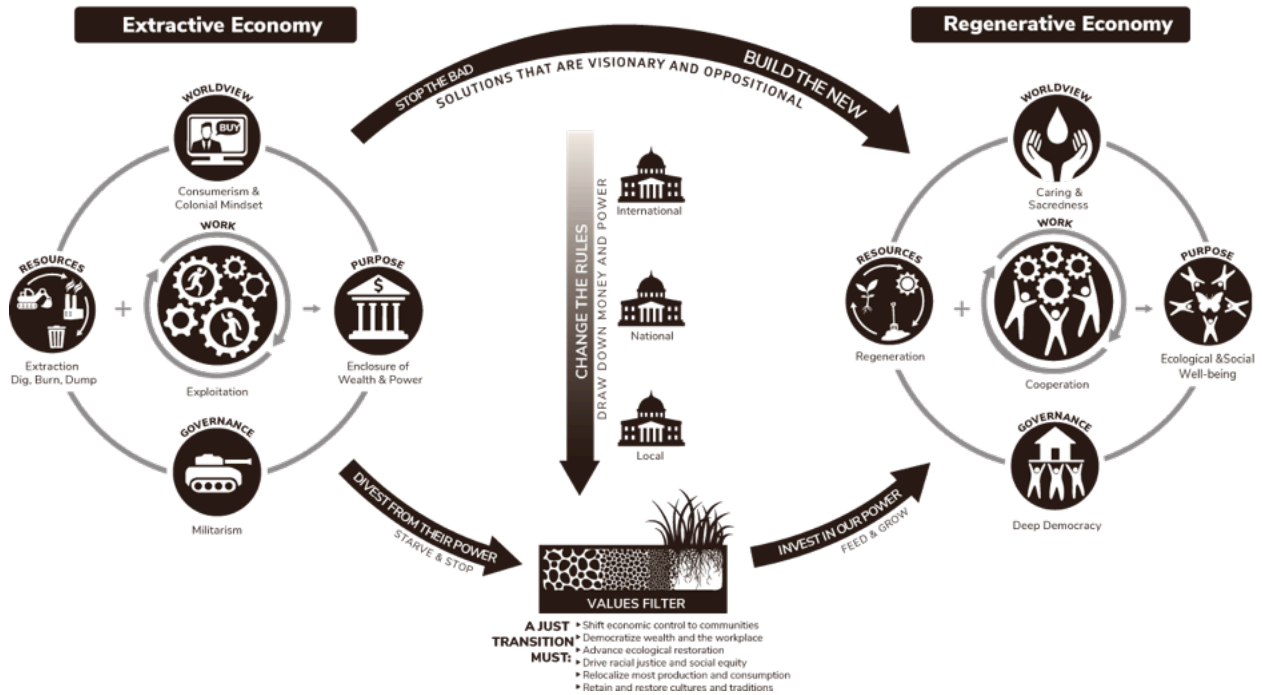


Figure 8: Moving from the left to the right requires a value shift away from profit and exploitation toward cooperation, consent and care (website explanation over [here](#)).

Of particular importance to this project is the regenerative circle on the right. This circle embodies the values of care, cooperation, and consent with the goal to bring forth ecological and social wellbeing. Existing with each other upholding the mentioned values inherently asks for changing power relations of our systems. I may briefly mention that keeping values in mind when designing structures (such as our communication spaces and practices) is very important because values can be seen as the essence that stays within the structures we create. Values, purpose, and the sense of what we hold sacred are the smallest building blocks of our base understanding regarding the nature of reality and being (ontology) ([McGilchrist 2021](#)). These three pieces can be referred to as *ontological primitives*. Since we know that our social systems can exhibit signs of living systems, we need to pay close attention to the values embedded within them to ensure that the structures they create try to keep alive are actually conducive to social & ecological wellbeing. Therefore, it matters that humans reflect periodically on their collective values, visions, and goals to ensure that the seeds they plant contain the essence (or DNA) that invisibly conditions how the seed grows into a larger structure. Oftentimes, we focus on the fruit we desire; the outcome of the system. Yet the ontological primitives embedded in the system will stay alive throughout the whole system forth these desired essences that can otherwise stay unnoticed yet will deeply affect what shapes the system grows over time.

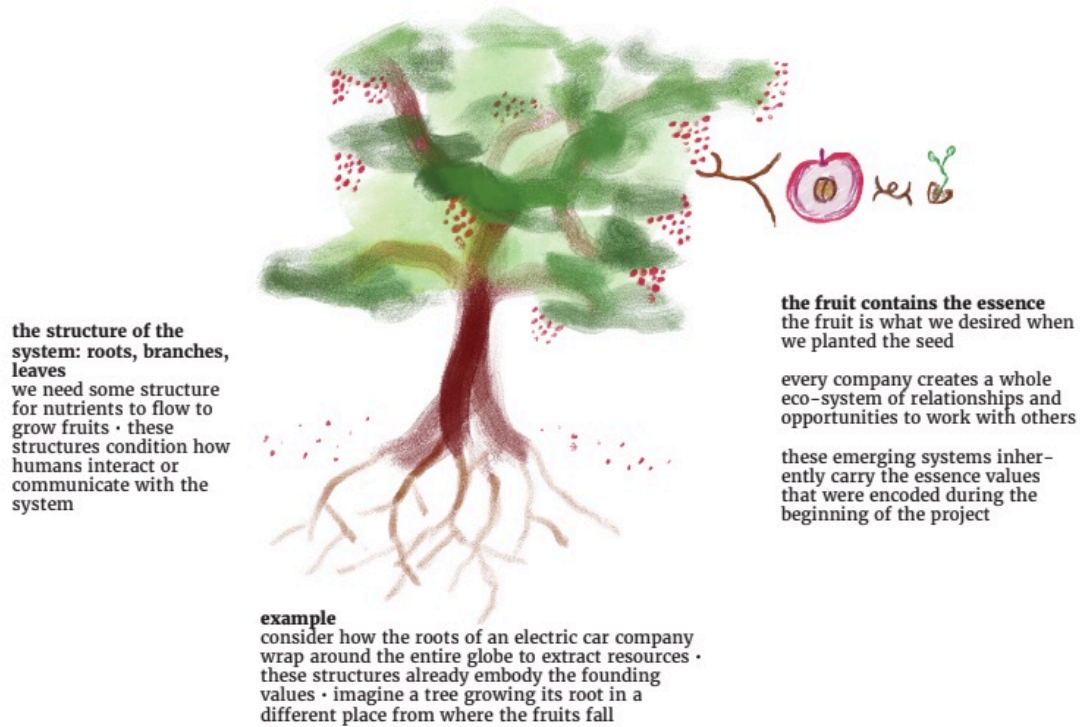


Figure 9: A visual metaphor depicting how the essence of a social system or project is recreated in the fruits the project bears. This essence can be thought of as the DNA which creates a structure that replicates the values in, including values embedded in new seeds that emerge from this system. Adopted from Santen (2023, p. C-5).

The practice we choose for stewarding our garden (our land, our systems, our people) directly relates to how we choose to make decisions. This means that working toward ecological and environmental justice inherently asks for the transformation of power relationships toward democratic and consent-oriented flows of power. The design concepts developed in this paper seek to re-empower community members to make decisions collectively and with awareness of each other's perspectives to shape the management of our collective garden.

Erik Olin Wright attempted to illustrate the relationships of power within our capitalist systems that largely operate without any democratic decision making processes. Therefore, social power is low within capitalist social systems. However, "in a fully democratic society, all people would have broadly equal access to the necessary means to participate meaningfully in decisions about things that affect their lives" (Wright 2013, p.5). Actual democracy therefore asks for much stronger social power which can be summarized with the term socialism, referring to the values of consent and self-determination. Wright's frameworks help us reason on a system level how power flows.

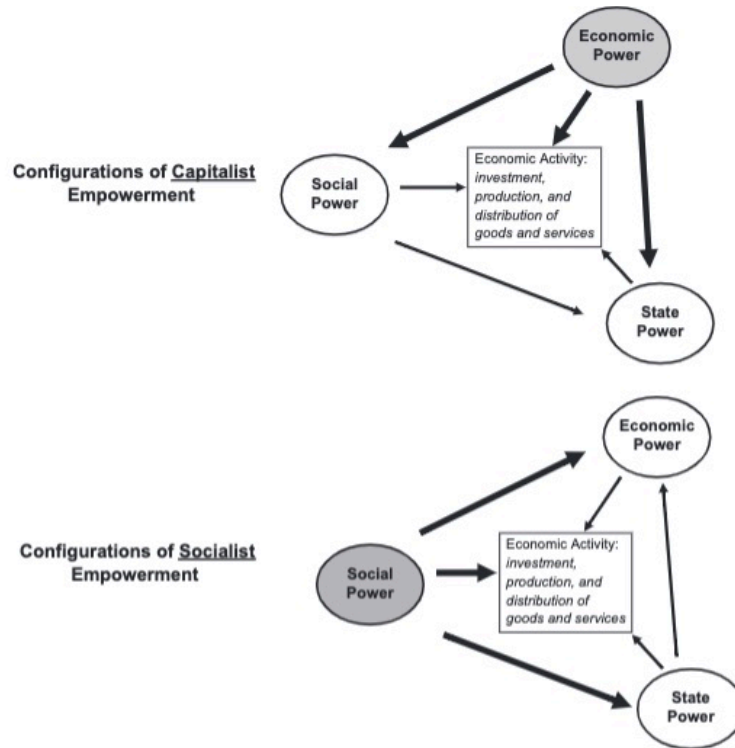


Figure 10: Empowering communities to manage their home and economy collectively means to shift power away from the traditional economic sector to the social sector to shape their respective economy (Wright 2013, p. 25).

Building a digital communication medium

While I will share examples of inspiring designs in this section, I first want to contemplate how we may build a medium for communication and connection.

Creating a medium to build movement together

The podcasters Damon Williams and Daniel Kissinger created a list of emancipatory principles for media creation. Williams and Kissinger define media as any medium that connects people, ideally to *humanize each other, reflect, and build movement*. In their work, they seek to humanize subject-to-subject conversation (William and Kissinger 2023). They seek to create media to enable *activation, education, and archiving* (William and Kissinger 2023).

Their practice of media creation is aligned with the following principles:

1. Operate without being beholden to traditional institutions.
2. Acknowledge and create within contradiction (within you or your story).
3. Name people and organizations that are already doing the work.
4. Direct resources that are not focused on productivity to your community.
5. Let your actions be guided by ground work and relationships rather than access to power.
6. Attempt to account for colonial power structures & implications in ourselves, dialogue, and the work we do.
7. Share which problems are important through the lens of the organizations doing the work.

(William and Kissinger 2023)

These principles have served as a reference point for creating media that is meant to grow movement toward creating caring human networks, building better systems, and experimenting together.

Design inspirations: visualizing projects and sharings

Several design approaches of this thesis explore the creation of a space to sense each other's work and projects to induce collaboration & collective vision building. The organization *1 Million Experiments* shares community-based projects that “expand our ideas about what keeps us safe.” They intentionally call these projects experiments as we do not know one perfect solution but can only embark on experiments together (Nagao 2023). They host an interesting virtual city called *The City of One Million Experiments* (link [here](#)) where they showcase community projects by mapping them on an illustrated map (see section A of Figure 11). This intuitive interface for exploration has inspired visualization approaches in this thesis. Artificial intelligence technologies might help to keep such complex forms of visualizations updated over time.

Spencer Chang and Jacky Zhao developed a website ([we-b.site](#)) to “imagine and create alternative futures for the internet” by giving users the option to share visions packaged up in a visual letter on a page (see section B of Figure 11). The visual representation sparks inspiration, centers fun, and makes browsing through ideas easy while keeping the social aspect of sharing and dreaming together in the center of the interface. A “digital garden” is a similar concept arisen from online communities that desired to re-personalize the internet and how we share online (see an explanatory article [over here](#)).

Less personalized but still quite effective forms of sharing opportunities are the job opportunity websites *Climate Tech List* and *Social Change by Design Database V2* both reliant on the service from Airtable (link [here](#) and [here](#) respectively).

The City of One Million Experiments



we-b.site a living collection of internet dreams



Figure 11: The virtual *City of One Million Experiments* (link [here](#)) raises awareness for community projects in Chicago (left). The *we-b.site* helps the internet community to sense emergent visions through the representation of letters with personalized stamps and fingerprints (link [here](#)).

Design inspirations: visualizing communication

We may communicate with other people or our past self. With respect to personal knowledge management, the platforms *the Archive* and *Obsidian* offer building networks to interconnect pieces of insights, knowledge, ideas or whatever the user seeks to input. This referential and linked form of saving knowledge is inspired by the knowledge management practice (called “Zettelkasten”) developed by Niklas Luhmann (Luhmann 1982) who wrote insights on pieces of paper that he kept in boxes (in German called “Kasten”). A certain slip of paper (in German called “Zettel”) would reference other slips, creating a web that would allow your future self to engage in a form of communication with your past self, similar to how memory linkages work. The platform *Obsidian* visualizes these networks which may portray how different disciplinary insights might be connected or separated from one another (see section C of Figure 12). Alongside this thesis, I have been developing my personal website tool to share slips with others in an effort to “create a medium to facilitate “movement building” in my personal circles”, which I call *MyMarbleSharings* or *Mostly.Mutual.Studio* (website [here](#)).

With respect to chat communication among large amounts of people, Zhang et al. (2017) developed a communication approach called “Wikium” that asks people to summarize their chat messages to help people grasp themes and allow them to dig deeper as they please (see section A in Figure 12). Crawford (2017) developed a design approach to build a *Non-Linear Conversational Medium* that broke the typical linear scroll of chat messages to allow users to go on tangents (see section B in Figure 12). Krieger (2020) puts Crawford’s and Zhang’s work into context in his wonderfully illustrated comic called *Chatting with glue: cognitive tools for augmented conversation* (link [here](#)).

Lastly, the platform Polis is a direct democracy “real-time system for gathering, analyzing and understanding what large groups of people think in their own words, enabled by advanced statistics and machine learning” (link [here](#)).

While all of the platforms above contain parts of the essence relevant to this project. This thesis explores more concretely how the focus on the human experience with each other can stay in the focus while simultaneously leveraging the power of visuals to enable networks of change makers to become complex systems thinkers in an intuitive way. As all research is finite, similar tools might be out there. Yet I could not find anything that focuses on empathy, visual systems thinking, and trans-disciplinary cooperation. If you read this and have other pieces or insights to offer, please reach out to me (leonsanten.info).

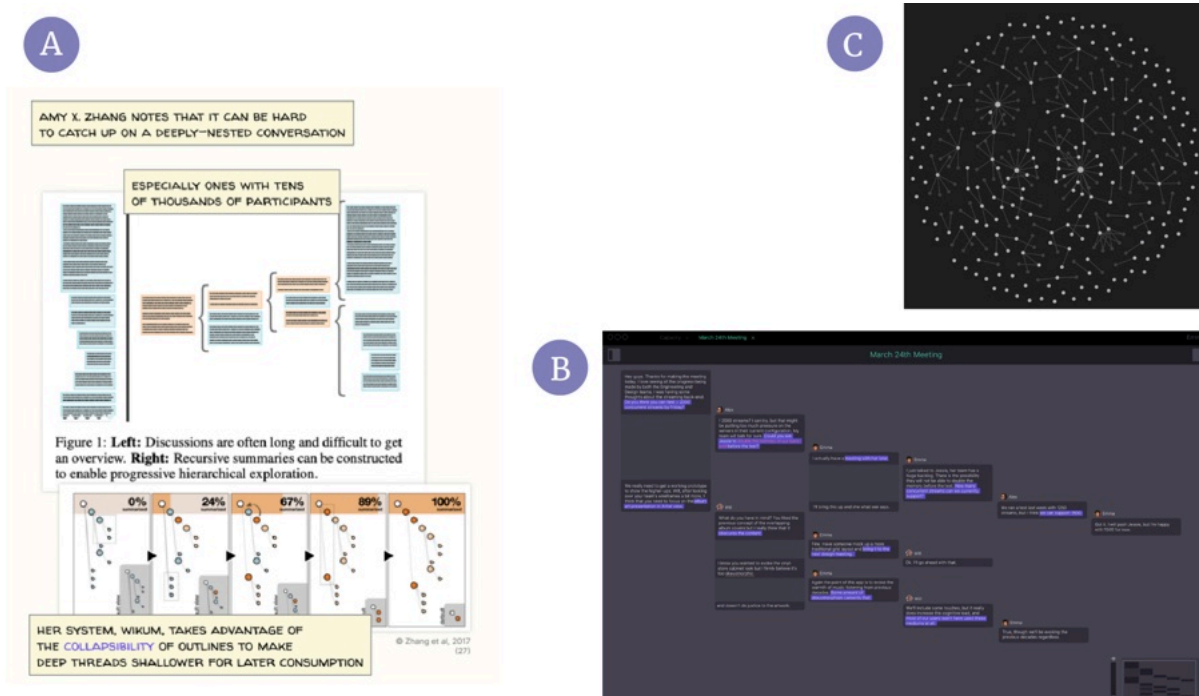


Figure 12: (A): Zhang et al. (2017) found that summarization of large amounts of text into condensed sentences helps readers to grasp large conversations (image from [Krieger 2020](#)). (B): Crawford’s (2017) Non-linear Conversational Medium attempts to open up visual space for tangential conversations. (C): The visualization of knowledge relationships on the Zettelkasten application Obsidian builds intuitive awareness of complex relationships.

METHODOLOGY

Personal context: how this methodology arose from my life experience

This program was truly a blessing because the instructors and teachers gave me an incredible amount of freedom to stay connected to my own interests and creative urges. This capstone project is the manifestation of a continued journey to stay as close as possible to my personal interests to shape my life path meaningfully while maintaining a delicate balance with respect to emerging needs of people and living beings around me.

For these reasons, I chose a methodology for this capstone project that considers my personal life experience (autoethnography) while paying close attention to stories voiced by the people I chose to reach out to (ethnographic research).

On top of my own experience, I cared about this project as a catalyst for personal relationships. I see now how learning how to work with people I care about (such as close friends and mentors) is likely going to be a project for life. My approach to designing and learning is the direct manifestation of this aspiration. Many insights arose during conversations with friends and caring professors. I consider all of these experiences valid data and it would be reductive if I pretended that only the official number of interviews informed my design work.

Methodology and data

The methodology for this project is a fusion of autoethnography, ethnographic interview-based human-centered design, liberatory design, and iterative collaboration with friends and interviews.

During the official part of this study, I collected data through fourteen one-hour long interviews spread out over three months. This data includes audio recordings, notes, video recordings, and drawings created during calls with interviewees. Before this semester, I had discussed the question of this thesis with friends, course facilitators, and cohort members in numerous calls. I have a small selection of drawings and notes from these previous calls. Another formative time of community engagement was a five week facilitation program for *Offers and Needs Markets*, taught by the Post Growth Institute ([website here](#)). Many of their ideas have shaped my creations and subsequent interview questions.

Prior to this capstone project, I volunteered for a newly forming organization called *Village Builders* (website [here](#)) to conduct two 90-minute interviews to understand the current loneliness epidemic in the United States by focussing on the stories of a queer trans organizer of my age and a handicapped older woman. Insights from interviews and debriefing sessions with respect to reducing the loneliness epidemic influenced this study's design path.

The initial interviews during the official interview phase shaped the first iteration of my designs, which I then shared with new interviewees who gave feedback on emerging themes and designs.

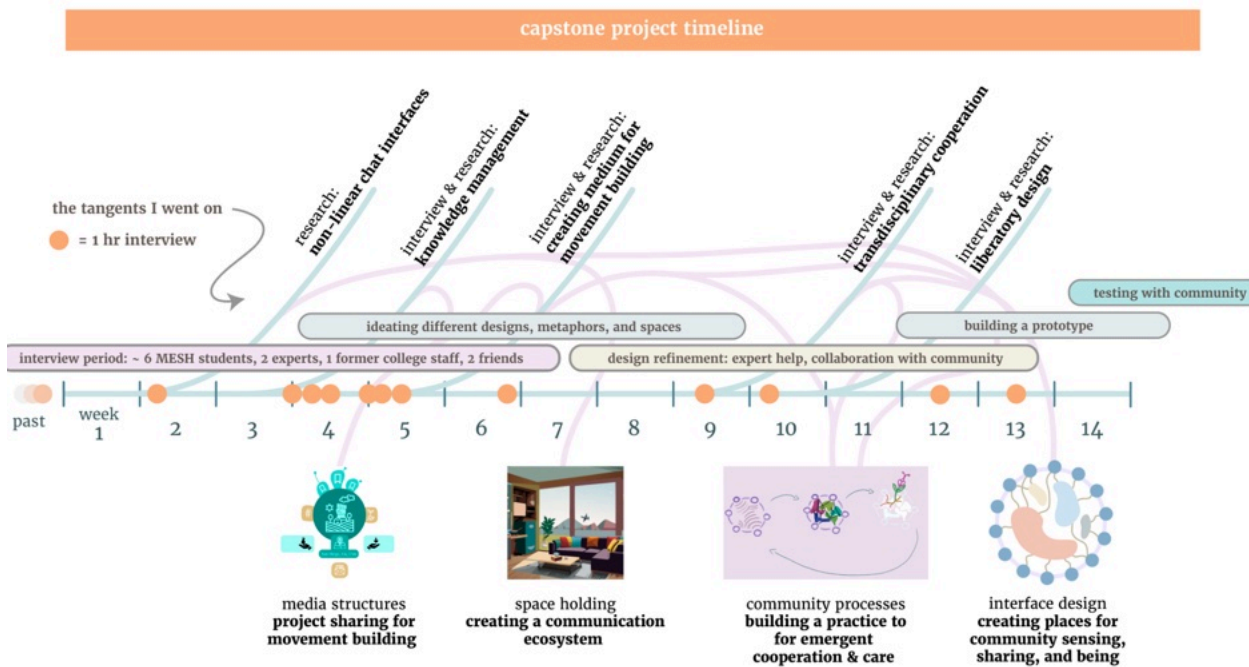


Figure 13: Diagonal blue lines refer to research inquiries during this project. Purple lines refer to the epistemological building blocks embedded in the designs. Interviews extended beyond the first interview process, iteratively informing emergent designs.

During the official part of this capstone semester, I reached out to interview six students from this Master’s program ([MESH](#)), two course facilitators of this program, two experts in the fields of knowledge management and transdisciplinary knowledge building, four engineering friends and organizers with a particular focus on social justice, one engineer and podcast host who interconnects people in the field of climate technology, and a designer who helps people to group-think and create. I told interviewees beforehand that I might cite them anonymously. For the sake of creating a personalized and movement-oriented thesis paper, I reached out to every person who is referenced with their name after I chose to include their words in this report.

The data does not suggest any single one story but rather paints a complex and diverse picture of experiences with respect to learning how to work toward shared aspirations, stay connected as human beings, and build new systems and economies. I acknowledge that I could have interviewed even more people with wider experiences, especially people who are part of large functioning activist organizations. I chose the set of people above because their expertise and perspectives seemed to inform the most immediate opportunities of my research journey. For instance, I had always wanted to draw from the wisdom of my friends with the aspiration to “stay connected as change makers,” distributed across the country. Therefore, re-connecting with friends over this project was a direct manifestation of the aspiration of my design work - a proof of concept in itself as I would not have been able to sustain motivation and technical development at the rate you can witness in this report. This thesis and design work is the beginning of a life-long journey. I

invite you to share your critical reflection and desires to co-create with me. The methodology I chose for this form of research is one that I choose for my life. This paper manifests a reflection and sharing point during this ongoing learning process. This capstone project was a perfect practice of reaching out to people around me who are similarly interested in building new systems based on care, cooperation, and consent.

RESULTS: INSIGHTS ON PRACTICE AND INTERFACE DESIGNS

Throughout all my work, I came across a consistent desire for continued and deepened community online and in-person. I take the excitement from my friends and cohort members as direct confirmation (on a thought level and energetic level) that my work is meaningful. Two of my classmates reported during the interviews: “I am so excited to see your creations!” “We need this!” As I write this paper, I have continued to share these ideas with my circle of friends. Collaboration with my dear friend Odalyz Benitez (she/her) emerged naturally during an interview and led into the process of co-designing a communication space and the technical manifestation in the form of a community visualization prototype linked to a survey.

We created a minimum viable product that arose from the sets of interviews and an iterative design process. This minimum viable product is a modular mapping tool for projects and community communication with an intentional focus on personal, emotional, and political context on top of deeper resource sharing options. The design draws from the natural systems metaphor “tending to a garden” with respect to building a new economy that is deeply interconnected with roots drawing nutrient from various people and other projects. This main design concept is also a coded, technical tool that can be adjusted and improved to serve communication within a variety of spaces.

The following sections explore the principles that emerged during the interview sessions and the bandwidth of needed places for communication and collaboration, introducing you to a variety of design ideas of which some are easily implementable.

This section is structured in a chronological order, ending with the furthest developed concepts for building relationship and support-oriented communities and practices for my surrounding groups of change-makers.

The big themes: building human relationships in context

I will start by pointing out that a certain magic happened every time I showed interviewees, in particular students, a simple map of our cohort member names with their project names below them, spatially arranged based on project similarity (see below).

Sensing the MESH community

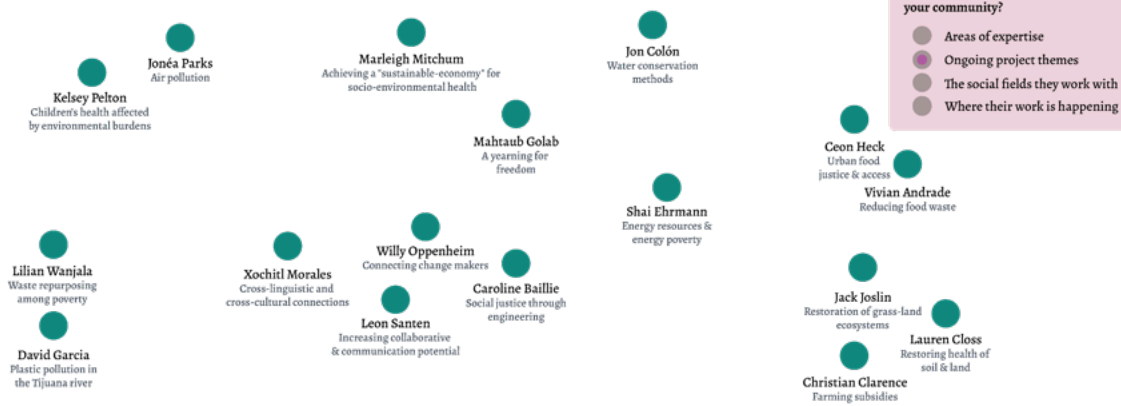


Figure 14: a simple interface mockup that I showcased to students and interviewees to receive feedback on desired features.

"Just by looking at this map, I would immediately reach out to four students!" said a student from a cohort one semester below the cohort depicted in the graphic above.

Visualization of our network seemed to be an important building block to elicit the desire to reach out to other people, to connect and create together. There seemed to be a piece missing in the current existing spaces where people shared and came together. When I say spaces, I think of online places like LinkedIn where people share a lot of work. Or I think of the current online space of this master's program where we write a large amount of blog posts and papers.

"You see the activity but not the people," responded another MESH student when I asked them about their experience with LinkedIn.

All four students, one friend of mine, and one expert in the field of knowledge building shared with me that it makes all the difference to see real people with a personal relationship to their work. Using different words, the (personal, political, emotional) context of our work seems to be as important as the detailed intellectual zoomed-in work. It helps to bridge the gap of different disciplines.

"There are two processes involved in thinking: convergent and divergent thinking," pointed out knowledge building researcher Chris Rose.

What this means is that zooming out and presenting context, narrative, and meaning (divergence) is just as important as focusing on details, niche literature, and complex theories. Chris Rose also shared that we may introduce any work or person through a shallow, context- and meaning-oriented lens before diving into deeper aspects of their work. This insight was backed up by my interview with Christian Tietze who built the knowledge management software *The Archive* (website [here](#)), which I have used extensively in my

academic practice. He pointed at the complicated nature of sharing detailed bits of knowledge without giving a full-blown introduction about the context.

Obviously, the project work of people mattered but what seemed to matter even more was the human behind the project and their relationship to it. It seems to matter less that a student can contribute to a project compared to the fact that a student can be in a relationship with another student through the structure of a project. Care may arise from human relationships. Closely related is creative motivation to build new systems together and collaborate.

This insight became visibly clear when I asked a friend from my former engineering college, Odalys Benitez (she/her), to describe back to me why she was so inspired by my project and chose to invest her time in helping me build a digital interface prototype:

“I think we are trying to create spaces that actually feel inclusive. We want to build community, and dismantle the hierarchy between people. We hope that the natural byproduct of people expressing themselves fully (more than just an academic or professional sense) will create natural authentic connections that will enable people to invest in each other and create beautiful things, as well as protect our planet. By doing this, we also make it so that the only requirement to make positive change in the world is to genuinely care.”

Garden metaphors for describing interconnected, complex systems

The metaphors of plants and roots play inspire all design ideas. People are either rooted to plants to provide nutrients or water them as stewards of a garden. Throughout all designs, the idea of embedded values in the DNA of our seeds of our project work applies (also called ontological primitives as described above). Roots draw nutrients and represent needs and exchange of support. We may think of the communication eco-system developed in this thesis as a garden where we plant seeds that require watering and care but may eventually become resilient systems (projects, organizations, networks). Yet, every garden needs stewardship by people who equally take care of each other while the fruits of the garden may take care of them. “Eric Liu and Nick Hanauer argue that moving from ‘machinebrain’ to ‘gardenbrain’ thinking calls for a simultaneous shift away from believing that things will self-regulate to realizing that things need steward” states Raworth in her book Doughnut economics ([Raworth 2018](#), p.135).

For the sake of building a coherent interface capable of depicting the complexity of interconnected humans and projects, I created a framework where projects are plants that are nurtured by people, other plants, and the sun or aspirations that nurtures all plants within a certain garden.

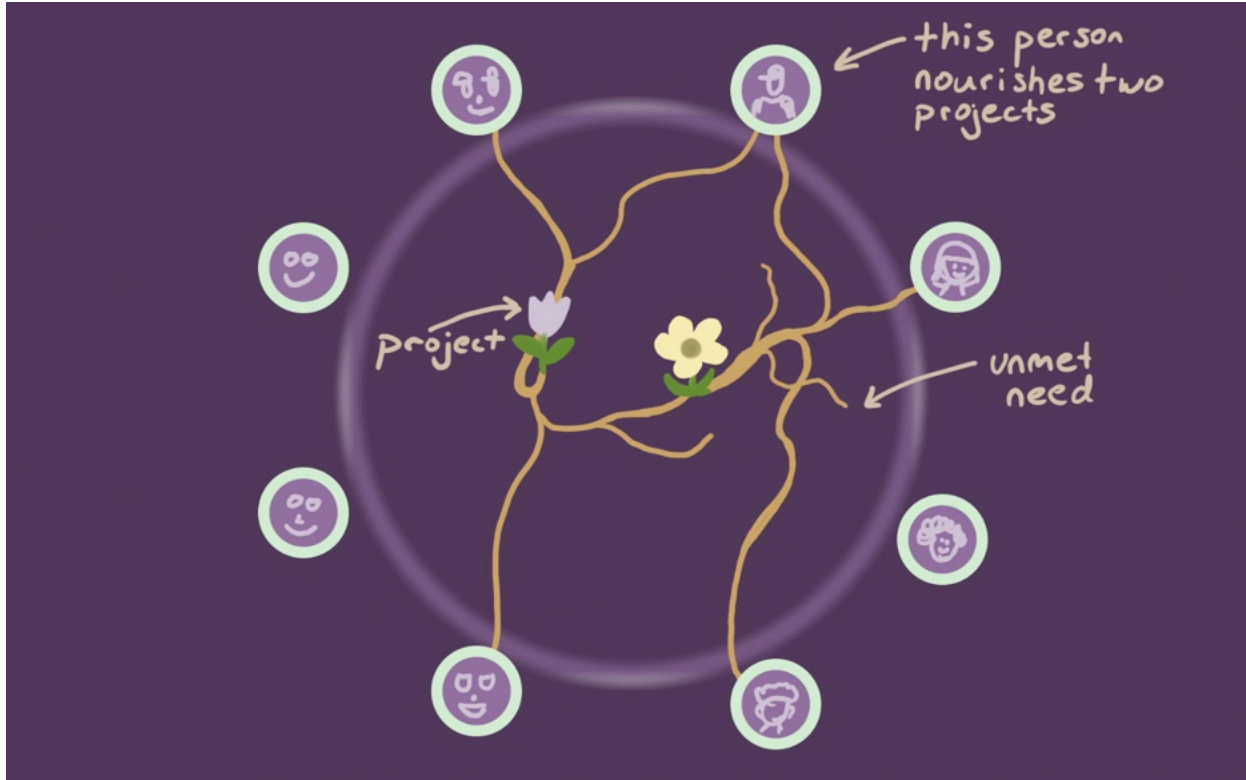


Figure 15: Explorational sketch that depicts how people tend to projects in their collective garden. Roots were chosen to symbolize the flow of nutrients or care while other metaphors would equally make sense (watering, adding fertilizer etc.).

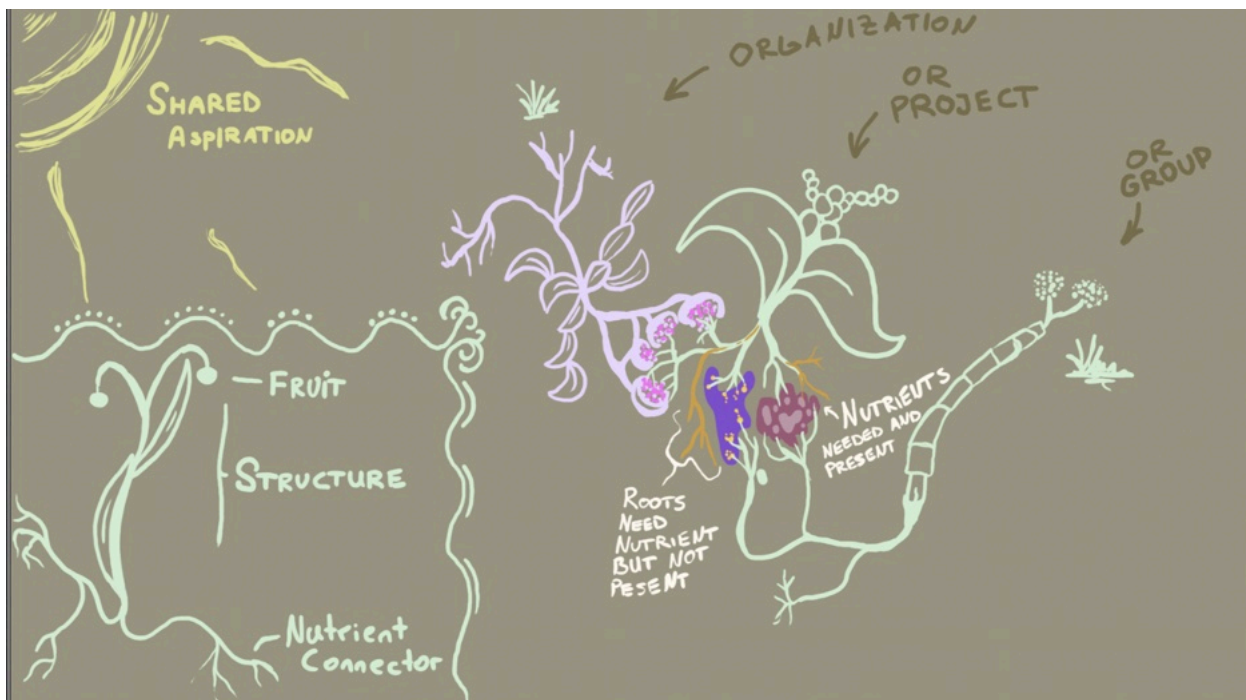


Figure 16: Oftentimes, we create structures with the intention to receive fruits. Yet, to receive fruits we build large structures necessary to grow fruits. The fruits always contain the seed or DNA of the original seed.

Time-space (or a practice) is a prerequisite for coming together in a physical space

I loosely conceptualize creating space for community-gatherings into having time-space and physical space (physical place includes digital space). Both depend on each other. While parts of this paper explore the physical design of a space for coming together, I want to emphasize that the tools imagined and created in this paper are only as meaningful as their integration into the practice of a community. When we say that we need time-space to come together, we also mean that we need mental space and intention. To phrase this metaphorically:

The nicest projectors and chairs will not be of any use if the people in the room are too tired, distracted, and disconnected from each other to have meaningful conversations.

With respect to educational spaces, we state the strong recommendation to give students the time-space and mental space to be present with each other and build relationships before embarking on any change-oriented path. The liberatory design principles call this part *empathizing*. Lambropoulos et al. (2012) point out that engagement in online cohorts increases due to social and emotional awareness of each other.

Time also refers to the continuous process of coming together over time to tune the communication paths of the system. The system needs to learn how to maintain itself by reflecting on ways of sensing each other. The cycle illustrated below could be defined as an adaptive cycle as present in a complex living system as explained by Holling (2001). As the system learns to maintain itself to stay alive and adapt, it may take on autopoietic characteristics, as tends to be the case with social systems (Albert 2016). In fact, we seek to nurture the ability of the social communication system to take on a self-maintaining, self-referential characteristic to grow into a self-sufficient system that requires less labor-intensive stewardship.

The process (or cultural tool) that I attempted to visualize in the illustration below may be of larger importance than the technical/visual tool described later on in this thesis.

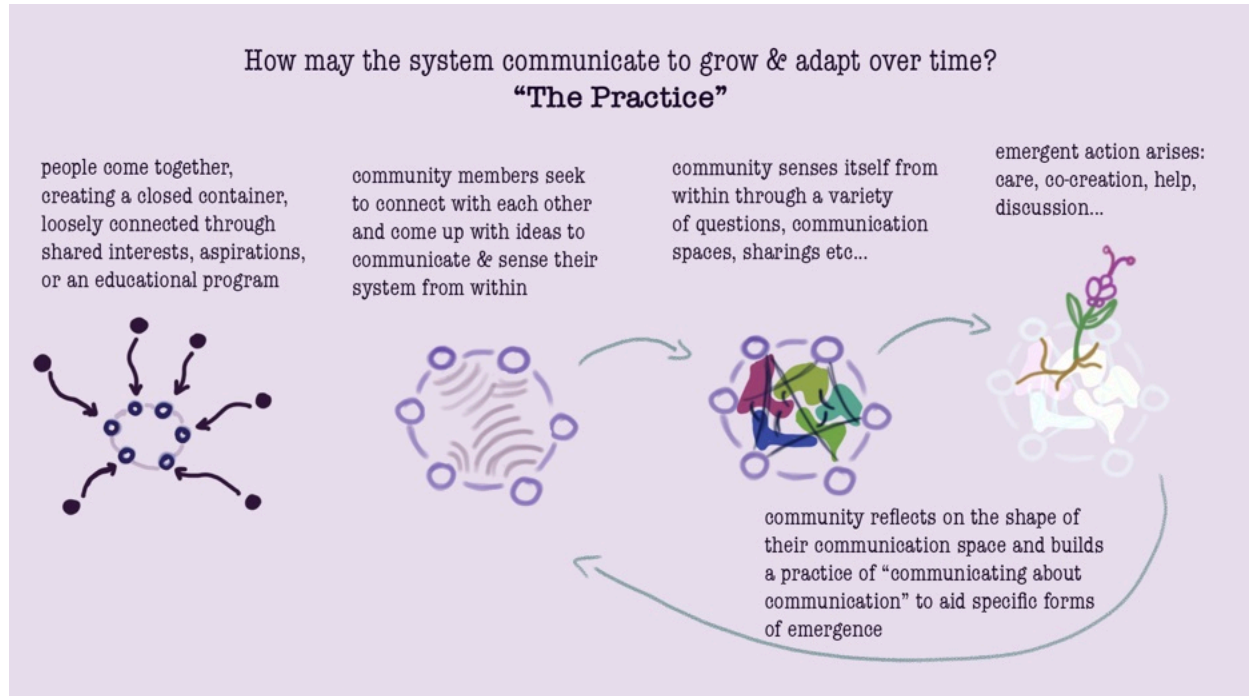


Figure 17: Community members reflect on past ways to sense each other and adapt the systemic sensing process over time to work in favor of shared aspirations and values.

Why it matters to have a physical place for something

One might say that our goal is to facilitate communication, yet the wording to “hold space” encapsulates that communication arises out of an environment (garden) or place. We may be intentional space holder that collectively shape the space. Niklas Luhmann points at this characteristic of communication:

“communication is an emergent reality” and “Communication has no goal or end, no immanent entelechy” (Luhmann 1992, p. 252 & 255). This understanding aligns with complex systems thinking as we can never control the outcome of complex systems, we can only create conditions of an environment to let emerge spontaneous action or creativity emerge.

“I frame my aspiration as *creating places for things and people*,” shared my friend Wyatt Smith (they/them) who is on a journey to build socially and environmentally responsible industrial engineering and manufacturing systems.

Wyatt’s statement arose during a phase of contemplating how to share resources and knowledge on the *Social Justice, Engineering, and Peace* website. To create a place for something means to create some structure that signals belonging to certain forms of communication and being. A student, for instance, might share their personal struggles in an environment that was intentionally created for it, yet they will likely refrain from sharing such experiences in a traditional assignment container.

A very similar notion to hold space for certain forms of communication arose half a year earlier when four MESH students (MENTION NAMES) jumped on a call with me to check-in and imagine ways of

interacting with each other that pay attention to the complexity and depth of our human experience and desire to be in community. A high-point of excitement arose when we imagined a living room with different sections that invite different forms of communication (or being together). The ideas that arose during this call were the following:

- A cry corner, a stew on the stove where ideas are simmering,
- a wall with art and quotes that community members share with each other,
- a desk with everyone’s project work, a phone to ask for accountability buddies,
- a quiet area where people can share emotions, ask for help, and
- a couch to hang out and chat.

I continued to explore the metaphor of a space to set the tone for a particular way of coming together. In my final project for a class called *Getting to Zero Waste*, I explored how student efforts are wasted when they are not considered in connection to each other. I framed this as follows:

The forgotten ingredient for movement-oriented education: organizing the students

A case study & visual design exploration for a collaborative economy

(see the [blog article](#) or the [full paper](#))

I came up with the concept of a MESH Bazaar to encapsulate the essence of coming together to connect as humans as well as exchange on a professional level. The idea to zoom out and look at the larger picture of what was happening with a 3D or 2D visual for comprehension stood in the foreground.

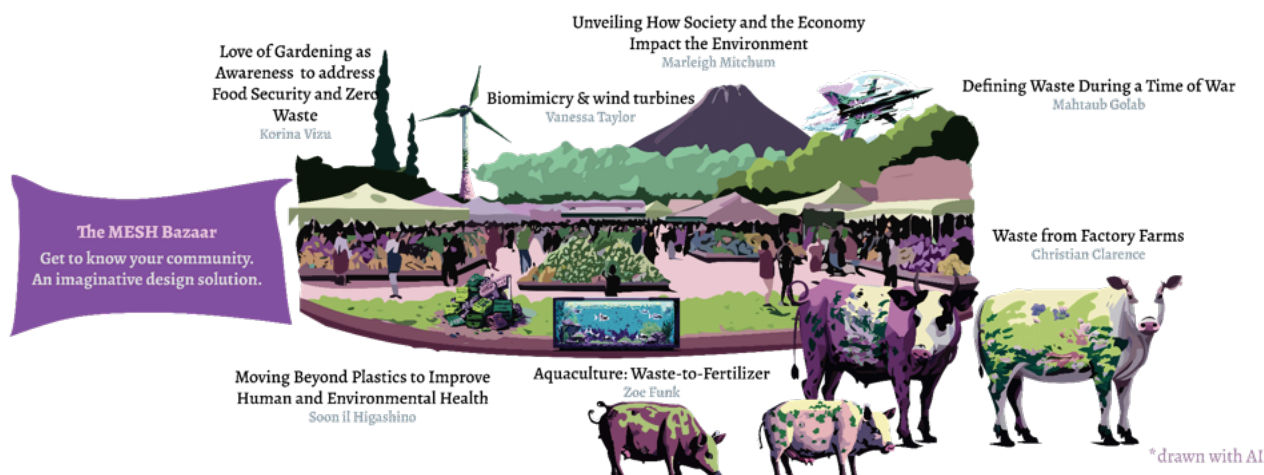


Figure 18: A visual summary of seven MESH projects drawn with the help of AI

The variety of conversations may be brought together in a room, house, or other form of ecosystem. And here we make the loop back into creating a new *economy*, as economy translates to management of our home. The metaphor of a house, garden, or bazaar are helpful imaginary partners on the journey of learning

how to communicate and stay connected to all aspects of life with each other. As with any garden or house, a certain level of maintenance is required. The places for things, people, or plants need to be shaped intentionally to keep alive desired energy flows. The goal of this thesis is not only to create the appropriate spaces but enable the people who come together in these spaces to shape them as active participants. The recent developments of AI might help here to empower the effective shaping of shape as depicted below:



Figure 19: a community space with components imagined by interviewees fully generated with the generative AI feature of Adobe Illustrator to prove that building a virtual space is feasible.

While the space above is designed with coherent colors and images, community participants may choose to shape their space with images or drawings they choose themselves. The community could choose an artist to draw features on paper and add them. The different areas of the room can be linked to a variety of chat rooms or visual spaces with simple technology.

The bandwidth of interfaces: communication structures

The generative part of this project has given rise to a communication ecosystem as opposed to one isolated solution. The living-room concept from above could also be a village. Many different communication structures are needed to balance the ecosystem. While we chose to develop a particular solution, I want to use this section to archive and share the bandwidth of ideas.

I prefer the term *experiment* over the term *solution* because I cannot claim to know the solution, yet I see a need to experiment with re-newed forms of communication. As the fun online map of the City of 1 Million Experiments (website [here](#)) suggests, we need to explore. My interviewee Chris Rose framed it as “building

to understand.” Designer Ela Ben-Ur refers to the last stage of her Innovator’s Compass (website [here](#)) as the experimentation stage. Not the solution stage. The word experimentation reduces attachment and opens our ears to listen to the web of feedback around us.

Throughout the ethnographic research and interview process, I mapped out a variety of possible design experiments that arose in accordance with the key principles I derived from my conversations.



Figure 20: The central principles that arose during the interviews.

As you can see in the graphic above, design ideas depend on the space of people. With respect to this master’s program, communicating within a closed container of changemakers was strongly desired, both during the educational program and after graduation. Within a closed container, people may choose to share personal ideas and vulnerable parts of themselves.

The space of communication needs to open up to a public audience as efforts to spread to grow systemic change. As it opens up, the creation of media aligned with movement-building principles as introduced in the literature section moves into the foreground.

Map to display the communication ecosystem in relationship

The community shapes this ecosystem in a practice of reflection just as a village may democratically choose how shape their public space. Different sections of the map lead the user to different practices or communication spaces. The map could take on the shape of a living-room or or village (see Living Room concept above and refer to The City of One Million Experiments). Below I share a variety of communication structures that would be placed into the village or living:

(A) Bulletin board communication ecosystem

People share their ongoing needs, emotions, and creative desires. Participants are periodically encouraged to make an effort to reach out to each other as they see opportunities for support.

(B) Bottling up project work as a medium for movement-building media

A medium is space through which communication flows. It can be an image or podcast. It can also be a simple, interactive graphic that is used to connect people with each other.

(C) Prototype design: Visualizing networks of people and projects spatially to elicit group sensing and collaboration

As we think about relationships to each other, we think about systems. Interviewee and designer Ela Ben-Ur framed it this way: “What makes systems thinking as a practice really unique is that it uses pictures.” The use of metaphorical imagery and maps that display relationships create an intuitive language that is hard to convey in words or tables.

(D) *Twitter but with questions*

This idea flips around the standard communication practice on Twitter (or now X) to share monologues to which others can respond. This idea arose out of the observed blockage on LinkedIn, Instagram, and X to share without a direct intention to reach out to anyone nor reveal much about oneself. This idea is largely a practice and can easily be prompted. During one interview with a MESH student, they suggested asking every student to share their strengths and weaknesses. Students would then be asked to reach out to each other to ask for help if they see that other students have corresponding strengths to offer. This idea could be extended and applied to the general structure of the ecosystem as the community reflects on how to sense and question itself.

BULLETIN BOARD FOR OUR STUDENT COMMUNITY

can someone help me with this?



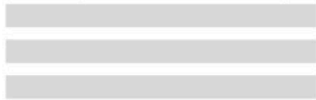
I have an idea, what do you think?



Look at this opportunity!
I have something to offer to you all!



what do you all think about this topic?



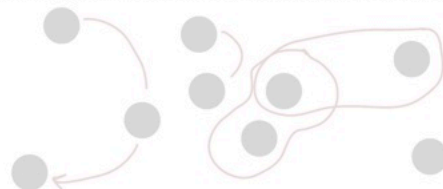
I'm doing schoolwork right now, happy to co-work.



check-in: what emotions surface in our community?



what are our community projects and how do they relate?



sharing art, photos, creations, fun things



Figure 21: (A) Partially developed wire frame to imagine a bulletin board for a community

Building an educational practice for sharing project work to collaborate, educate & support each other, create social connections, and build movement

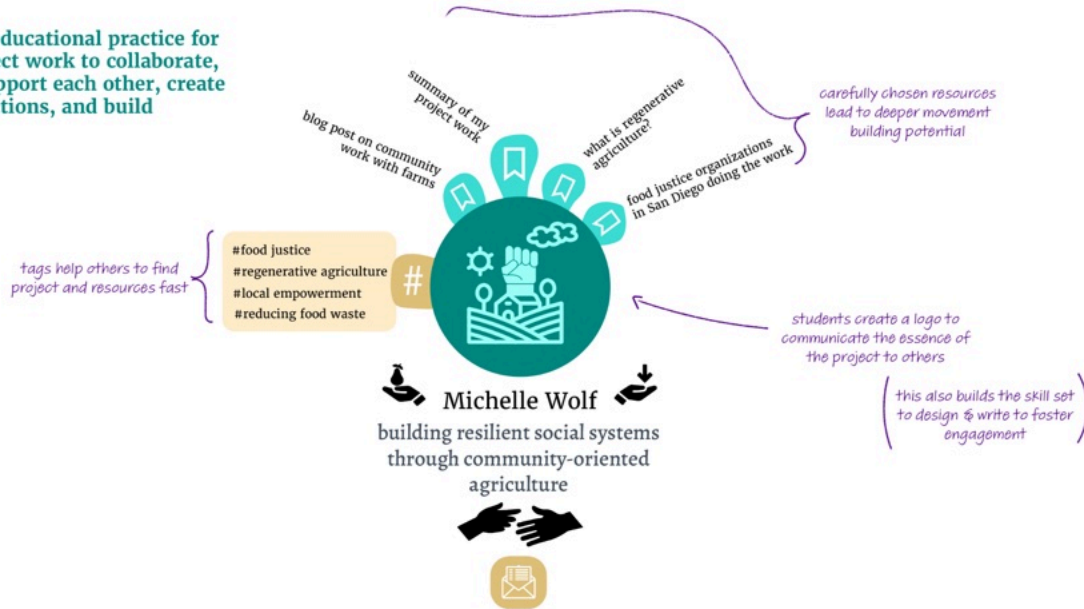


Figure 22: (B) Bottling up project work: a design artifact exploring the visual representation of a project guided by movement-building principles. Please note that this visual directly connects the human with the project, which is a depiction tried to avoid later on in the design process.

Engagement prompt:

Look at your peer project, do you see overarching themes? Draw a circle around the projects that seem similar.

Draw roots between project that could benefit each other. Draw roots between people that could support a certain project.

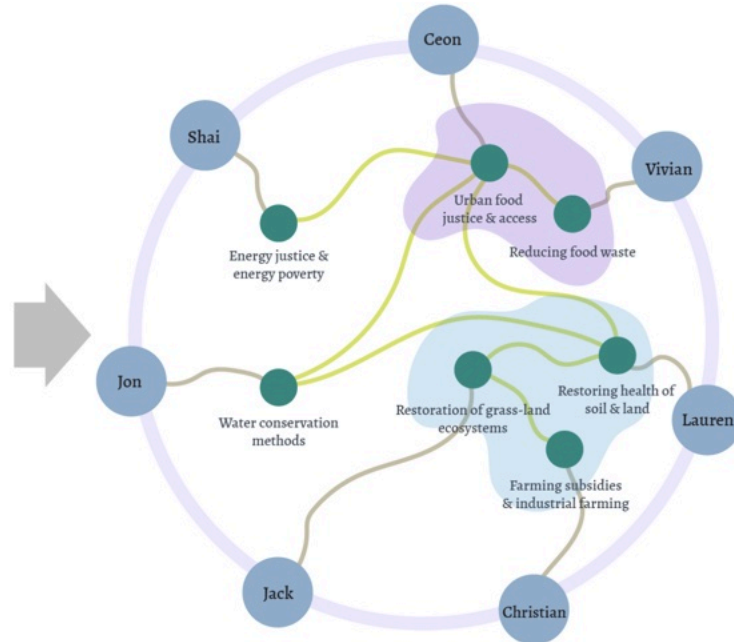


Figure 23: (C) Interface design concept for systemic reasoning: the engagement prompt may be chosen by the community of people involved. Commenting features were requested by interviewees. While I chose the project titles, they roughly represent the students’ capstone themes.

The prototype for systemic sensing and co-creating

This thesis paper marks a summary point of an effort toward humanizing communication. The tools presented below are the concrete interface designs and the code-based first minimum viable product. We, Odalys Benitzed and Leon Santen, developed and co-designed a tool that visualizes responses to a Google survey on a static website. Yet, the interface design aspires to be more interactive than its current implementation with Google surveys.

Interface design: dreaming big

With this prototype, we seek to aid systematic sensing and give community members a toolset of shaping their communication interfaces for different purposes. While the coded prototype is shown farther below, we first share aspirational interface designs below.

(I) The first step of engagement: the community responds to a question

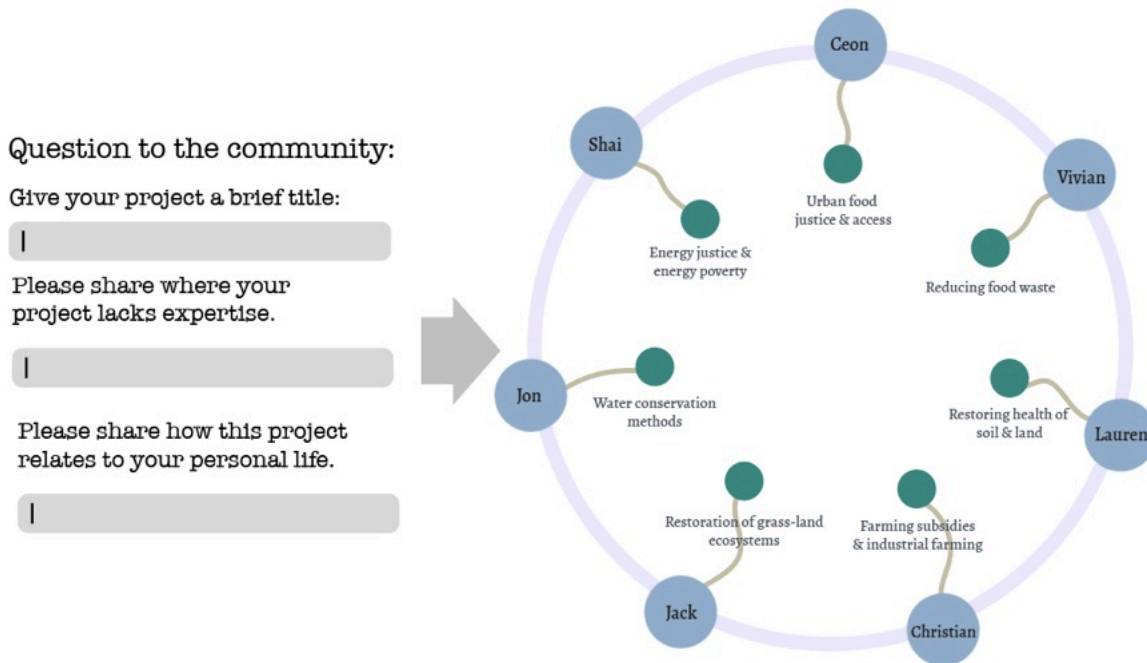


Figure 24: The first stage of systemic sensing. Everyone shares their “offering” to the community based on the collectively agreed upon interrogation question.

(II) The second step of engagement: the community co-thinks about their system

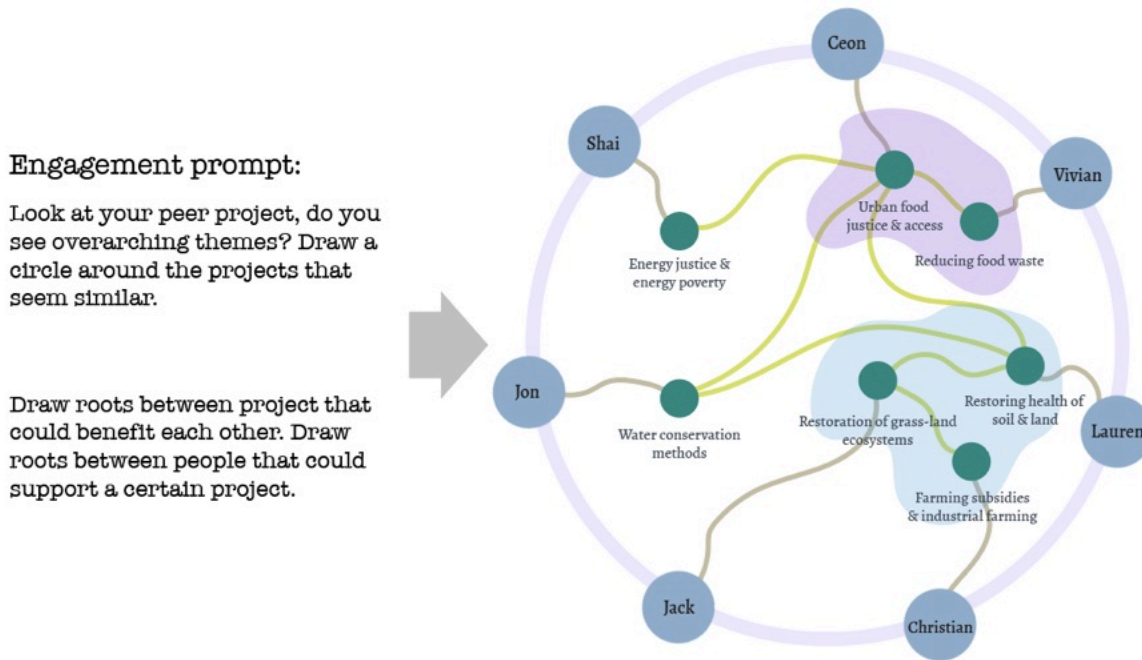


Figure 24: The second stage of the systemic sensing and thinking process. Participants suggest how they may support each other, each other's projects, and how projects outcomes may relate to other projects. The suggestion of a connection may be accompanied by an explanatory comment.

(III) Infinitely more steps: emergent communication

The final aspiration for this interface design is to elicit interactive shaping of the systemic visual. Participants may comment on sections of the visual, suggest new linkages, or discuss conflicts in tangential threads.

(IV) Reflection on the communication structure

As mentioned in the section on building an intentional time-space or practice, the community needs to eventually reflect on the usefulness of the particular framing of the communication structure. Maybe, instead of asking each other what their project lacks, they could investigate how people feel in their personal lives and reason how experienced challenges relate to emergent actions. Lifeforms grow through being challenged and “gain new strength by overcoming [...] limitations,” which “brings about an influx of energy” (Tolle 2024). Sensing challenges and pain may therefore be a crucial component for raising systemic intelligence, leading to transformative actions (Santen 2023).

Question to the community:

Which feelings have been most prevailing for you? Select from the list below or add new ones:

- contentment
- rage
- fear
- anxiety
- other...

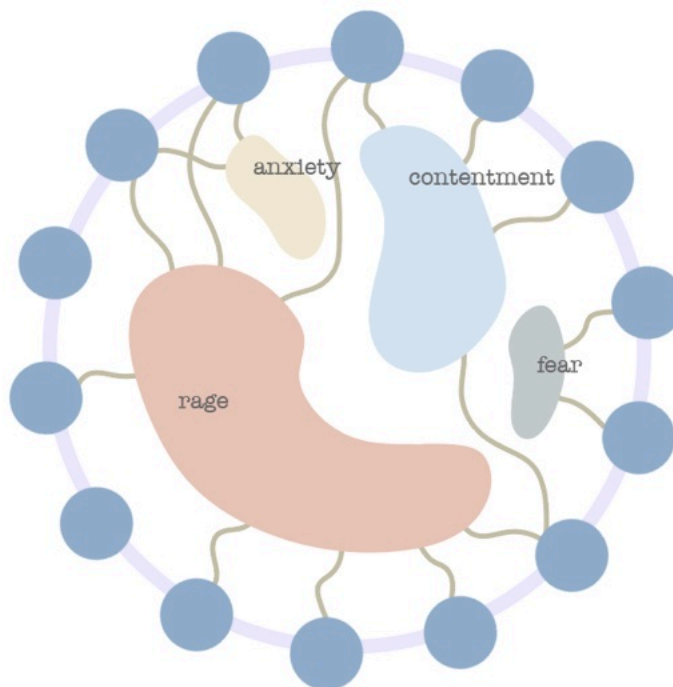


Figure 26: People represented by blue dots share their emotional states with their community. As participants see the map of emotions, they choose to relate emotions to each other, add emotions they had not thought of to their own emotional state or share narratives and comments about their own experience.

First steps toward a prototype

This first coded design is a static implementation of the design from above. Users can shape the visual by filling out a google survey that is linked to a spreadsheet. Every question in the survey should contain a unique ID (such as “Q1” or “Q2”). These IDs can be linked to different visual representations (bulletin board, flowers in a circle, etc). Users can then explore the visual by clicking on bubbles which expand upon a click. The current prototype does not allow for commenting because it is based on a spreadsheet for simplicity. Yet, more elaborate forms of engagement may be implemented after this we will have tested the prototype in real-life community settings.

This mockup tool is built with JavaScript, HTML, and CSS. It can easily be hosted on any website. We chose google survey implementation due to its wide accessibility and easy connection to spreadsheets. For this reason, participants might directly interact with the spreadsheet instead of filling out a survey.

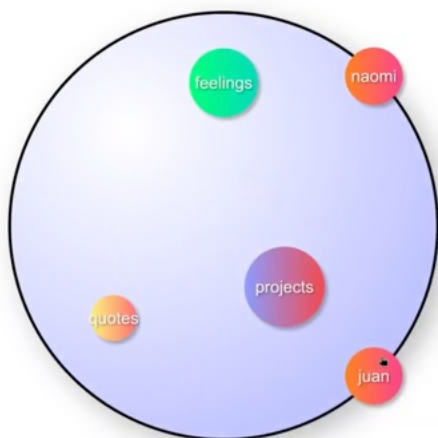


Figure 27: The coded prototype in its early stages with several bubbles in the middle that open up upon a click, depicting the range of questions asked in a google survey. As the bubbles open up, they may link a variety of visuals as explored in the section on “bandwidth of interfaces.”

CONCLUDING REMARKS

This work is the beginning of a life-long journey to organize our immediate and trans-national social fields. With respect to my community, I will use the emergent practices and (in-development) tools for intentional sensing of the MESH community and visualization to allow for emergent cooperation among it. As the secretary of the organization “Engineering, Social Justice, and Peace,” I similarly plan to hold space for people to come together and support each other. I hope that the tools developed in this project will eventually be easy enough to use for other to incorporate them on their own.

The strongest parallel to this work has been the idea of *Offers and Needs Markets* (link [here](#)) and I hope to connect people in this way through the tool developed in here and through intentional practice in the future.

This report might be incomplete. Certain sections such as methodologies could be more refined. Yet, I needed to come to an end. To finish something is to continue with more. The real work starts. This is the ground work for creating a space and intentional intellectual structure. This structure will help me to communicate my idea with the world around me.

Images are very powerful. Every image in here, I have shared numerous times with interested folks. For this reason, I see so much value in building our visual tools for systemic reasoning and connecting. We can share an image instead of a paper. The paper can be a link much deeper.

SUMMARY

This research and design project manifests the natural continuation of my efforts to enhance our collective ability to connect with each other, dream together, collaborate, and create radical change in a world suffering under fragmentation and disconnection. During this master's program called "Engineering, Sustainability, and Health" (MESH), I explored with fellow students and course facilitators how we can stay connected as a community of changemakers, during the educational experience and beyond. I interviewed students, friends, communication and collaboration experts to draw in perspectives for a design concept aimed at creating a medium to humanize communication, build relationships, and build up our capacity for collective action and movement-building. The MESH community, my closest friends, and myself were the primary stakeholders during this design process. In collaboration with Odalys Benitez, I iteratively designed and developed a variety of communication design concepts prototype that will hopefully help my change-maker friends and ongoing MESH students to communicate meaningfully with each other during the learning process and with communities to sense each other as human beings, moving collectively across the globe toward a regenerative future.

REFERENCES

- Zhang, A. X., Verou, L., & Karger, D. (2017). Wikum: bridging discussion forums and wikis using recursive summarization. *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing - CSCW '17*, 2082–2096. New York, New York, USA: ACM Press.
<https://doi.org/10.1145/2998181.2998235>
- Zastavker, Y. V., & Venkatesh, M. J. (2020). Democratizing engineering education through contemplative and mindfulness practices. *2020 IEEE Frontiers in Education Conference (FIE)*, 1–4.
<https://doi.org/10.1109/FIE44824.2020.9273937>
- Williams, D., & Kissinger, D. (2023, September). *Divesting from Despair: Building a Liberatory Movement Media Ecosystem*. Presented at the Conference 2023.
- Wright, E. O. (2013). Transforming Capitalism through Real Utopias. *American Sociological Review*, 78(1), 1–25. <https://doi.org/10.1177/0003122412468882>
- Torrey, S., & Rose, A. (2023). Villagebuilder. Retrieved April 6, 2024, from <https://www.village.builders/>
- Tolle, E. (2024, April). Eckhart Tolle on Transforming Suffering into Awakening. Retrieved April 15, 2024, from YouTube website: <https://www.youtube.com/watch?v=h2bbqFwKtYE>
- Tietze, C. (n.d.). The Archive (macOS) • Zettelkasten Method. Retrieved April 15, 2024, from <https://zettelkasten.de/the-archive/>
- Scharmer, O., & Kaeufer, K. (2013). *Leading from the Emerging Future: From Ego-System to Eco-System Economies* (1st ed., p. 304). San Francisco: Berrett-Koehler Publishers.
<https://www.penguinrandomhouse.com/books/575194/leading-from-the-emerging-future-by-otto-scharmer-and-katrin-kaufer/>
- Santen, L. (2023). *How can we transform ourselves?* Final Paper for Environmental Justice Class (MESH). Retrieved from Final Paper for Environmental Justice Class (MESH) website:
<https://leonsanten.info/contemplatingChangeForEJ.html>
- Santen, L. (2021). *Holistic engineering and a renewed science of holism for a thriving world* (Undergraduate thesis). <https://leonsanten.info/collaboration-holisticEngineeringThesis-mostRecent.html>
- Raworth, K. (2018). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* (Illustrated, p. 320). Chelsea Green Publishing. <https://www.kateraworth.com/>

Post Growth Institute. (2011). The OANM Story - The Offers and Needs Market. Retrieved April 6, 2024, from <https://offersandneeds.com/story/>

National Equity Project. (n.d.). Liberatory Design. Retrieved April 15, 2024, from <https://www.nationalequityproject.org/frameworks/liberatory-design>

Nagao, E. (2023, September). *Divesting from Despair: Building a Liberatory Movement Media Ecosystem*. Presented at the Conference 2023.

Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and Cognition: The Realization of the Living (Boston Studies in the Philosophy of Science, Vol. 42)* (1st ed., p. 171). Dordrecht, Holland: D. Reidel Publishing Company.

McGilchrist, I. (2021). *The Matter With Things: Our Brains, Our Delusions, and the Unmaking of the World* (p. 1500). Perspectiva.

Luhmann, N. (1992). What is Communication? *Communication Theory : CT : A Journal of the International Communication Association*, 2(3), 251–259. <https://doi.org/10.1111/j.1468-2885.1992.tb00042.x>

Luhmann, N. (1982). Kommunikation mit Zettelkästen. In H. Baier, H. M. Kepplinger, & K. Reumann (Eds.), *Öffentliche Meinung und sozialer Wandel / Public Opinion and Social Change* (pp. 222–228). Wiesbaden: VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-322-87749-9_19

Lovelock, J. E., & Margulis, L. (1974). Atmospheric homeostasis by and for the biosphere: the gaia hypothesis. *Tellus*, 26(1–2), 2–10. <https://doi.org/10.3402/tellusa.v26i1-2.9731>

Ledwith, M. (2017). Emancipatory action research as a critical living praxis: from dominant narratives to counternarrative. In L. L. Rowell, C. D. Bruce, J. M. Shosh, & M. M. Riel (Eds.), *The palgrave international handbook of action research* (pp. 49–62). New York: Palgrave Macmillan US. https://doi.org/10.1057/978-1-137-40523-4_4

Krieger, M. (2020). Chatting with glue: cognitive tools for augmented conversation. *Conference Companion of the 4th International Conference on Art, Science, and Engineering of Programming*, 208–208. New York, NY, USA: ACM. <https://doi.org/10.1145/3397537.3397550>

Holling, C. S. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, 4(5), 390–405. <https://doi.org/10.1007/s10021-001-0101-5>

Crawford, G. (2017). Nonlinear Conversational Medium. Retrieved January 25, 2024, from <https://www.graycrawford.com/nonlinear-conversational-medium>

Climate Justice Alliance. (n.d.). Just Transition Principles. Retrieved August 2, 2022, from <https://climatejusticealliance.org/just-transition/>

Brown, A. (2023, February). *The Wheel of Oppression and Liberation by Monica Dennis*. Presented at A breath away from freedom - AORTA.

Ben-Ur, E. (n.d.). Innovators' Compass. Retrieved April 6, 2024, from <https://innovatorscompass.org/about#Why-What-How-When>

Albert, M. (2016). *Luhmann and systems theory*. Oxford University Press. <https://doi.org/10.1093/acrefore/9780190228637.013.7>

Repurposing Construction and Demolition (C&D) Waste to Improve the Built Environment of Informal Settlements in Nairobi.

Case Study: Kibera- (Sarang'ombe ward- Kiandaa and Soweto locations)

Lilian Maruti Wanjala

MSc in Engineering, Sustainability, and Health (MESH), University of San Diego

ESH-501-01-FA22- Capstone Project

Dr. Willy Oppenheim

25th April 2024

Abstract

This Capstone Project is a feasibility study that explores how repurposed construction and demolition waste can improve living conditions in Kibera, an informal settlement in Nairobi through a circular economy model that looks at how both supply-side and demand-side needs can be harmonized. By leveraging interviews with informal settlements residents and ethnographic observations, this research identifies the critical needs of Kibera resident in areas of home improvement like poor drainage, poorly constructed homes, and leaking roofs, as well as their constant efforts to improve residences by any means possible. The project further highlights inspiring community-driven initiatives where residents use repurposed construction and demolitions waste to address these issues. By analyzing these initiatives through social and environmental frameworks, the project demonstrates the potential of C&D waste as a cost-effective and sustainable approach for Kibera's development

Table of Contents

Acronyms

1 Introduction

2 Literature Review

2.1 Introduction

2.2 Colonial Legacy and Nairobi Urban Dynamics: Colonial Land Policies and the Rise of Nairobi's Informal Settlements

2.2.1 Understanding the history of Kibera

2.3 Current State of Informal Settlements and Low-income Housing

2.3.1 Informal settlements: Local building culture

2.3.2 Informal settlement: Building and materials

2.3.3 Informal settlements: Incremental improvements to existing structures

2.4 Sustainable Waste Management Strategies

2.4.1 The current landscape of waste management in Nairobi

2.4.2 Opportunities and benefits of repurposing C&D waste

2.4.3 Existing policies, regulations, and guidelines

2.5 Theoretical frameworks

2.5.1 Sustainable construction practices and circular economy (CE) framework

2.5.2 Sustainable construction practices, community development practices and peace engineering

2.6 Conclusion

3 Methodology

3.1 Social Constructivist Epistemology

3.2 Theoretical frameworks

3.2.1 Circular Economy

3.2.2 Peace engineering

3.3 Data collection

3.3.1 Qualitative research

3.3.2 Quantitative research

3.4 Data Analysis

3.4.1 Participatory analysis

3.4.2 Thematic analysis

3.4.3 Statistical analysis

3.4.4 Visualization

3.4.5 Triangulation

3.4.6 Ethics and Epistemology

4 Results and discussions

4.1 Introduction

4.2 Community needs and aspirations

4.2.1 Results

4.2.2 Discussions

4.3 C&D Waste Characterization

- 4.3.1 Results
- 4.3.2 Discussion

4.4 Cost Analysis

- 4.4.1 Results
- 4.4.2 Discussion

4.5 Environmental Impact Assessment (EIA)

- 4.5.1 Reduced reliance on virgin materials
- 4.5.2 Waste reduction and diversion
- 4.5.3 Energy Consumption

4.6 Limitations and future research

5 Conclusion

Bibliography

Acronyms

- BCI- Building Construction Industry
- CE - Circular Economy
- C&D – Construction and Demolitions
- Ksh- Kenyan Shillings
- UN- United Nations

1 Introduction

Nairobi, Kenya's capital city, faces an acute shortage of sustainable and affordable housing, leaving many residents in inadequate conditions. In 2020, the World Bank predicted that 51% of Kenya's urban population lived in informal settlements (World Bank, 2021). According to the Nairobi cross-sectional slum survey, between 60-70% of Nairobi residents are estimated to be living in slums, a consequence of the rapid urbanization and uncontrolled population explosion which caused a proliferation of informal settlements in Nairobi (APHRC, 2012). The World Population Review estimated Nairobi is home to approximately 2.5 million slum-dwellers in 40 slum neighborhoods with 60% of the city's inhabitants living in low-income settlements housing. Kibera, one of the largest slums in the world, holds approximately 250,000 of the 2.5 million slum dwellers in the city (World Population Review, 2024).

Currently, many of the structures in Kenya's informal settlements are made from materials collected from landfills and construction sites including discarded iron sheets, wood scraps, and plastics, as well as clay mud from neighboring rivers. The average size of a shack in Kibera is 12ft x 12ft built with mud walls, and a corrugated tin roof with a dirt or concrete floor (APHRC, 2012). These structures are unsafe, offering little protection against rain, wind, and vermin entering the structure. While demolishing these structures may seem like the best way to force people out of unsafe living conditions, the social, political, economic, and environmental challenges of doing so are compelling enough to consider refurbishment rather than demolition.

At the same time, Nairobi is facing a growing waste management crisis. The main landfill in Nairobi, Dandora, is full and has been for years. Plans to relocate have been stalled due to various factors, including a lack of political will and a readily available alternative landfill site, making finding any alternative challenging, especially given the resistance by Nairobi residents to establishing new landfills due to environmental degradation concerns. While the exact numbers are not known, the UN-Habitat in 2018 estimated that construction and demolition waste account for as much as 30% of total landfill waste (UN-Habitat, 2018). As the waste management challenge escalates, several other illegal dumpsites are springing up all over Nairobi and mostly close to low-income areas leading to further environmental degradation and health concerns affecting the communities adjacent to these sites.

This project proposes a holistic approach to improving living conditions in Nairobi's low-income settlements by leveraging Construction and Demolitions (C&D) waste through a circular economy approach that leads to more sustainable, incremental development. What makes this compelling is its potential to harness the inherent value of waste materials. By repurposing C&D waste to improve the built environment of informal settlements, I envision a greener future for the city where waste is diverted from landfills, environmental impact is minimized, and tangible benefits are delivered to communities and their residents. This aligns perfectly with the sustainability and social impact goals that Nairobi, like many cities, professes to strive for (Government of Kenya, 2012).

Current solutions tend to address the challenges of housing and waste management in isolation. This study, however, aims to tackle these challenges by recognizing and appreciating the role that communities play and can play in unlocking a transformative solution with wide-ranging benefits including improved living conditions and built environments in their informal settlements, while at the same time providing environmental protection through reduced landfill waste and resource conservation. The knock-on effect of this proposed approach can also lead to community empowerment through job creation and skill

development, and the establishment of a replicable circular economy model that addresses both housing and waste management challenges in other urban contexts.

The findings from this feasibility study will inform strategic decisions and pave the way for potential project implementation. Ultimately, the goal is to empower communities, capitalize on a circular economy that optimizes resource usage, and foster a more sustainable future for Nairobi's low-income, informal settlement residents.

2 Literature Review

2.1 Introduction

The rapid urbanization and population growth in Nairobi, Kenya, has led to increased construction and demolition activities, resulting in a large volume of construction and demolition (C&D) waste. This waste poses environmental challenges, but at the same time presents opportunities for a circular economy. One such opportunity lies in repurposing C&D waste to improve the built environment of informal settlements (or slums). This approach simultaneously addresses environmental issues as well as social issues. This literature review explores existing research and practices related to the repurposing of C&D, focusing on sustainable waste management strategies, circular economies, and informal settlement upgrading solutions. This review will also explore the potential socio-economic impacts in the context of Nairobi's informal settlements.

2.2 Colonial Legacy and Nairobi Urban Dynamics: Colonial Land Policies and the Rise of Nairobi's Informal Settlements

The historical trajectory of Nairobi's development, particularly the emergence of slums, is deeply intertwined with its colonial legacy. In 1901, the Crown Lands Ordinance effected the seizure of vast tracts of land by the British crown, dispossessing indigenous communities, reserving prime areas for European settlement and economic activities, and laying the groundwork for the skewed land ownership and persistent disparities in development that resonate to this day (GoK, 1966). This persistent legacy is evident in the juxtaposition between affluent neighborhoods and sprawling informal settlements.

Even after Kenya's independence in 1963, Nairobi continued to struggle with challenges stemming from economic stagnation, political instability, and governance issues. After 1963, the restrictive colonial policies were relaxed resulting in a rapid influx of people into Nairobi. This further worsened the problem of housing, especially in Nairobi in terms of supply and demand, resulting in overcrowding and the proliferation of informal settlements (Owuor & Teresa, 2008).

Moreover, the forces of globalization and neoliberal economic policies (privatization, market primacy, deregulation etc.) have further shaped Nairobi's urban landscape in recent decades. Globalization has been found to play a role in increasing the gap between the rich and the poor, thus creating more isolation, apprehension, and division between people (Owuor & Teresa, 2008). Rapid urbanization and economic growth have accompanied the growth of informal settlements, worsening existing inequalities and emphasizing the complex interconnections between historical legacies and contemporary urban dynamics.

Kibera's roots lie in colonial land dispossession. Understanding this legacy, exemplified by the Crown Land Ordinance Act, is critical for this project. It informs strategies to address systemic constraints faced by the community. This ensures our project, focused on improving living conditions with community-driven solutions, contributes to equitable development in Kibera.

2.2.1 Understanding the history of Kibera

The history of Kibera, Nairobi's largest slum, is a complex one, intertwined with Kenya's colonial past and the challenges of urbanization. Nairobi's founding in 1899 created a need for a European enclave, excluding African workers relegated to "native reserves" while Europeans occupied the prime lands. Kibera's origins lie with Nubian soldiers who served in the British colonial army in World War I. In 1904, these soldiers were given land as a reward for their service, settling on the outskirts in a forested area which was named "Kibera" which translates to "forest" in Nubian (The East African Review, 2011). Over time, other Kenyan ethnic groups, particularly the Luo, came to Kibera, often renting land from Nubian landlords. This early influx laid the groundwork for Kibera's future growth.

After Kenya's independence in 1963, Kibera was designated as an illegal and unauthorized settlement (Mitullah W. , 2003). Due to these shifting demographics, Kibera residents lost legal recognition for their land occupancy. This informality meant the government did not provide basic infrastructure like sanitation or waste management. Despite these challenges, Kibera's proximity to Nairobi attracted a steady stream of migrants seeking work opportunities, leading to its densification.

Presently, Kibera is a bustling hub of activity, with a strong sense of community spirit. Residents run small businesses, create art, and work tirelessly to improve their lives. However, poverty, overcrowding, and inadequate sanitation remain pressing issues. Despite the hardships, residents demonstrate remarkable resilience and entrepreneurial spirit, constantly innovating to meet their needs (Watson, 2014).

2.3 Current State of Informal Settlements and Low-income Housing

Nairobi is home to more than 60% of Kenyans living in informal settlements who struggle with pervasive challenges including overcrowding, substandard housing conditions, limited access to essential services, and environmental degradation (World Bank, 2019). Access to affordable housing remains a significant challenge for these marginalized communities exacerbating socio-economic disparities.

In 2016, the UN-HABITAT reported that the rise of urban informal settlements mirrors a broader global trend affecting low-income populations in many developing countries, corresponding to the manifestation of a problematic socio-economic condition affecting these marginalized communities (UN-HABITAT, 2016) (Giulia & Guillaume, 2021). Further research indicates that a lack of economic resources and political will has led to the failure of local governments to keep up with the high housing demands, especially for low-income areas (Pugh, 1997) (Giulia & Guillaume, 2021).

With global urbanization projected to rise, urban areas like Nairobi will suffer significant pressure to accommodate growing populations. The United Nations predicts that by 2050, urban areas will host 68% of the world's population, further straining existing housing resources, with centers like Nairobi being likely to continue to rely on informal settlements as a necessary solution for the housing gaps (United Nations, 2018). This demographic trend highlights the urgent need to address housing disparities, especially in informal settlements where residents face high unemployment rates, hindering their transition to more dignified permanent housing solutions.

Despite these challenges, the need for large-scale construction within informal settlements presents an opportunity to stimulate local economies through tailored construction initiatives that have the potential to create local employment opportunities while addressing housing and built environment inadequacies. Given the challenges of addressing this housing problem due to limited resources and lack of political will,

improving existing informal settlements through creative rehabilitation projects continues to be an important part of the solution. This also ensures that the residents are intimately involved in the ways their lived environments are transformed.

To successfully move in the direction of engaging with the local dynamics rather than disrupting them, it is imperative to first engage with the socio-economic and cultural dimensions of informal settlements (Giulia & Guillaume, 2021). Understanding the dynamics of informal settlement, particularly their construction sectors, is essential for developing contextually relevant housing solutions that empower local communities and promote sustainable urban development.

2.3.1 Informal settlements: Local building culture

In a study carried out in Fiji, the researchers define local building culture as a comprehensive framework encompassing various aspects of habitat consideration, including construction components (materials, techniques, structure, and shape), construction organization (construction, maintenance, social and economic impact), design, and symbolic significance (Caimi, et al., 2017). They emphasize that a local building culture emerges from a community's adaptation to the environmental conditions of its territory, encompassing physical, climatic, social, economic, and cultural factors (Giulia & Guillaume, 2021). This holistic perspective emphasizes the interconnectedness between building units or components and the broader environmental context.

Understanding local building culture becomes imperative when considering informal settlements, where the classic building industry and regulatory systems are almost non-existent, and the building culture is driven by landowners, tenants, small businesses, community-based organizations (CBOs), and cartels operating in the slums. Such a multidisciplinary approach is particularly relevant to this study, which seeks to deepen the understanding of informal settlement construction by bridging its technical and social dimensions.

Viewing built environments as cultural products shaped by a system of knowledge, rules, procedures, and habits allows one to recognize the human-centric nature of our building processes and their outcomes. Research by (Kulshreshtha, et al., 2020) focused on specific cultural dimensions of building and construction to identify bottlenecks or drivers for the adoption of particular building technologies. However, in the context of informal settlements, this approach has not been extensively applied to understanding local building culture (Giulia & Guillaume, 2021).

Building upon this foundation, this study aims to delineate the key components that shape local building cultures within the informal settlements in Nairobi, particularly Kibera with insights applicable to informal settlements globally. By looking into the socio-economic, political, environmental, and technical dimensions of the building sector, encompassing materials and extending into the nuances of local building culture, this study seeks to formulate pertinent construction strategies for reusing construction and demolition waste to refurbish low-income housing and the infrastructure that supports that housing. Such an approach ensures that construction initiatives are not only technically feasible but also socially and culturally relevant, respecting the ongoing efforts within every informal settlement to try and make living conditions more bearable. By ensuring that the context drives the solution, there will always be enhanced effectiveness and a much greater chance of sustainability within the community.

2.3.2 Informal settlement: Building and materials

Research has highlighted the significant housing challenges faced in Nairobi, home to 3.5 million residents, with 60% of its population residing in informal settlements occupying less than 1% of the city's area and less than 5% of its residential space (Mitullah W. , 2003). Nairobi's informal settlements, popularly referred to as "slums" or "ghettos" are characterized by structures that are non-compliant with planning and regulatory bodies and often located in hazardous areas (Giulia & Guillaume, 2021). They are also known for their substantial sizes. A report by Amnesty International indicated that Kibera alone houses 1.2 million inhabitants spread across 550 acres (Amnesty International, 2009) while Mathare, Nairobi's second-largest settlement, stretches over 3 km along the Mathare River and is estimated to be home to approximately 600,000 residents (Karanja & Makau, 2011). Despite the extensive sizes and strategic locations, facilitating access to urban opportunities, these communities lack formal urban planning, leaving over half of its twenty-four villages devoid of basic services such as sewage and water.

The UN defines a "slum household" as a group lacking one or more of the following conditions: access to improved water, access to improved sanitation facilities, sufficient living area, structural quality/durability of dwellings, and security of tenure (UN-HABITAT, 2015). The most common building materials in urban informal settlements worldwide include iron sheets, lightweight panels, and prefabricated lightweight concrete blocks and bricks, with iron sheets particularly prevalent in Africa and Southeast Asia, and lightweight concrete blocks and bricks more common in Latin America (Giulia & Guillaume, 2021).

Different local cultures and resource availability/scarcity determine building variations in different sites highlighting the unique resourcefulness, creativity, and resilience of informal systems. In Nairobi, the "slum dwellings" are characterized by a variety of building variations and materials, ranging from more consolidated stone-based developments to more temporary structures, primarily constructed of iron sheets, organized in housing clusters (Mitullah W. , 2003).

Despite the perceived temporary nature of the dwellings, the population residing in these areas, many of whom were born and raised in these locations, are permanently settled in inadequate and unsafe housing units. The discomfort stemming from these housing conditions is exacerbated by the lack or insufficient provision of essential household services throughout their lives. These missing services include access to clean water, sanitation, sewage disposal, reliable electricity supply, public lighting, transportation, waste collection and sorting, medical assistance, urban planning, and education (Mitullah W. , 2003).

2.3.3 Informal settlements: Incremental improvements to existing structures

The housing structures in these informal settlements in Nairobi consist mainly of clustered single-story iron sheet structures, known as "mabati" or "10x10" due to their size measured in feet. The majority of residents are renters rather than owners, facing the constant threat of eviction with limited rights and protections (IRIN News, 2013). These low-income areas serve as a refuge for individuals priced out of Nairobi's formal housing market, even for some who might have the ability to afford proper housing but cannot find viable options.

In the past, the government attempted to improve living conditions in the slum areas under the Kenya Slum Upgrading Program (KENSUP) aimed to improve living conditions in informal settlements through better housing, infrastructure, and potentially social services. While well-intentioned, KENSUP faced challenges with slow implementation and limited community participation, hindering its long-term success due to concerns over its sustainability (IRIN News, 2013).

In 2023, the Kenyan Parliament approved a 1.5% tax on all salaried workers to be directed towards funding an ambitious Affordable Housing Project (The Star, 2023). This project aimed to create a dedicated fund for constructing new, affordable housing units across Kenya. While not exclusively targeting slum dwellers, this project was expected to benefit low and middle-income earners, including those residing in informal settlements. However, the proposed funding mechanism and the housing levy, faced criticism for placing an additional financial burden on taxpayers, and raised concerns that not everyone would directly benefit. This controversy culminated in the High Court suspending the levy due to a legal challenge (The Star, 2023).

For decades there have been countless attempts by the government and international aid agencies to improve Nairobi's informal settlements through concepts of rebuilding habitats. These efforts have largely failed given the scale of the problem and the socio-political and logistical challenges of determining where to start, what to do with displaced residents, and how to cover the massive costs that replacing derelict structures with sound, livable spaces would incur. Instead of complete overhauls that remove existing structures and replace them with entirely new housing units in low-income settlements, this study proposes a different approach: accelerating the incremental improvements that communities within these informal settlements are already pursuing using repurposed construction and demolition (C&D) waste. This strategy focuses on further empowering residents to make gradual enhancements to their current living conditions within the socio-political dynamics of the community that otherwise stifle any attempts at improving residents' lives.

Simply by repurposing readily available materials, residents can address critical issues like leaky roofs, improve security with sturdier doors and windows, or potentially even elevate living areas above floodplains using processed C&D debris (with proper engineering considerations to ensure safety). These incremental improvements, while not a complete solution to the challenges faced by informal settlements, represent a significant step towards a safer and more dignified living environment for residents and meet the community where they are, building on their efforts to improve their conditions.

2.4 Sustainable Waste Management Strategies

The ever-growing mountain of solid waste is a pressing global challenge. It is estimated that 2.24 billion tons of solid waste are generated worldwide (Kaza, Yao, Bhada-Tata, & Woerden, 2018). Out of this, construction and demolition (C&D) waste accounts for at least 30% of the waste and this volume is projected to increase with the growth in the urbanization (Kabirifar, Mojtahedi, Wang, & Tam, 2020)

For Nairobi, effective waste management strategies are essential for addressing this growing problem of C&D waste. Several studies emphasize the importance of sustainable waste management practices, including 3R principles—reduce, reuse, and recycle. Integrating Circular Economy (CE) principles into C&D waste management offers numerous benefits including:

- Resource efficiency: By maximizing the reuse and recycling of C&D waste, it is possible to minimize the need to extract virgin resources like raw materials and timber, promoting resource conservation.
- Reduced environmental impact: Recycling C&D waste reduces landfill burden and associated environmental issues like methane emissions and water contamination.

Furthermore, studies show the potential of advanced recycling technologies, such as advanced sorting systems and innovative construction techniques, in maximizing the recovery of valuable materials from C&D waste. These technologies can play an important role in allowing for the repurposing of C&D waste to be used in the upgrading of inadequate, informal housing units by combining high-quality recycled materials and rehabilitation techniques to improve informal settlement structures at a sustainable cost.

2.4.1 The current landscape of waste management in Nairobi

Developing countries like Kenya struggle with inefficient approaches to C&D waste management, including lacking comprehensive regulations and infrastructure. Inadequate collection, disposal, and recycling practices in Nairobi have led to environmental degradation and health hazards in informal settlements like Kibera, Dandora, Mathare, etc. Limited data on C&D waste generation, its composition, and how it is dealt with further hinder effective management strategies.

There are policies and regulatory frameworks that currently emphasize the 3R principles—reduce, reuse, and recycle—as the cornerstone of waste management strategies. The Sustainable Waste Management Act provides clear guidelines on the promotion of a circular economy in waste, waste valorization, and establishing a framework for responsible producer extended responsibility schemes. However, despite the theoretical acknowledgment of these principles, their practical implementation encounters several challenges within the context of C&D waste management.

Governmental oversight and regulatory guidance pertaining to C&D waste management are often deemed inadequate and ineffective, posing significant barriers to the successful implementation of the 3R principles. The absence of robust regulatory frameworks undermines efforts to enforce sustainable practices and hampers the integration of the 3R principles into mainstream C&D waste management practices. Andre Dzikus, coordinator of the urban basic services section of the UN Human Settlements Programme (UN-Habitat), told IRIN “Due to budgetary deficiencies, town authorities find it difficult to address solid waste management sustainably. In addition, insufficient public awareness and enforcement of legislation is also a hindrance,” (IRIN News, 2013).

2.4.2 Opportunities and benefits of repurposing C&D waste

Repurposing C&D waste into usable materials that can improve the quality of housing in informal settlements presents an important step towards sustainable, adequate developments with multiple benefits. Various studies have demonstrated the technical feasibility of using recycled C&D materials in rehabilitation construction, reducing demand for virgin materials and minimizing environmental impacts (José-Luis Gálvez-Martos, 2020). Repurposing C&D waste aligns with circular economy principles, promoting resource efficiency and waste reduction (Ellen MacArthur Foundation, 2021).

The concept of sustainable construction practices has gained momentum in response to the environmental impact of traditional construction methods. Scholars have emphasized the importance of adopting sustainable approaches, including waste reduction and recycling, to mitigate the adverse effects of construction activities on the environment. Several studies have provided evidence supporting the feasibility of utilizing integrated Construction and Demolition Waste Recycling Processes (CDWRP) in construction projects (Ding, Wang, & Zou, 2023). Research has shown the viability of using recycled concrete (Jones, Zheng, Yerramala, & Rao, 2012) and the use of recycled aggregates (Rafaela, Rui, Brito, & Dhir, 2016). Several other studies have been conducted on technical feasibility and environmental benefits providing valuable insights into the diverse applications of recycled materials derived from construction and demolition waste, highlighting their potential to contribute to sustainable upgrading construction practices, resource efficiency, and circular economy principles.

2.4.3 Existing policies, regulations, and guidelines

The operational landscape of waste management, construction, and housing in Nairobi is governed by a combination of national and local policies, regulations, and guidelines. These frameworks aim to address various aspects of sustainable development, including waste management and housing provision, within the city. At the municipal level, the Nairobi County Integrated Development Plan (CIDP) serves as a foundational document outlining strategic objectives and interventions for sustainable development. This plan encompasses key areas such as waste management and housing provision and provides a roadmap for addressing these issues within the county (Nairobi County Government, 2018).

Complementing local initiatives, national legislation also plays a crucial role in shaping the regulatory framework for waste management in Kenya. The National Environmental Management and Coordination Act (EMCA) serves as a cornerstone legislation, providing overarching guidelines and regulations for environmental management, including waste management practices (NEMA, 2021). Additionally, the Environmental Management and Coordination (Waste Management) Regulations offer specific directives and standards to govern waste management activities across the country.

However, the unique challenges posed by informal settlements like Kibera necessitate a nuanced approach to policy implementation. The UN reported that in various cities, planning regulations and standards have been reluctant to adapt to the reality of urban informality, often designating the land on which informal settlements are located for other forms of development or imposing stringent regulations on their improvement (UN-HABITAT, 2016). Other cities simply fail to integrate them at all into city development schemes. In Nairobi, despite the existence of national policies and regulations, informal settlements often operate within distinct dynamics characterized by informal governance structures and community-based initiatives. These settlements may also navigate informal land tenure systems, which can negatively influence the implementation of waste management and housing upgrading initiatives in these areas if imposed by outside interests, that do not understand the complex informal systems and strong impediments to change and are not rooted in the realities of how these informal settlements work.

Therefore, while national policies provide a framework for waste management and housing initiatives in Nairobi, addressing the specific challenges and dynamics of informal settlements requires tailored strategies, deeply rooted in the contextual realities of the informal settlements and driven by the community members

themselves. It is only through such an approach, a community-based co-design initiative, that the unique socio-economic and governance dynamics within these communities can be integrated into the solution. This is what this study aims to achieve.

2.5 Theoretical frameworks

The following are the theoretical frameworks guiding this study:

2.5.1 Sustainable construction practices and circular economy (CE) framework

The concept of the circular economy (CE) has gained significant momentum and attention in various sectors, including textiles and agriculture. Research has highlighted the adoption and implementation of CE principles within these sectors, emphasizing the importance of resource efficiency, waste reduction, and sustainable practices (Esposito, Sessa, Sica, & Malandrino, 2020). However, the same cannot be said for the building construction industry (BCI) despite the substantial amount of waste generated and the unsustainable approach to resource waste. There is no similar adoption and implementation of CE in the BCI.

Countries like Germany have become pioneers in resource recovery, setting a valuable example for others. In 1996, the German parliament enacted a groundbreaking law called "kreislaufwirtschaft" which translates to "circular economy" (Ogunmakinde, 2019). This legislation prioritized waste reduction through a hierarchy that emphasizes avoiding waste generation in the first place, followed by closed-loop recycling to keep materials circulating within the system (Lehmann, Leeuw, Fehr, & Wong, 2014).

Germany's approach also introduced the concept of extended producer responsibility. This means manufacturers are held accountable for the entire lifecycle of their products, incentivizing them to design for minimal waste, ensure efficient recovery at the end of a product's life, and promote reuse throughout the production and use phases. Building on this success, Germany further revised its circular economy and waste management laws in 2012, aligning with European Union guidelines. These revisions aimed to achieve even greater environmental protection, combat climate change, and ensure responsible resource use.

Efforts to promote circularity within the BCI should focus on strategies such as recycling and repurposing construction and demolition waste, promoting sustainable design and construction practices, and fostering collaboration among stakeholders to create a more circular and sustainable built environment. By addressing the challenges and barriers to adopting circular economy principles within the BCI, the industry can move towards a more sustainable and resilient future.

The circular economy has introduced a new business model for managing C&D waste. Instead of simply recycling C&D waste, CDWREs capture the waste's residual value by using it as a raw material for the production of new products (Ding, Wang, & Zou, 2023). In the context of repurposing C&D waste into the rehabilitation of informal structures in Nairobi's slums, integrated sustainable construction practices are essential for minimizing environmental impact and maximizing resource efficiency. By incorporating waste reduction and recycling techniques into informal housing improvement projects, such as the reuse of reclaimed materials from C&D waste, developers can contribute to achieving sustainable development goals and reduce their contribution to environmental degradation while addressing the needs of populations within the informal settlements.

2.5.2 Sustainable construction practices, community development practices and peace engineering

Community development methodologies provide a framework for ensuring that circular economy initiatives like repurposing C&D waste for the upgrading of informal settlements are inclusive, empowering, and sustainable in the long term. These methodologies emphasize the importance of community participation, capacity building, and social inclusion in development projects (Australian Government, 2023). Peace engineering recognizes that technical solutions can only lead to a more peaceful, equitable, and sustainable future if the engineers involved in the technical solution are integrated into community development methodologies and processes that engineers typically avoid, oftentimes to the detriment of the initiative. Peace engineering has been described as an emerging discipline aimed at integrating engineering design and practice toward outcomes of peace by fusing engineering approaches with the study and practice of peacebuilding (Yarnall, Olson, Santiago, & Zelizer, 2021). But in practice, peace engineering is more about integrating the knowledge of engineers with the deep contextual knowledge of communities, through transdisciplinary processes that are sensitive to conflict dynamics often prevalent in informal settlements.

In the context of informal settlement upgrading in Nairobi, community-led best practices highlight the need to recognize the efforts that communities are already making and to engage and empower local communities from where they are at in their efforts through participatory approaches that involve resource allocation and other decision-making processes, skills development, and capacity-building activities. By pursuing problem-solving with a community-driven framework, applied through a peace engineering lens, resulting in a circular economy solution that repurposes C&D waste into built environment improvements, implementers can have a much greater incremental impact while ensuring community ownership, socio-political cohesion, and long-term sustainability. For example, initiatives should prioritize community engagement throughout the project lifecycle, from planning and design to construction and maintenance, to ensure that local perspectives, priorities, and practices are incorporated into the design and implementation processes. Additionally, skills development programs can empower community members to participate in construction activities, fostering a sense of ownership and pride in the housing projects (Australian Government, 2023).

2.6 Conclusion

These theoretical frameworks, case studies, and policy considerations will provide a strong basis for my feasibility analysis of repurposing C&D waste for upgrading housing and the built environment in Nairobi's informal settlements such as Kibera. By examining how these frameworks intersect and interact within the context of initiatives focused on improving informal settlements, concepts can be developed, funding secured, and projects implemented that demonstrate the viability of a circular economy as it pertains to C&D waste and the critical need to improve the living conditions in Nairobi's slums.

3 Methodology

3.1 Social Constructivist Epistemology

This study employed a social constructivist epistemology. In this worldview, individuals actively construct their understanding of the world through lived experiences leading the researcher to look for the complexity of views rather than narrow the meanings into a few categories or ideas (Creswell, 2007). This aligns with the peace engineering lens through which this project was developed and implemented, and specifically its commitment to community-driven and owned solutions. Qualitative methods were employed that informed community dialogue on the opportunities to use repurposed C&D waste and were informed by the community's understanding of its context, its own best practices, and its prioritization. By dedicating time to engage with various stakeholders in the community, a process of co-designing was established that ensured community ownership from the outset and led to a better understanding of the subjective lived experiences, perceptions, and needs of the community. Constructivism acknowledges the social construction of knowledge and the importance of interpreting diverse perspectives, particularly when navigating the complex socio-economic, political, historical, and cultural context of informal settlements. Focus group discussions, in-depth interviews, and co-design exploration captured and embedded residents' perspectives, their lived experiences, and their needs regarding C&D waste repurposing into the research. The result was a participatory action research approach that aligned deeply with the social constructivism epistemology.

3.2 Theoretical frameworks

To maintain an ethical lens in this feasibility study, two main theoretical frameworks reviewed in detail in the previous section, guided this study: circular economy and peace engineering.

3.2.1 Circular Economy

The circular economy framework emphasizes principles of resource efficiency, waste reduction, and sustainable consumption and production. By adopting circular economy principles, the study aimed to identify opportunities to minimize waste generation, optimize resource utilization, and promote the reuse and recycling of materials within the construction sector. Methodologies such as life cycle assessment (LCA) and material flow analysis (MFA) were employed to quantify the environmental benefits of adopting circular economy practices in the repurposing of C&D waste. This study recognizes that for a truly sustainable circular economy model to thrive, both the supply side and the demand side of the equation must be motivated by not only their interests but also by the interests of others. In this case, the driving force behind both supply and demand sides must be a commitment to bettering lives and the environment.

3.2.2 Peace engineering

Peace engineering integrates engineering principles with social, economic, political, and environmental considerations to promote a transdisciplinary approach to sustainable development, conflict resolution, and social justice. By integrating the technical competencies of engineering with other disciplines focused on health, community development and peacebuilding, the needs and aspirations of the community can be more effectively driven by the community itself, engaging contextually grounded stakeholders in decision-making processes, and addressing socio-economic inequalities they face. The study aims to explore opportunities for a circular economy while contributing to the promotion of peace, stability, and sustainability within the

community. Methodologies such as participatory action research (PAR), community-based co-design, and developing solutions that recognize and celebrate ongoing community efforts were employed to not only ensure the active involvement of community members in the design and implementation of sustainable housing solutions but also to demonstrate a commitment to rebalancing power and ensuring that the decisions that affect the lives of the residents of Kibera informal settlements are in the hands of those residents and not of outside interests.

3.3 Data collection

The data collection process for this study encompassed both qualitative and quantitative research methods. The case study was in Kibera, Sarangombe ward.

3.3.1 Qualitative research

3.3.1.1 Interviews

A total of 30 interviews were conducted with various stakeholders, including residents of Kibera and their leaders, construction industry leaders, construction workers, local builders familiar with the community or similar types of communities, policymakers, regulators, government officials, community-based organizations (CBOs), and grassroots movement leaders. These interviews explored a range of topics, including housing and built environment needs and concerns, experiences with C&D waste, knowledge of repurposing techniques, perceptions of using repurposed materials, existing policies and regulations impacting waste management and construction practices, community dynamics, recycling initiatives, and potential collaboration opportunities.



Figure 1 Surveys and interviews conducted with various stakeholders within the community and in construction sites within Nairobi

3.3.1.2 Ethnographic observations

This study employed ethnographic observations to understand the lived experiences of residents in Kibera. For one month, I conducted immersive observations within the community, participating in daily activities

and engaging in informal conversations with residents. This approach allowed for a nuanced understanding of the challenges and dynamics at play within the settlement.

3.3.1.3 Focus Group Discussions (FGD)

To facilitate discussions with community members to explore specific themes identified in individual interviews, a focus group discussion was organized. This helped to facilitate the gathering of collective insights and foster interaction among the 10 participants.



Figure 2 FGD to facilitate collective insights and foster interaction among participants.

3.3.1.4 Participatory co-design workshops

Residents and community stakeholders were engaged in participatory workshops that I organized aimed at co-designing potential solutions for improving housing and other aspects of the built environment in their community using repurposed C&D waste. This workshop aimed to encourage ownership and community participation in the research process.



Figure 2.5 Community stakeholders engaged in participatory workshops aimed at co-designing potential solutions for improving housing and other aspects of the built environment in their community using repurposed C&D waste.



Figure 3 Community stakeholders were engaged in participatory workshops aimed at mapping out Kibera community

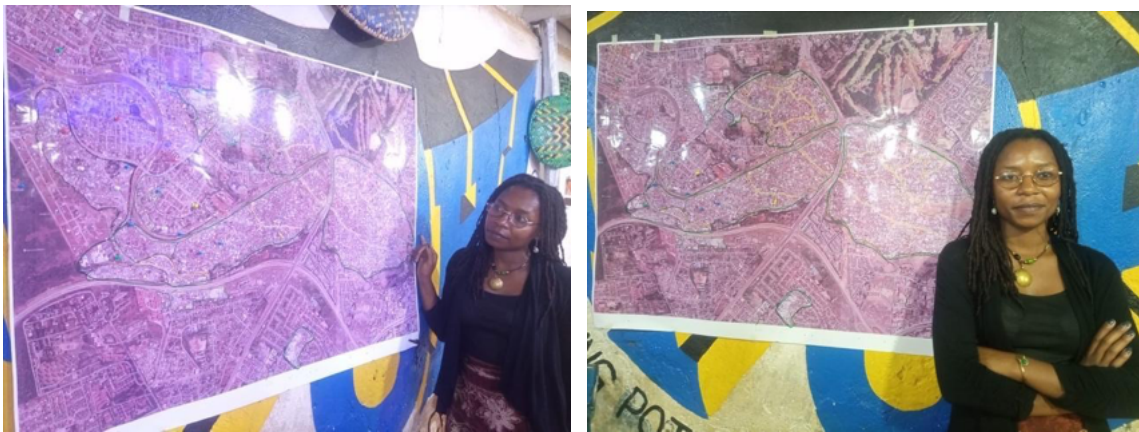


Figure 4 A mapping of the Kibera community by the community stakeholders indicating the crucial landmarks and the needs and improvements required in these built environments

3.3.2 Quantitative research

3.3.2.1 C&D waste characterization

Surveys and site visits were conducted to assess the types, quantities, and quality of C&D waste available in sites within Nairobi. The focus was on materials suitable for repurposing in housing and built environment construction repairs.



Figure 5 Surveys and site visits were conducted to assess the types, quantities, and quality of C&D waste available in sites within Nairobi.

3.3.2.2 Cost analysis

Data was collected on material costs, labor requirements, and transportation needs for construction using repurposed materials compared to traditional methods. This analysis provided insights into the financial implications of repurposing C&D waste.

3.3.2.3 Environmental Impact Assessment (EIA)

The potential environmental benefits of using repurposed C&D waste were analyzed, considering factors such as reduction in construction waste generation, resource consumption, and greenhouse gas emissions. This assessment provided valuable insights into the environmental sustainability of repurposing C&D waste for built environment improvements in informal settlements like Kibera.

3.4 Data Analysis

3.4.1 Participatory analysis

While most data analysis was left to the researchers, the peace engineering framework employed included participatory analysis allowing stakeholders the opportunity to weigh into how the data should be analyzed. This was done during the focus group discussion.

3.4.2 Thematic analysis

Data collected through qualitative methods were analyzed thematically to identify key themes, patterns, and stakeholder perspectives related to housing needs, community dynamics, and political and socio-economic factors.

3.4.3 Statistical analysis

Data collected through quantitative methods were analyzed using statistical techniques to quantify the economic, environmental, and social impacts of repurposing C&D waste, aligning with the principles of evidence-based decision-making advocated by both frameworks (circular economy and peace engineering)

3.4.4 Visualization

Tables and images were used to present key findings in an accessible format.

3.4.5 Triangulation

Triangulation combined qualitative and quantitative data to help ensure the validity and reliability of the research findings, providing a more comprehensive understanding of the feasibility of repurposing C&D waste to improve the built environment of Kibera.

3.4.6 Ethics and Epistemology

Obtaining a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI) was paramount to ensure adherence to ethical research practices in Kenya. This involved navigating the regulatory framework and obtaining official approval for the study. In parallel, informed consent forms were prepared, outlining the study's purpose, the voluntary nature of participation, and the confidentiality of responses to be obtained from interviewees.

4 Results and discussions

4.1 Introduction

The lack of effective management of construction and demolition (C&D) waste represents a critical challenge in urban environments, particularly in rapidly developing cities like Nairobi, where infrastructure projects abound. However, amidst this growing urban landscape, the lack of comprehensive data on C&D waste production poses significant challenges in devising sustainable waste management strategies. This information gap hinders our understanding of the volume, composition, and origin of this waste stream. Despite the absence of official records, this research highlights the complexities of waste management, emphasizing innovative approaches and community-driven initiatives aimed at transforming C&D waste from a burden into a resource. Through on-the-ground observations and stakeholder engagement, I gained valuable insights into the informal practices and resourceful endeavors employed by Kibera residents to repurpose waste materials.

This section demonstrates the essence of the forthcoming discussions, emphasizing the imperative of collaborative efforts and adaptive strategies in addressing the multifaceted issues surrounding C&D waste management in Nairobi's urban landscape.

4.2 Community needs and aspirations

4.2.1 Results

Thematic analysis of qualitative data from focus groups and interviews revealed the following critical needs in Kibera's built environment:

- **Poor Drainage:** Residents consistently reported issues with flooding due to inadequate drainage systems.
- **Integrity of housing structures:** This included:
 - **Leaking roofs:** Residents described the prevalence of leaks due to old and damaged roofing materials. The widespread use of worn-out brown roofing sheets across Kibera led to the community nickname "Chocolate City."
 - **Collapsing walls:** The structural integrity of many houses was compromised due to rain due to the nature of the mud houses. Also, some resident alluded to the fact that wind blew away their roofs because most of the roofs were only held on the top of the houses using stones.
 - **Lack of ventilation:** Poor air circulation due to a lack of windows in most structures.
 - **Lack of Proper Sanitation Facilities:** Inadequate sanitation facilities were a significant concern.
 - **Overcrowding:** Many houses were overcrowded, further straining the existing infrastructure. The residents explained that during times of emergencies like fire or

whenever a resident fell in and needed to be rushed to hospital, it would present a challenge in finding proper access to move in speed.

- Limited Building Materials: Residents expressed a lack of suitable and affordable materials for repairs and improvements



Figure 6 Areas with critical needs for improvement in Kibera's built environment as pointed out by the community members

Despite these challenges, residents in Kibera have demonstrated remarkable resourcefulness in addressing some of these issues using repurposed C&D waste. Here are some case studies obtained through on-the-ground observations and interviews with community members;

- Improved drainage with repurposed concrete debris: One remarkable resident-led initiative involved collecting concrete debris from nearby construction sites. They used this material, mixed with cement to cast a drainage channel in a specific part of Kibera that was particularly prone to flooding. This initiative, while modest in scale, highlights the potential of repurposing C&D waste to address critical infrastructure needs.



Figure 7 Before, during-construction, and after-construction images of a resident-led drainage initiative

- Another noteworthy example of community-driven action involves a drainage project involving the youth and children. This project specifically addressed flooding issues in a particular area. The project utilized C&D materials, including side drains collected from nearby demolition sites or waste piles. Concrete debris, gathered from an illegal dumpsite in the riverbed of the river passing through the community, was also used in the project. This project highlights the active participation of young

people in improving their living environment. Their involvement not only addresses a critical need but also fosters a sense of ownership and responsibility within the community.



Figure 8 Before, during-construction, and after-construction images of the drainage channel. A community-driven initiative by the youth and children

- Another resident-led initiative, spearheaded by a local construction worker, involved collecting C&D materials from various sites and secondhand yards. These repurposed materials were then used to construct a new community hall that serves as a space for residents to gather for games and watch football matches. This project exemplifies the potential of C&D waste for not just basic repairs but also for the development of new community assets.



Figure 9 The construction process of a new community hall that serves as a space for residents to gather for games and watch football matches. The hall is made entirely from recycled C&D waste.

- Finally, the construction of a usable footbridge across the Ngong River illustrates both a failed external initiative and community-led ingenuity to repurpose materials to meet their needs. Several years ago, an outside organization did an external assessment of needs within Kibera without engaging the community effectively. They concluded that one of the challenges to bringing more sustainable electrification into Kibera was the lack of poles to support power lines. They secured funding and went ahead to install poles throughout parts of Kibera without any assurances or follow-up that those poles would be utilized and that power would be brought into the communities through overhead lines. After the poles stood dormant and unused for some time, community members realized they would be much better served for other uses. The extraction of several of these poles allowed residents to construct a bridge over the river, providing a critically needed transport route for getting goods, including repurposable C&D waste into the community for housing and communal space upgrading. This is at the same time, an illustrative example of a failed externally-driven development and a successful community-based initiative.



Figure 10 Various bridges constructed over the river by community members by repurposing electric poles

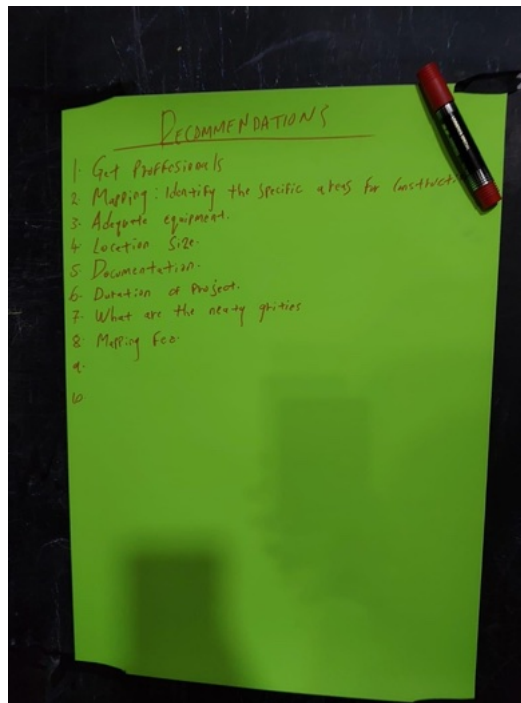
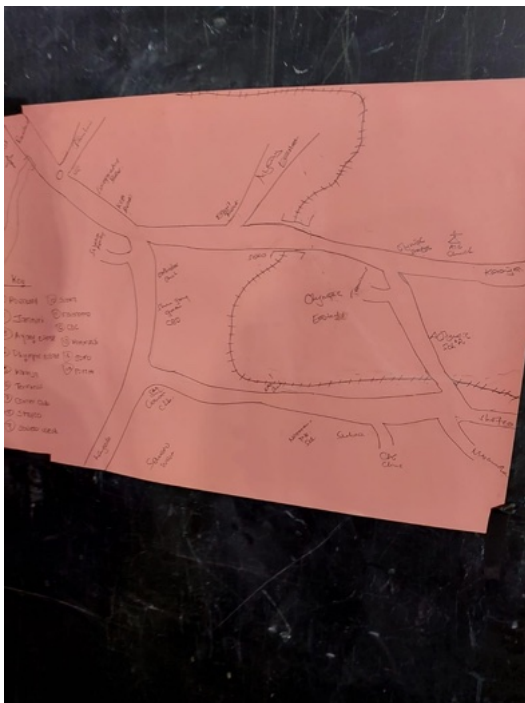
4.2.2 Discussions

The poor quality of housing, lack of proper sanitation facilities, and inadequate drainage highlight the urgency of improving living conditions in Kibera. These findings align with the principles of peace engineering, which emphasizes social justice and promoting community well-being. The residents' descriptions of leaking roofs, structural instability, and inadequate sanitation underscore the need for immediate action.

While the data was not quantified, the consistent emphasis on these needs across all focus groups and interviews suggests they are widespread in Kibera. Future research endeavors could incorporate housing surveys to quantify the exact percentages of households affected by each issue.

The community's receptiveness to using repurposed C&D waste demonstrates their willingness to participate in solutions. This aligns with the social constructivist approach, where knowledge is co-constructed.

Kibera community's experience with recycled materials in construction projects like the community hall and drainage systems strengthens the case for adopting repurposed C&D waste on a larger scale. These community-driven efforts highlight the residents' willingness to participate in solutions and their existing knowledge about using repurposed C&D waste for improvements. Moreover, residents' resourcefulness in utilizing repurposed materials resonates with the social constructivist approach, where knowledge is co-constructed through collaboration and shared experiences. While the effectiveness of these specific initiatives may not be comprehensively quantified, they offer valuable insights and serve as a foundation for exploring the potential of wider-scale implementation.



These projects highlight the potential of repurposed C&D waste for addressing critical infrastructure needs. This approach aligns with the principles of a circular economy by minimizing waste generation and promoting resource utilization within the construction sector. However, to effectively implement this strategy, a deeper understanding of the types and quantities of C&D waste available in Kibera and Nairobi is necessary.

The next section explores the characteristics of C&D waste through site visits, surveys, and field observations. This analysis will help determine the feasibility and potential of using repurposed C&D waste for construction projects in Kibera.

4.3 C&D Waste Characterization

4.3.1 Results

Site visits and surveys conducted in Kibera identified a variety of C&D waste materials suitable for repurposing, including:

- Machine-cut stones
- Foundation stones
- Bricks
- Wood offcuts
- Deformed steel
- Metals
- Mesh wires
- Doors
- Windows
- Plastic pipes
- Tiles
- Roofing sheets
- Concrete debris

Construction Materials				
Market Price	Materials	Recommended Price	unit of measurement	
50 Ksh	Foundation stones	30 Ksh	per Running foot.	
50 Ksh	Masonry cut-stones	50 Ksh	per piece.	
400 Ksh	Roofing sheets	200 Ksh	per metre	
1100 Ksh	Reinforced steel	70 Ksh	Full length (20m)	
1200 Ksh				" D 10
700 Ksh				" D 12
400 Ksh				" D 8
4300	Binding wire	3000	per 25 kg Roll	
400				Wall post
3000	Roof eave	2,000	per Tone	
2600	Square-cut steel	1800	Full length	
2400				" "
2000				" "
2000				" "
6000	Wooden doors	1200	N/A	
1500	Metallic doors	5000	N/A	
1500	Wooden Windows	400		
3000	Metallic Windows	1000		
300	Roofing Nails	200		
200	Construction Nails	100		
	Welder's gloves			
600	B-20	30	per piece	
1000	Welding	1000	per hour	
200	U bolts	200	per piece	

Figure 11 Suitable repurposing materials as identified by community members and their recommended costs

Notably, some community members were observed stockpiling a significant amount of these materials, demonstrating a community-driven approach to waste collection and reuse.



Figure 12 Various C&D materials collected and stored by community members

However, interviews revealed limitations due to financial constraints and lack of adequate storage spaces, restricting the overall quantities found within Kibera.

Similar types of C&D waste were identified at construction and demolition sites across Nairobi. Field observations confirmed the presence of these materials at various locations, including ongoing construction projects, renovation works, and demolition activities. The informal nature of many construction practices in Nairobi suggests potentially significant C&D waste generation within the city.



Figure 13 C&D Materials identified in various construction sites within Nairobi

Obtaining precise data on C&D waste quantities and compositions proved challenging due to the lack of record-keeping by local authorities and site representatives. This highlights the need for improved waste management practices and data collection systems in the construction sector.

While exact quantification was not possible, observations suggested that construction sites in Nairobi generate considerably more C&D waste compared to what is collected in Kibera. Residents attributed this disparity to several factors:

- Limited access to construction sites due to security restrictions or unclear ownership.
- Financial constraints that limit residents' ability to transport collected materials.
- Selective collection practices where residents prioritize materials for their immediate needs.
- The quality of the C&D waste was generally comparable between Kibera and construction sites, with occasional variations due to damage during transportation.

4.3.2 Discussion

The observed difference in C&D waste quantities between Kibera and construction sites highlights the potential for a more comprehensive waste collection system that bridges this gap. This aligns with the principles of a circular economy by optimizing resource utilization and minimizing waste disposal. The residents' selective collection practices demonstrate their resourcefulness and knowledge of suitable materials. However, a more coordinated approach could ensure a wider variety of materials are collected and effectively repurposed.

The availability of these C&D waste materials presents a promising resource for construction projects in Kibera. This aligns with the principles of a circular economy by minimizing waste generation and promoting resource utilization within the local construction sector. The observed moderate-to-good quality of collected C&D waste suggests its potential for various construction applications once proper processing techniques are implemented.

The limited quantity of readily available C&D waste within Kibera underscores the need for a collaborative model for C&D waste management to maximize this resource's potential. Recognizing the challenges in data availability, such a model should emphasize responsible acquisition of C&D waste through community engagement and ethical considerations. Strategies could include raising awareness among stakeholders about sustainable waste disposal practices and the benefits of repurposing C&D waste. To address the lack of official records, the project proposes empowering residents through training programs on waste identification, sorting, and safe handling practices. Partnerships with local community organizations and businesses can further enhance capacity for effective waste repurposing.

To evaluate the economic viability of using repurposed C&D waste in Kibera's built environment improvements, this research compared the costs associated with acquiring, processing, and transporting these materials to the costs of conventional building materials commonly used in Kibera. The results of this cost analysis are presented in the following section.

4.4 Cost Analysis

4.4.1 Results

The cost analysis compared the economic viability of using repurposed C&D waste against conventional building materials commonly used in Kibera. Here's a breakdown of the key findings:

	Conventional building materials	Repurposed C&D waste
Acquisition costs	Generally stable and predictable costs.	Much lower than conventional materials, depending on collection methods and transportation distances.
Processing costs	No additional processing or transportation costs are required for readily available materials.	Additional costs may be incurred for sorting, cleaning, and crushing the C&D waste for reuse.
Transportation Costs	The cost of transporting conventional building materials can be high due to: <ul style="list-style-type: none"> ▪ The perceived importance of new materials, leading to longer transportation 	Hauling C&D waste from collection points to construction sites may add to the overall cost.

	<p>distances from established suppliers outside Kibera.</p> <ul style="list-style-type: none"> ▪ The extra cost incurred by transporters to bypass youth groups or cartels who might control access points and demand bribes for allowing deliveries. 	
--	--	--

Table 1 Comparison of using repurposed C&D waste against conventional building materials commonly used in Kibera

A cost comparison table was created from the survey to illustrate the potential cost savings of using repurposed C&D waste for specific materials commonly used in Kibera.

	Market price for new building materials	Cost of buying from C&D repurposing waste suppliers
Foundation stones	Ksh 80/ running foot	Ksh 30 piece (including transportation cost)
Machine cut	Ksh 50/piece	Ksh 20 (including transportation cost)
Steel doors	Ksh 12,000-18,000	Ksh 5,000
Roofing sheets	Ksh 400/m	Ksh 200/m
Wooden doors	Ksh 6,000-8,000	Ksh 1,200-2,000
Square hollow tubes (SHS)- (Full length)		
2'x2'	Ksh 2,600	Ksh 1,800
4'x2'	Ksh 4,200	Ksh 2,500
4'x4'	Ksh 8,580	Ksh 5,500
3'x3'	Ksh 5,900	Ksh 3,500
Deformed steel bars (full length 38ft)		
D12	Ksh 1350	Ksh 800-1,000
D10	Ksh 1100	Ksh 700
D8	Ksh 780	Ksh 400- 500
R6	Ksh 420	Ksh 200-250

Table 2 cost analysis comparison of using repurposed C&D waste against conventional building materials commonly used in Kibera

The cost comparison table clearly demonstrates the significant cost savings achievable by using repurposed C&D waste for a variety of building materials in Kibera. The potential cost reductions range from 25% to 75% for materials like foundation stones, steel doors, and roofing sheets. These savings could be crucial for residents in Kibera who are struggling with limited financial resources for building improvements.

4.4.2 Discussion

The cost analysis suggests that repurposed C&D waste has the potential to be a more economical option compared to conventional building materials, particularly when acquisition costs are low. The table showcasing the cost comparison of materials highlights this potential for savings. However, several hidden costs need to be factored in:

- **Transportation:** The cost of transporting C&D waste from collection points to construction sites can be significant, especially if the distances are long. Strategies to minimize transportation distances, such as establishing local collection points closer to Kibera could be explored.
- **Processing:** Depending on the intended reuse application, repurposed C&D waste might require cleaning, sorting, and crushing before being suitable for construction. These processing costs need to be carefully assessed against the potential cost savings from lower acquisition costs. While my research suggests that sieving construction debris for sand and ballast might not be a substantially expensive process due to the potentially cheap labor available, a larger-scale operation might require machinery, increasing processing costs. However, this project's focus on small, incremental steps makes large-scale machinery use less likely.

Overall, the economic viability of using repurposed C&D waste depends on a careful evaluation of all costs involved, including acquisition, transportation, and processing. In some cases, the cost savings from using repurposed C&D waste might be offset by these hidden costs. However, repurposed C&D waste offers the additional benefit of reducing reliance on virgin materials and promoting a more sustainable construction approach.

Having determined the economic viability of using repurposed C&D waste for improving built environment in Kibera, the next step is to analyze its environmental impact to understand the potential environmental benefits and drawbacks associated with using this alternative building material in Kibera.

4.5 Environmental Impact Assessment (EIA)

This section highlights the Environmental Impact Assessment (EIA) of using repurposed C&D waste in construction projects within Kibera. This is an analysis based on available research.

4.5.1 Reduced reliance on virgin materials

Repurposing C&D waste offers a significant environmental benefit by reducing the demand for virgin materials. This translates to a reduced need for quarrying and mining. Extracting new resources like stones, gravel, and sand disrupts natural habitats, alters landscapes, and can lead to soil erosion. By using repurposed C&D waste, this environmental impact can be minimized. Unfortunately, data on the estimated amount of C&D waste repurposed in Kibera's construction projects is not currently available which limits our ability to quantify the specific percentage reduction in virgin materials achieved.

4.5.2 Waste reduction and diversion

Repurposing C&D waste diverts significant quantities of material from landfills, leading to reduced pressure on landfills. Landfills are reaching capacity and pose environmental risks like methane emissions and groundwater contamination. Reusing C&D waste reduces the need for landfill space and associated environmental concerns. Data on the total amount of C&D waste generated in Nairobi's construction activities is currently unavailable which limits the ability to calculate the percentage of C&D waste diverted from landfills through repurposing efforts.

4.5.3 Energy Consumption

Manufacturing new building materials from scratch often requires significant energy consumption. Repurposing C&D waste has the potential to lower energy consumption due to less processing and lower energy inputs. Data limitations prevent me from quantifying the exact reduction in energy consumption achievable through repurposed C&D waste in Kibera. However, the potential for lower energy use compared to virgin materials remains a significant environmental benefit.

4.6 Limitations and future research

While this study provides valuable insights, several limitations and opportunities for future research remain. Improved data collection systems, community engagement strategies, and comprehensive environmental impact assessments are essential for advancing sustainable C&D waste management practices. Additionally, longitudinal studies can track the long-term effects of community-driven initiatives and policy interventions on urban resilience and environmental sustainability.

The lack of data on the quantities of C&D waste repurposed and total construction waste generation hinders a more comprehensive quantification of the environmental benefits. Future research efforts could address these gaps by:

- Implementing waste collection monitoring systems to track the amount of C&D waste diverted for reuse in construction projects.
- Conducting surveys among residents and construction site managers to estimate the volume of C&D waste generated and repurposed.

Despite the data limitations, the potential environmental benefits of reduced reliance on virgin materials and waste diversion are well-established. Repurposing C&D waste aligns with the principles of a circular economy and promotes a more sustainable approach to the construction sector in Kibera.

5 Conclusion

In conclusion, this research highlighted the multifaceted challenges and opportunities inherent in managing construction and demolition (C&D) waste in urban environments, with a focus on Nairobi's landscape, particularly Kibera. Despite the lack of official records, the study reveals a compelling narrative of resilience and resourcefulness among Kibera residents in tackling critical infrastructure needs through innovative repurposing of C&D waste.

The identified community needs and aspirations highlight the urgent imperative for action, emphasizing the integral role of collaborative efforts and adaptive strategies in addressing the pressing challenges of poor drainage, structural integrity issues, sanitation inadequacies, and overcrowding. Through a series of case studies and community-driven initiatives, we witness firsthand the transformative power of repurposed C&D waste in addressing these challenges, from improved drainage systems to the construction of vital communal spaces like the community hall and footbridges.

Moreover, the comprehensive analysis of C&D waste characterization reveals a rich source of materials suitable for repurposing, both within Kibera and across Nairobi. While data limitations hinder precise quantification, the observed moderate-to-good quality of collected C&D waste presents a promising avenue for addressing critical infrastructure needs while minimizing waste generation.

Furthermore, the economic viability analysis demonstrates significant cost savings achievable through the utilization of repurposed C&D waste, underlining its potential as a more affordable alternative to conventional building materials. Despite hidden costs such as transportation and processing, the overall benefits in terms of reduced reliance on virgin materials and promotion of a circular economy model are evident.

In considering the environmental impact, repurposing C&D waste emerges as a sustainable solution, reducing the demand for virgin materials, diverting waste from landfills, and potentially lowering energy consumption in the construction sector. While data limitations pose challenges in quantifying these benefits, future research endeavors could bridge this gap through enhanced waste monitoring systems and stakeholder engagement.

This research advocates for a paradigm shift in urban waste management practices, from viewing C&D waste as a burden to recognizing it as a valuable resource for sustainable development. By harnessing the collective ingenuity of communities and fostering collaboration between stakeholders, we can pave the way for a more resilient, inclusive, and environmentally conscious urban future. As we navigate the complexities of urbanization, let us draw inspiration from Kibera's innovative spirit and forge a path toward building cities that are not only sustainable but also equitable and harmonious for all.

Bibliography

- World Bank. (2019, December 11). *Kenya Informal Settlements Improvement Project 2*. Retrieved from The World bank:
<https://documents1.worldbank.org/curated/pt/364621576423240976/pdf/Project-Information-Docum ent-Integrated-Safeguards-Data-Sheet-Kenya-Informal-Settlements-Improvement-Project-2-P167814 .pdf>
- UN-HABITAT. (2016). *Up for Slum Dwellers- Transforming a Billion Lives Campaign Unveiled in Europe*. Pugh, C. (1997). Poverty and Progress? Reflections on housing and urban policies in developing countries. *Urban studies*, 1776-96.
- United Nations. (2018, June 2018). *68% of the world population projected to live in urban areas by 2050*. Retrieved from Department of Economic and Social Affairs.
- Giulia, C., & Guillaume, H. (2021). Beyond materials: The construction process in space, time and culture in informal settlement in Mathare Nairobi. *Development Engineering* 6.
- Caimi, A., Cr  t  , E., Joffroy, T., Moles, O., Serlet, M., & Gutierrez, E. S. (2017). *Detailed country profile Fiji: local building cultures for sustainable and resilient habitats*. CRAterre.
- Mitullah, W. (2003). *Understanding slums: case studies for the global report on human settlements 2003: the case of Nairobi, Kenya*. Nairobi: UN-HABITAT.
- Amnesty International. (2009). *THE UNSEEN MAJORITY: NAIROBI'S TWO MILLION SLUM-DWELLERS*. Nairobi: Amnesty International.
- Karanja, I. W., & Makau, J. (2011). *An inventory of slums in Nairobi*. Nairobi: Sdi. Retrieved from Sdi:
<https://sdinet.org/what-we-do/>
- UN-HABITAT. (2015). *Habitat III issue papers: 22 – informal settlements*. New York: United Nations. Retrieved from <https://unhabitat.org/habitat-iii-issue-papers-22-informal-settlements>
- IRIN News. (2013, March 13). *Kenya's waste management challenge**. Retrieved from The New Humanitarian:
<https://www.thenewhumanitarian.org/report/97638/kenya%E2%80%99s-waste-management-challenge>
- The Star. (2023, November 28). *Don't celebrate yet! Sifuna tells Kenyans after Housing levy ruling*. Retrieved from The Star:
<https://www.the-star.co.ke/news/2023-11-28-dont-celebrate-yet-sifuna-tells-kenyans-after-housing-levy-ruling/>
- The Star. (2023, December 28). *Nairobi slum dwellers, contractors hold pro-housing levy protests*. Retrieved from The Star:
<https://www.the-star.co.ke/news/realtime/2023-12-28-nairobi-slum-dwellers-contractors-hold-pro-housing-levy-protests/>
- Kaza, S., Yao, L., Bhada-Tata, P., & Woerden, F. V. (2018). *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. World Bank Publications.
- Kabirifar, K., Mojtahedi, M., Wang, C., & Tam, V. W. (2020). Construction and demolition waste management contributing factors coupled with reduce, reuse, and recycle strategies for effective waste management: A review. *Journal of Cleaner Production*, volume 263.
- Ogunmakinde, O. E. (2019). A Review of Circular Economy Development Models in China, Germany and Japan. *Recycling* 4(3), 27.
- Lehmann, M., Leeuw, B., Fehr, E., & Wong, A. (2014). Circular economy. Improving the management of natural resources. *In World Resouce Forum*.

community, c. s. (n.d.).

Creswell, J. W. (2007). *QUALITATIVE INQUIRY & RESEARCH DESIGN Choosing Among Five Approaches*. London: SAGE Publications.

UN-Habitat. (2018). *Guidelines for the Reuse and Recycling of construction and demolitions waste*.

Owuor, S. ..., & Teresa, M. (2008). Post Independence Development of Nairobi City, Kenya. *Workshop on African Capital Cities*, 22-23.

World Bank. (2021). *Population living in slums (% of urban population) - Kenya*. Retrieved from The World Bank: <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=KE>

APHRC. (2012). *Population and Health Dynamics in Nairobi's Informal Settlements. Report of the Nairobi Cross-sectional Slums Survey (NCSS) 2012*. Nairobi : APHRC.

World Population Review. (2024, april 4). *World Population Review 2024 (live)*. Retrieved from World Population Review: <https://worldpopulationreview.com/countries/kenya-population>

GoK. (1966). *Report on the Mission on Land Consolidation and Registration In Kenya*. Nairobi: The larence Mission Report.

The East African Review. (2011). Kibera: The Biggest Slum in Africa? *Open Editions Journals*, 23-33.

Kulshreshtha, Y., Mota, N., Jagadish, K. S., Bredenoord, Vardon, P. J., Loosdrecht, M. C., & Jonkers, H. M. (2020). The Potential and current status of earthen materials for low-cost housing in rural India. *Construction and Building Materials Vol 247*.

Ding, Z., Wang, X., & Zou, P. X. (2023). Barriers and countermeasures of construction and demolition waste recycling enterprises under circular economy . *Journal of Cleaner Production* .

Rafaela, C., Rui, V. S., Brito, J. d., & Dhir, R. (2016). Use of recycled aggregates from construction and demolition waste in geotechnical applications: A literature review. *Waste Management*, 131-145.

Jones, R., Zheng, L., Yerramala, A., & Rao, K. (2012). Use of recycled and secondary aggregates in foamed concretes. *Magazine of concrete research*, 513-525.

Nairobi County Government. (2018). *COUNTY INTEGRATED DEVELOPMENT PLAN 2018-2022*. Retrieved from Nairobi City county:

<https://nairobi.go.ke/download/cidp-county-integrated-development-plan-2018-2022/>

NEMA. (2021). *ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT, 1999 (ACT NO 8 OF 1999)*. Nairobi: NEMA.

UN-HABITAT. (2016). *UN-Habitat Support to Sustainable Urban Development in Kenya Addressing Urban Informality*. Nairobi: United Nations Human Settlements Programme.

Esposito, B., Sessa, M. R., Sica, D., & Malandrino, O. (2020). Towards Circular Economy in the Agri-Food Sector. A Systematic Literature Review. *Sustainability*, 7401.

Australian Government. (2023). *What is community development?* Retrieved from Australian Institute of family studies: <https://aifs.gov.au/resources/resource-sheets/what-community-development>

Yarnall, K., Olson, M., Santiago, I., & Zelizer, C. (2021). Peace engineering as a pathway to the sustainable development goals. *Technological Forecasting and Social Change Vol 168*.

Government of Kenya. (2012). *Sustainable Development in Kenya: Stocktaking in the run up to Rio+20*. Nairobi: G.o.K.

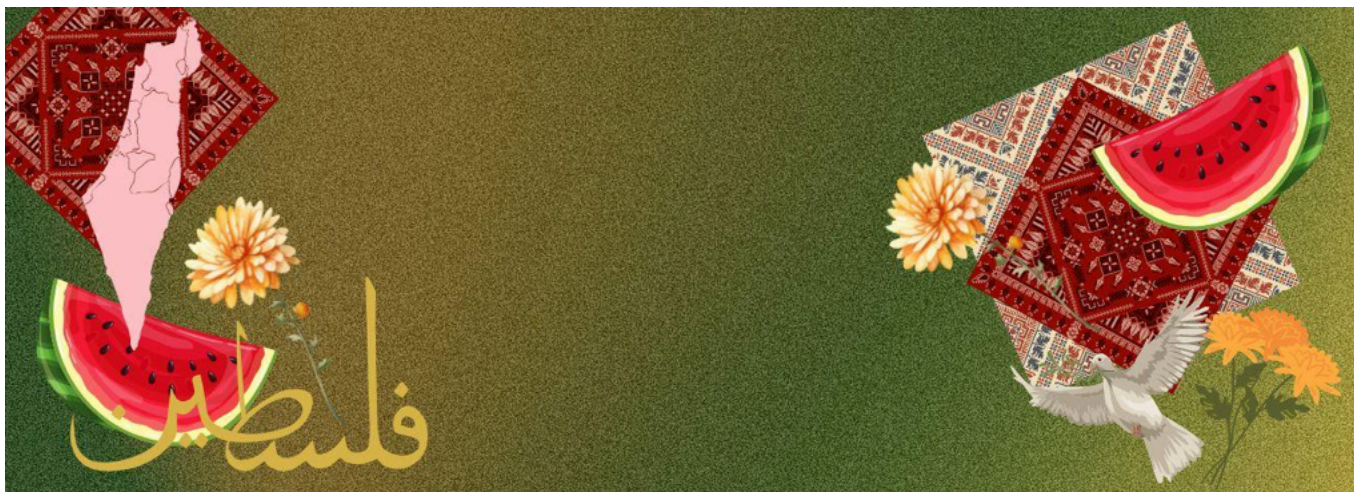
Mitullah, W. (2003). *Understanding Slums: Case Studies for the Global Report on Human Settlements, 2003 – The Case of Nairobi, Kenya,*”. Nairobi.

Watson, V. (2014). *Kenyan Slums: A History of Neglect and Innovation*. McFarland & Company Inc.

José-Luis Gálvez-Martos, I.-R. I. (2020). 2.5 Advances in Construction and Demolition Waste Recycling. *Management, Processing and Environmental Assessment*, 51-68.

Ellen MacArthur Foundation. (2021, September 8). Reusing construction materials to limit biodiversity impacts: Upcycled Studios. Denmark. Retrieved from

<https://www.ellenmacarthurfoundation.org/circular-examples/reusing-construction-materials-to-limit-biodiversity-impacts-upcycles>



**An Exploration of Palestinian Educators and Advocates,
*Educational Capacity Building and the Right to Self Determination for Palestinian Youth***

Mahtaub Golab
Masters of Engineering, Sustainability and Public Health
Capstone Final Project | ESH 540
April 14, 2024

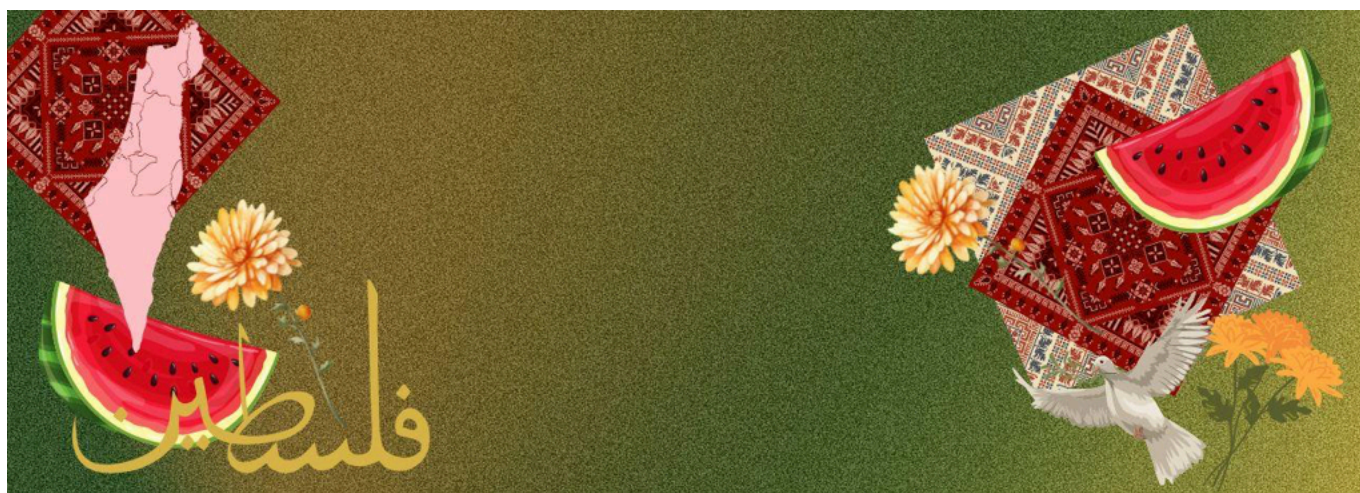


Table of Contents

Abstract.....

Glossary.....

Introduction.....

Literature Review

Methodology.....

Early Stages and Influence of Theoretical Perspective to Define Methodology.....

The Interview Methodology | Structured to Semi-Structured

Results and Discussion.....

Celebrating the Collective's Voices

Learning New Methodologies & Situating their Experiences in Existing Literature.....

Situating their Experiences in the Present Day Crisis | What Can We Do?.....

Concluding Summary and Next Steps

Dedication

Bibliography

Abstract

The division of historic Palestine into the present day territories of Gaza and the West Bank, created two primary locations where Palestinian youth participate in their educational systems. This study examines the roles and responsibilities of one collective of Palestinian, educational advocates and the ways they engage with the Palestinian youth population within these territories. Using the Interview Methodology to document first hand narratives, this project explores the collective's obstacles of sustainable educational development under occupation, apartheid and military siege. With respect to insight participants provided on their development, strategies and innovations as a form of advocacy against oppression, this project considers the perspectives of critical theory, post colonial theory, and the pedagogy of the oppressed as the theoretical frameworks to bring this research into focus. The qualitative research methods of this paper highlight the educational advocates' experiences in building resiliency not only within the local, youth community, but also through bridges of international, education-based solidarity. Drawing in additional resources through published literary, governmental, and journalistic writings the interviewed participant's words ground political discourse with first hand narrative discourse and considers how perspectives against such terminologies like apartheid and occupation to describe Palestinian may be considered disingenuous. Results at the end of the research add to the existing literature that emphasizes for sustainable systems to be developed in Palestine, namely, those of education, Palestinian youth must have the right of self determination, free of occupation and military rule.

Key Words

Palestinian Youth, Self-Determination, Palestinian Educators, Advocacy, Occupation, Apartheid, Sustainable Frameworks, West Bank, Gaza, Critical Theory, Interview Methodology

Glossary of Key Terms Discussed in Research

➤ Occupation

- “the status of one nation with a military presence in another nation for an extended period of time. This generally occurs during or following a war” ([Cornell Law School, 2020](#))

➤ Apartheid

- “Apartheid is a policy that is founded on the idea of separating people based on racial or ethnic criteria. Usually, the separation operated by apartheid is exercised over geographical areas, putting one part of the population in an area separated from the others, or forbidding a group to access some areas solely based on their belonging to a race or ethnicity.” ([Cornell Law School, 2022](#))

➤ Siege

- “Siege warfare is an operational strategy to facilitate capture of a fortified place such as a city, in such a way as to isolate it from relief in the form of supplies or additional defensive forces.” ([Oxford Public International Law, 2009](#))

➤ Occupied Palestinian Territories (oPT)

- “The OPT consists of the West Bank (including East Jerusalem) and Gaza” ([European Council on Foreign Affairs, 2020](#))
- “The Occupied Palestinian Territory faces a protracted protection and political crisis characterized by more than 56 years of Israeli military occupation, 16 years of the Gaza blockade, internal Palestinian divisions, lack of adherence to international humanitarian and human rights law, and recurrent escalations of hostilities between Israeli security forces and Palestinian armed groups.” ([UNOCHA, 2024](#))

➤ Pedagogy of the Oppressed

- Paulo Friere’s work which defines oppression as, “Any situation in which ‘A’ objectively exploits ‘B’ or hinders his and her pursuit of self-affirmation as a responsible person... [interfering] with the individual’s... vocation to be more fully human” ([Gomes, 2022](#))

➤ Critical Theory

- “Critical theory” refers to a family of theories that aim at a critique and transformation of society by integrating normative perspectives with empirically informed analysis of society’s conflicts, contradictions, and tendencies” ([Stanford Encyclopedia of Philosophy, 2023](#))

➤ Interview Methodology

- “An interview is a qualitative research method that relies on asking questions in order to collect data. Interviews involve two or more people, one of whom is the interviewer asking the questions. There are several types of interviews, often differentiated by their level of structure. Structured interviews have predetermined questions asked in a predetermined order. Unstructured interviews are more free-flowing. Semi-structured interviews fall in between.” ([George, 2022](#))

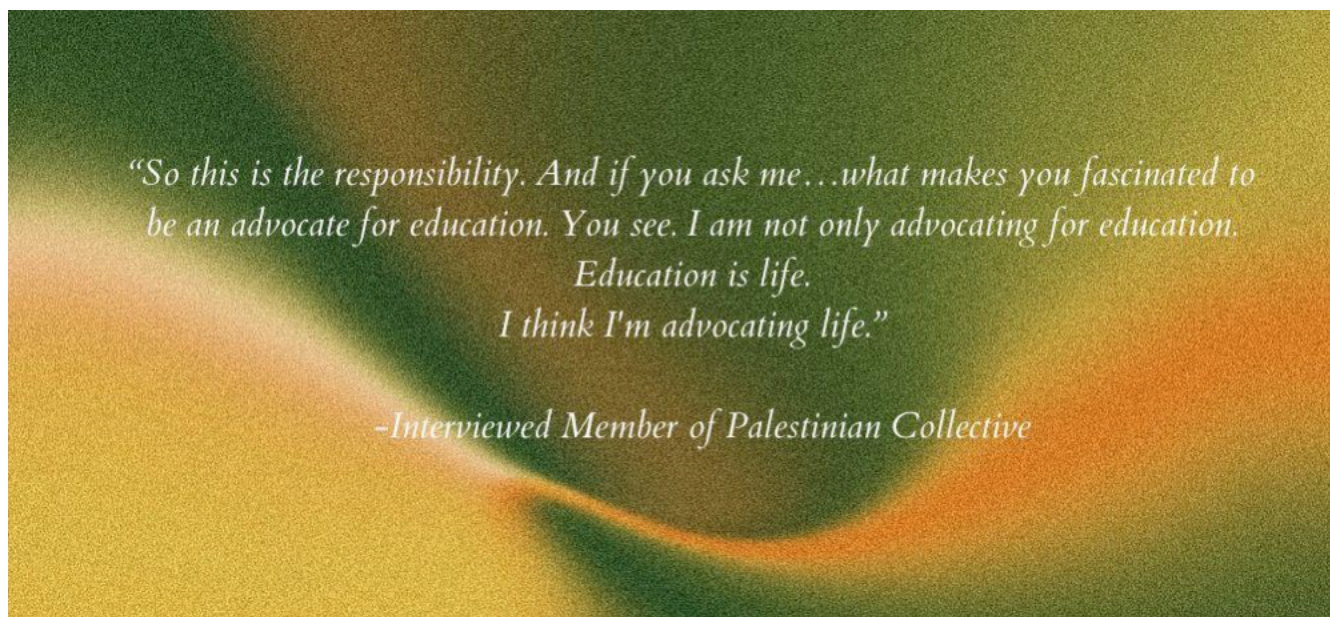
➤ Sumud

- “Sumud is the Arabic meaning of resilience, which was first used to describe such acts following the 1967 war, known among Palestinians as the Naksa, which led to the annexation and occupation of the West Bank, east Jerusalem and Gaza.” ([Alhelou, 2019](#))
- “Academics define the concept of Sumud as a socio-political ethical concept and refer to ways of surviving in the context of the military occupation, colonization and hegemony.” ([Alhelou, 2019](#))
- “The first Intifada – the first popular uprising which started in 1987 until the establishment of the Palestinian Authority (PA) in 1994 – saw the use of a number of factors, which boosted the Sumud, such as employing the use of patriotic songs, poetry, poster art, folk dancing, graffiti, praising acts of resistance, general strikes, demonstrations, as well as street gatherings during eulogy festivals and weddings.” ([Alhelou, 2019](#))
- “The symbol associated with the concept of Sumud as a political strategy and the Palestinian sense of rootedness in their land is the olive tree.” ([Alhelou, 2019](#))
- “Sumud is the anti-thesis of submission, subjection and injustice, and as long as the battle of self-conscious continues, Palestinians are not going to vanish” ([Alhelou, 2019](#))

Introduction

What are the varying roles of education within a society, and what are the experiences of those who take on the responsibility of guiding and supporting the youth? How do the lived realities of a society influence the resources and tools educators have access to? When access to education is stifled through various forms of oppression, how then do lines of an educator and an activist become blurred? These questions and more guide the qualitative research my paper explores.

If the position is taken that the overlapping responsibilities of education and activism seek to transform life, then we may consider how participants within both these roles are striving to actively create more resilient lives for their youths' futures. Paulo Freire, expressed in his work, *Pedagogy of the Oppressed*, "If true commitment to the people, involving the transformation of the reality by which they are oppressed, requires a theory of transforming action, this theory cannot fail to assign the people a fundamental role in the transformation process." ([Freire, 2005, pg.121](#)) Oppression, Freire explains, goes beyond a conceptualized theory, but rather through defining it, also triggers actors of change noting, "leaders cannot treat the oppressed as mere activists to be denied the opportunity of reflection and allowed merely the illusion of acting" ([Freire, 2005, pg.121](#)). In respect to these reflections about meshed complexities of education, oppression, and life as well as the responsibilities of educators and activists, this paper focuses its lens on education in Palestine. Palestine - a nation whose society have been identified as experiencing "16 years of de-development and suppressed human potential and the right to development" ([UNCTAD, 2023, pg. 14](#)), within systems of apartheid ([Amnesty International, 2022](#)) and reasonable grounds of genocide ([Albanese, 2024, pg. 1](#)), works to support their youth - a population who must navigate their access to education - by navigating the checkpoints of an occupying military's siege on their lands. ([Shakir, 2021](#)).¹



¹ Omar Shakir, Israel and Palestine Director at Human Rights Watch, was the lead researcher of the 2021 report: *A Threshold Crossed Israeli Authorities and the Crimes of Apartheid and Persecution*

As such, this project studies the experiences of Palestinian educational advocates and the youth population they support through the lens of critical theory and post colonial theory authors, and the *Pedagogy of the Oppressed*, and communicates those findings within this paper. By rooting this paper's research within these theoretical lenses, the intention is not to victimize Palestinian resiliency. Rather it seeks to highlight their steadfast determination to build sustainable frameworks of education for their youth. Seeing as youth populations are the inheritors of these interdisciplinary systems, by adding to the discourse of injustice and its impact on education, this paper aims to provide another space for Palestinian youth and their educational advocates to reclaim agency, build community and discuss ways they envision a stronger, more resilient future for themselves. Critical theory as described by Olli-Pekka Moisio's 2013 work titled *Critical Theory* echoes [Max Horkheimer's 1972](#) work titled, *Traditional and Critical Theory*, by noting, "critical research and critique should be founded on the needs, longings, and moral demands of the people living under the conditions of the system or structure that are criticized" ([Moisio, 2013](#)), and as such became an appropriate theoretical perspective to consider my own project's research. Palestinians too, have the moral demand to build a life for themselves and their children, free of occupation and many seek to do so through frameworks of education. As such, this paper is driven by two research questions: **How do members of one collective of Palestinian activists and organizers engage with their community as educators? And how are they navigating obstacles in the field of education and development?**

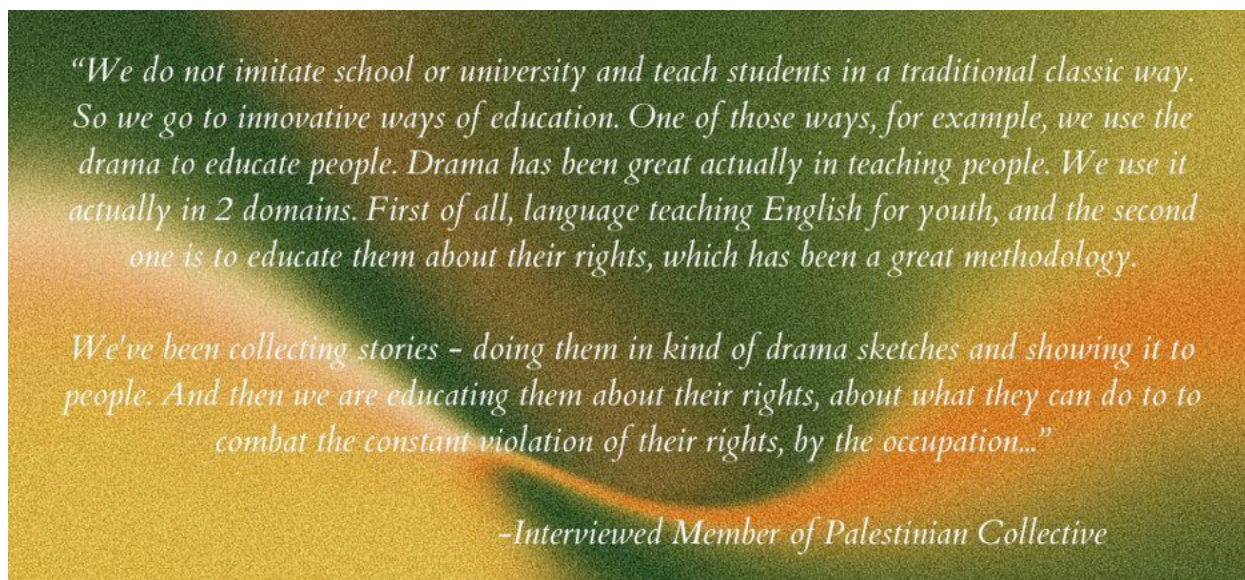
By interviewing these agents of educational change, this paper utilizes the Interview Methodology, shifting from a Structured Interview Methodology - with questions already predetermined and set to be asked in a specific order - to a Semi-Structured Interview Methodology, when in action. In practice the interview became more akin to a Semi-Structured Interview Methodology as questions sparked additional stories and questions by the collective, and in return myself. This adaptive interview process from one question or thought piece to the next, while not originally intended, created an atmosphere of pride and honor, where the collective was able to freely share their experiences as educational organizers. Through discussing their positive and negative experiences, this paper was also able to look at the system of education and its struggles with sustainability, within a larger context of other systems in Palestine. This brief evaluation of system-of-systems, also provided the ability to highlight the opposing narrative that claims Palestine is not an occupied nation, navigating apartheid. However, through sharing this collective's voices, while also drawing on existing literature of educational, social and environmental systems in Palestine, this paper also seeks to challenge those opposing perspectives. True to the deep nature of Palestinian resiliency, 'sumud'², their stories of transformation and innovation communicated their steadfast determination to build a life better than the day before. To hear these advocates speak of education as a giver of life and agency, cemented the position this paper holds - being - Palestinian youth deserve the right of education and self-determination, free of occupation and free of military siege.

² Sumud: "the anti-thesis of submission, subjection and injustice, and as long as the battle of self-conscious continues, Palestinians are not going to vanish." *The New Arab, The living spirit of Sumud: Palestinians' form of resistance and steadfastness continues to grow stronger*, 2019.

Literature Review

Positioning narratives from the collective within existing, critical theory literature creates a conversation that focuses on solidarity and movement building with the oppressed. In doing so, a community of educational advocate voices are drawn together spanning across decades and nations, all with the intention of highlighting post colonial, sustainable education frameworks as a building block towards holistics frameworks in all systems of Palestine. In situating the collective's experiences alongside works and case studies of - Friere, Abo Hommos, Asaad, Ramahi, Habashi, Said, Fanon, Ives et. al, and Dana - amongst other published pieces, the stage is set as if this paper is a drama production of social and educational justice, with the Palestinian collective as the actor in focus and the other writers as the supporting voices. This use of polyvocality, the "power of many voices to shift and sustain narrative change" ([Weidinger, 2020](#)), mirrors the power of intercommunication to, and values not only the individual, but the collective as a whole. Paulo Friere poses in his work, *Pedagogy of the Oppressed*, "The same is true of revolutionary action...In this theory of action one cannot speak of an actor, nor simply of actors, but rather of actors in intercommunication" ([Friere, 2005, pg.127](#)).

Dramatic pieces have the ability of transcending traditional forms of communication, welcoming intercommunication and allowing participants and observers to engage with one another in more emotional ways, akin to that of qualitative research. In respect to this dramatized perspective I shine light on the words of one collective member and the ways they use drama as a resource to engage with their youth population:



By highlighting the collective's voices this paper and their non-traditional ways of organizing and engaging with the youth, this framework of non-traditionality "will assist us as scholars to challenge the delusion of Cartesian views particularly in indigenous work, as noted in Janette Habashi's study, *Creating Indigenous Discourse: History, Power, and Imperialism in Academia*,

Palestinian Case, ([Habashi,2005.pg.15](#)), which explains Cartesian perspective as one that “values the individual over the group” ([Habashi,2005.pg.2](#)). Connecting drama, non-traditional forms of communication and revolutionary changes together echoes Freire’s earlier revolutionary sentiments. He reiterates in *Pedagogy of the Oppressed*, “Dialogue with the people is radically necessary to every authentic revolution. This is what makes it a revolution, as distinguished from a military coup... Its very legitimacy lies in that dialogue... The earlier dialogue begins, the more truly revolutionary will the movement be.” ([Friere,2005.pg.126](#)). This juxtaposition of dialogue versus military coup fits well with the perspective of the Palestinian educational collective and their decisions to use drama as a creative tool to foster dialogue, allowing the youth to express their needs and violations committed by the military occupation.

In referencing the military occupation of Palestine and its impact on sustainable education, it is of value to take a step back and provide a historical perspective for the instability within the educational institutions and frameworks in Palestine. This research further places historic reflection as a precursor to emphasize how the use of drama as an educational tool and resource took shape in Palestine. With this in mind, I turn attention to Hanan Ramahi’s case study titled, *Education in Palestine: Current Challenges and Emancipatory Alternatives*, which supports the perspective of drama based learning through the organization The Tamer Institute for Community Education. This institute works as an educational non-profit organization created by Dr. Munir Fasheh. Dr. Fasheh works to bring critical thinking into the educational sphere of Palestine as a way to combat deterioration and de-development ([Ramahi, 2015, pg.22](#)). The institute, Ramahi notes, was created to strengthen community education, providing youth a space separate from traditional forms of education that followed formal, structured modes of learning. Ramahi emphasizes the importance of this institute citing its development,

...coincided with the rise of grassroots movements in response to Israeli repression and severe restriction of education provision during the first intifada...Tamer remained critical of the transmission mode of teaching that does not promote critical thinking and transformational learning aimed at raising awareness of the socio-cultural and political forces of oppression. While Tamer did not underestimate the oppressive and destructive impact of the Israeli occupation, it sought to foster change intended to counter oppressive structures, both political and hegemonic. ([Ramahi, 2015, pg.22-23](#))

Donald Ellis’ piece titled *Apartheid*, however, would challenge Dr. Fasheh, the Tamer Institute and Ramahi’s words noting apartheid and occupation do not occur in Israel’s political framework ([Ellis, 2019](#)). He states, “This does not mean that there is not discrimination in Israel, but it is not institutionalized government policy. Certainly, some policies in Israel can be “repressive”, but not apartheid.” ([Ellis, 2019](#)). Yet, earlier in his paper Ellis proceeds to cite apartheid as, “an exhaustive system of racial discrimination that restricted education, political engagement, and social contact.” ([Ellis, 2019](#)). Historically though, Ramahi’s case study, echoing words by [Abo Hommos’, 2013](#) piece, *PA The Day After: Collapse and its Effect on Education*³, and [Asaad’s, 2000](#) work titled, *Palestinian educational philosophy between past and present* explains how,

During the Israeli occupation of the West Bank and Gaza in 1967, military authorities targeted the education system, despite the increasingly reductive and purely functionalist role of education. Repressive measures reached emergency proportions during the intifada civil protest movement starting in 1987, when Israeli military forces closed down schools and universities for periods of up

³ Dr. Abo Hommos served as the Palestinian Cabinet Secretary from 2009 to 2012, and was the Minister of Education & Higher Education from 2002 to 2006

to two years and disrupted, through harassment, informal attempts at educational provision (Mahshi and Bush, 1989).” ([Ramahi, 2015, pg.10](#))

And in the present day, Amnesty International’s article titled, *Where Are All the Students From Gaza?* explains,

...three Palestinian women blocked from attending the university of their choice. Why? Because it is located in the occupied West Bank. They live in Gaza – where an ongoing Israeli blockade imposes severe restrictions on freedom of movement and other human rights. Students are not allowed to pursue nearby programs in the West Bank...Since 2000, Israel’s blockade on education has prevented thousands of Palestinian students in Gaza from pursuing higher education in the nearby West Bank – no more than 60 miles away. This, despite the fact that both the Gaza Strip and the West Bank, including East Jerusalem, are all recognized as the Occupied Palestinian Territories – one single territorial unit. The Israeli military has cut the two apart. ([Amnesty International, 2013, para 3 & 5](#)).

In addition, international organizations such as The Human Rights Watch and B’tselem have published works reporting that in addition to occupation, Palestinians are living under an apartheid system enacted by the Israeli government ([Faikh and Shakir, 2023](#)). B’tselem, the Israeli Information Center for Human Rights in the Occupied Territories hosts on a series of reports on the impact of military occupation within Palestinian towns and the youth’s ability to access safe education. Several key pieces with both situational information and video footage are presented with the following titles: *Israeli soldiers and Border Police officers enter school in Hebron and attack students and teachers* ([November 2022](#)); *Israeli military closes off West Bank village for 50 days, invades it 17 times, arrests students at school and harasses residents* ([February 2022](#)); *Israeli soldiers harassing Palestinian students at entrance to al-‘Arrub campus for past 6 months* ([June 2018](#)). With these works in consideration, it is plausible how years-long occupation of Palestine has disrupted the continued access to education. As military checkpoints within the West Bank and the Occupied Territories and the border wall dividing Gaza and the West Bank have limited mobility of youth populations and their educators, access to the spaces and places of learning equally become limited. Karam Dana’s 2017 study titled, *The West Bank Apartheid/Separation Wall: Space, Punishment and the Disruption of Social Continuity*, further emphasizes the negative impacts the division of Gaza and the West Bank has had on all systems noting, “Not only do physical barriers hinder social interactions, but they also impact society in numerous ways. The effects on Palestinian society are largely invisible and have long-term and far-reaching consequences. These consequences run deeper than the physical barriers that have created them.” (Dana, 2017, pg.1). The boundary division of Gaza and the West Bank and the inability of students from Gaza to socially engage and cross land boundaries to enter school in the West Bank disproves Ellis' own argument that Israel is not an occupying presence exercising apartheid. His definition of apartheid resting in one nation preventing another to socially connect becomes the very definition of Palestinian youth’s educational experiences, and therefore Israel not being an actor of apartheid becomes disingenuous when both present day policies of educational restrictions as well as voices of the Palestinian collective, inform otherwise. Instead of negating the needs for creative outlets for the youth - the need for drama to express life under occupation, becomes even more apparent.

As Ramahi’s case study continues to echo the Palestinian collective’s belief in the value of drama and arts as an exploration of self and the role of a Palestinian youth within their society, the Palestinian collective echoed these sentiments. During interviews, the collective stated that through drama the students learn how to become better citizens - servicing not only their own needs, but also learning from a young age how to serve and take care of their Palestinian community, as a whole. In practice, the youth then becomes another member of the collective, “empower[ing] the collective and treat[ing] the individual as a member who is connected and committed to the community cause.” ([Habashi, 2005, pg.3](#)) The collective’s ability to support

Palestinian youth agency within the social reality of occupation provides an outlet for hope. That hope is again echoed in Ramahi's work citing,

expressive arts including art, drama and theatre, in order to create opportunities for reflection and self-expression. By focusing on youth as the hope for the future, the Institute seeks to provide spaces and opportunities for young Palestinians to narrate their personal stories in order to foster agential practices among. ([Ramahi, 2015, pg.23](#)).

The focus on 'hope for the future' and fostering 'agential practices' in youth education brings to focus the post-colonial theoretical perspective within this paper. Within Edward Said's 1993, work, *Culture and Imperialism*, he explains how educational systems themselves become colonized by the imperialist presence, noting that imperialism occurs, "beyond the level of economic laws and political decisions" ([Said, 1993, pg.40](#)), and makes attempts to consolidate its imperialist presence "within education, literature, and the visual and musical art" ([Said, 1993, pg.40](#)). Therefore, the decision of the collective to use drama and its performances as a way to actually discuss the occupation and violations committed against the youth, is a way for them to reclaim their agency and hope for the future and negate the possibility of their education being fully controlled through the occupation. Post-colonial writer Frantz Fanon ties together Said's perspective of imperial presence working to co-opt education, as well as Freire's emphasis on the importance of dialogue. Fanon's 1961 work, *Wretched of the Earth*, discusses assimilation and the oppressor, implying that historically - the oppressed, in order to sustain themselves, have often been forced to give up a part of their identity. That identity being their own intellectual ownership:

In order to assimilate the culture of the oppressor and venture into his fold, the colonized subject has had to pawn some of his own intellectual possessions. For instance, one of the things he has had to assimilate is the way the colonialist bourgeoisie thinks. This is apparent in the colonized intellectual's inaptitude to engage in dialogue. ([Fanon, 1961, pg.78](#))

Yet, the Palestinian collective's work with the youth actually ensures this abandoning of mind and identity does not happen through their non-traditional forms of communication and education. By dialoguing their experiences through drama and sharing with their fellow youth, they are maintaining control of themselves and their identity. This once again speaks to the position of this paper of Palestinian youth's right to self-determination - free of instability and violence. It suggests that sustainable education for Palestinians does not come from assimilating to their oppressor; rather it becomes sustainable when they are free from occupation. Studies and reports by [Ives et. al 2019](#), [Amnesty International, 2009](#), [Amnesty International, 2017](#), [Al-Mashharawy, 2022](#), all seek to communicate the current instability and violence within Palestine's systems, and how this impacts Palestinians sustainable access to resources. With limited agency to make decisions, it is then understandable why the collective turns to non-traditional forms of education with their students where development is more focused on communication and dialogue, as opposed to physical resources. The collective however goes on to note that the limited access to resources does not become a permanent limitation for them, rather they turn the limitations into opportunities for innovation:

“Whenever there are limitations more innovation is required. So this has actually been the case in Palestine forever. I can't remember anything else in all my time. We are always about innovating. There are limitations in, and also kind of restrictions - when we talk about the resources, we usually have problem with resources, even with financial resources, or even with human resources, as many people now prefer to go somewhere else, because it's safer because there are other opportunities.

So whatever left overs you need to work with to have a successful ingredients!

And this is the - the basic thing - that necessity, the source of innovation. And then with the live just living in Palestine. You are motivated because you can see many violations of rights. And when it comes to something like education, you think it's not only a luxury, it's the basis of everything. Actually, it's ... it's the source of relationship between the sectors, between the private sector, between the academic sector between with between the public sector, but also as a source of shaping a kind of ...what economy is going to to to be in Palestine. What.. what kind of gap there are between the educational system and the requirement of the labor market.

What does that market need? What does Palestine need?

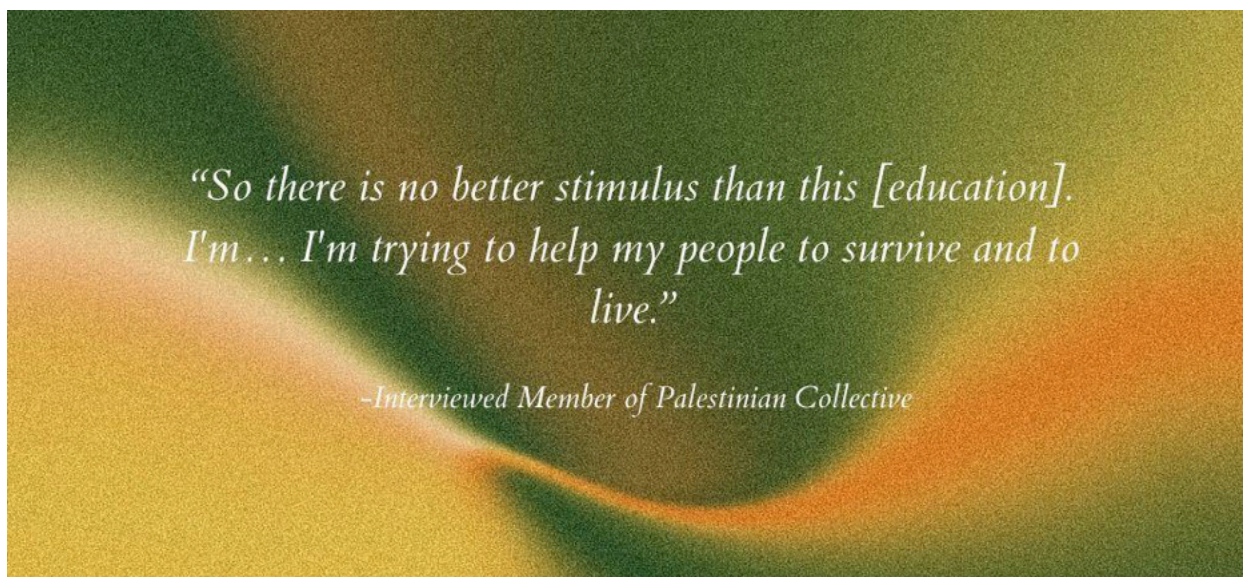
-Interviewed Member of Palestinian Collective

As conversations with the collective continued, they emphasized that drama opened the door for other non-traditional forms of education allowing students to become more expressive and emotional - connect with their emotions with the realities of life under occupation through a lens of advocacy; something that standard forms of education do not always support.

These revelations speak to the power of dialogue and communication, empathy and emotion when discussing hopes for a sustainable future. Framing this literature review for readers as a production of different theatrical voices sharing their radical and revolutionary perspectives on education and community action, also ushers in empathy onto the stage of academics. Creativity, radicalization and empathy have often been negated within the academic space, pushing the idea that radicalization is something solely negative, to be feared. This same mentality of negativity is often then pushed upon the oppressed and the actions they take to fight back against their oppressors. Yet, Friere asks us to consider radicalization as a tool for transformation. He notes,

And as those who have been completely marginalized are so radically transformed, they are no longer willing to be mere objects, responding to changes occurring around them; they are more likely to decide to take upon themselves the struggle to change the structures of society, which until now have served to oppress them... Radicalization, nourished by a critical spirit, is always creative...radicalization criticizes and thereby liberates. Radicalization involves increased commitment to the position one has chosen, and thus ever greater engagement in the effort to transform concrete, objective reality.” (Friere, 2005, pg. 31 & 35).

As the researcher, then I should state - I too have stepped into the empathetic role. As both an audience member observing these various stories, while also learning how to become an active participant, committed to collective action and concrete transformations, I find ways to connect dialogue and research to strengthen advocacy. Subsequently, this paper considers itself as a radical educational piece - a juxtaposition to the radical military occupation of Palestine - and invites readers to join the community of educational advocates for a self-determined Palestine.



Methodology

Early Stages and Influence of Theoretical Perspective to Define Methodology

By utilizing the qualitative method of research to, “[identify] patterns in language, theme, and structure, among other features, to understand human experiences” (SJSU, 2021), namely that of the Palestinian youth, this research paper questions: **How do members of one collective of Palestinian activists and organizers engage with their community as educators? And how are they navigating obstacles in the field of education and development?**

To lay the foundation of this research project I started by exploring the archival and present social, environmental and geopolitical systems in Palestine, namely Gaza, the West Bank and the Occupied Territories. With numerous reports coming out of human rights organizations, international governance institutions, journalistic works and peer-reviewed papers discussing Palestine and its occupied territories (*as noted in the Literature Review*), opinions vary on a wide spectrum on - the starting point of crisis, the responsibility of all parties involved and the terminology that should or should not be used to express social and political circumstances. While this was an appropriate methodology to acquaint myself with the existing literature surrounding the interdisciplinary systems of Gaza, the West Bank and the occupied territories - as noted in [Ives et. al. \(2019\)](#) study, *A systems-based assessment of Palestine's current and future infrastructure requirements*, there is a large influence on these systems that occurs politically through the occupation. Therefore, to better understand the experiences of Palestinians living under this political occupation, I understood the archival process was not the most effective methodology to center my focus on experiences of activists and organizers within the educational systems of Palestine. In order to build dialogue, community and learn from Palestinian educational advocates directly, I understood the need to utilize the Interview Methodology within this research.

In seeking to highlight both the interdisciplinary oppression within the region and existing interventions led directly by Palestinians, I thus shifted my research process to one of service first. Advocacy is a service driven process ([Ramahi, 2015](#)), where community is built through listening, learning and trust building; to transition into the interview methodology of my project I found great value in first giving my time and efforts to the community I wanted to learn from. Subsequently, I began supporting Palestinian educational advocates and organizers in their own projects. Through my interactions with this collective, key obstacles were highlighted as we discussed the goals, roadblocks and interventions of their projects and the research of mine. The collective emphasized themes such as apartheid, colonization, occupation, ongoing genocide and military check points to express the barriers in developing sustainable educational systems for the Palestinian youth population. These experiences shared through dialogues with one another echoes [Friere's, 2005](#) belief that dialogue and communication with one another has the power and ability to strengthen any movement - any revolution. Mirroring Friere's words Edward Said explains how speaking with/connecting with one another, we are also giving people the chance to reclaim their agency. This agency comes through narrating their own stories and self-determining who they are and what their experiences are ([Said, 1993](#)). He notes,

Self-definition is one of the activities practiced by all cultures: it has a rhetoric, a set of occasions and authorities (national feasts,' for example, times of crisis, founding fathers, basic texts, and so on), and a familiarity all its own. Yet in a world tied together as never before by the exigencies of electronic communication, trade, travel, environmental and regional conflicts that can expand with tremendous speed, the assertion of identity is by no means a mere ceremonial matter. ([Said, 1993, pg.64](#))

Conversations with the collective discussing the importance of building up the youth community situated the theoretical perspective of Pedagogy of the Oppressed, which highlights the importance of community over an individual leader. Even within the interview process, multiple collective members wanted to interview together, taking turns talking and building off one another's shared experiences - removing the idea that one leader could speak for all of their experiences or answer all the questions. Approaching the Interview Methodology through the theoretical lens of Friere's invites readers to consider how:

The oppressors do not favor promoting the community as a whole, but rather selected leaders. The latter course, by preserving a state of alienation, hinders the emergence of consciousness and critical

intervention in a total reality. And without this critical intervention, it is always difficult to achieve the unity of the oppressed as a class. ([Friere,2005.pg.141](#))

The Interview Methodology | Structured to Semi-Structured

In time, my acknowledgement of the collective's work created a collaborative atmosphere where they joined my research project as interview participants. The theoretical frameworks considered, coupled with the time spent with the collective of Palestinian educators and advocates then led to the methodological approach and core of my project - the Interview Methodology. The main goal of the Interview Methodology within the scope of this paper was, to the best of my ability, record the reflections of the collective and their relationship with their students, the occupation and their own dreams for Palestine. [Habashi, 2005](#) reflects on how many forms of education for indigenous communities rarely reflects the true complexity of oppressions, because portrayals are often told through the oppressive system itself. Yet Ramahi states,

By raising awareness of the root causes of social marginalization, economic inequalities and political exclusion, oppressed people are set free from fatalistic, irrational and deterministic mind sets and collectively empowered to improve their living conditions. This is done through praxis, the 'reflection and action upon the world in order to transform it' (Freire, 1970, p. 51). Pedagogical tools include dialogue, reflection, collaboration and action; these serve to enhance individual and collective agency, and communal ties in preparation for strategic collective action. This contrasts with traditional education models that emphasize self-improvement through academic qualifications that promote individual opportunities and rely on transmission modes of teaching ([Ramahi, 2015,pg.8](#))

Subsequently, considering Habashi's belief that reflections are often co-opted by the oppressor, interview questions prepared were intended to allow the interview participants to share as much as they wanted to within their own comfort, but also open the door for them to carry the narrative in the direction they wanted. This personal reflection and preparation was of great importance within my methodological process, because I want to advocate for Palestinian agency - and within the context of this paper - that agency came through the interview being a channel for people to tune into, and actually hear from the Palestinian collective directly. In preparation of this interview, I considered the following questions to ask the collective:

<u>Initially Planned Interview Questions</u>	
Please tell me about your role as an educational advocate and how many years you have been working in educational capacity building?	What interested you about becoming an educational advocate?
Given your years of experience, what insights as an activist in the field of education would you like to share?	What factors have you experienced that have hindered the development of educational capacity for your current student and future generations?
Within your comfort of sharing, what strategies have you as an educational advocate, focused on utilizing to collaborate with one another and build educational capacity, that address the existing hindrances to sustainable development?	How have these ways of co-creating and co-building, supported your role as Palestinian activists and organizers, to engage with your community as educators?
In what ways would you like to see further engagement and support from the international community to foster stronger educational development for your community?	

However - when considering how to foster greater empathy and advocacy for the Palestinian youth's cause of self-determination, there was a responsibility on me as the interviewer to ensure I provided the collective a space to share their experiences and emotions, safely and freely. **This meant, even if responses deviated from the original question, or if some questions were not asked - it did not matter.** The intention was to create a space for dialogue so the educational advocates, organizers and activists could speak about their own lives, in whatever way was important for them at that moment.

When asked...

What factors have you experienced that have hindered the development of educational capacity for your current student and future generations?

The struggles for us? Endless!

And all the time we were working on this, and it's a relentless effort to keep just coping, keep moving, and to navigate the apartheid ... and then the genocide... because whenever you achieve something I mean, I mean you bridge this gap a little bit. Then..

I mean. Nothing is ever static for our youth. Things and life are always moving fast, and the requirements and the bar are raising higher. So you need also to move ahead once again in order to be able to help those poor students, because I think - I think if you know about the Palestine, maybe you've read some of the statistics in our projects. In Palestine - it's opposite than the whole world. If you have a degree, then you have more potential to be unemployed, not to be employed! And this is not sarcastic. This is this is really something you cannot imagine.

So what's the solution?
To to be ignorant?
Of course this is not the solution for us, instead we advocate to be even smarter.

-Interviewed Member of Palestinian Collective

“At the moment I am in a university, and students cannot reach the university because of mobility restrictions they have. Right now in Gaza... tens of tens of thousands of students are without any kind of education, because their schools and their universities are totally destroyed”

-Interviewed Member of Palestinian Collective

Empathy in this moment of preparation also took on the shape of ethical concerns and considerations. I questioned, what is my role as an interviewee who wants to both highlight the needs and oppressions of a community, without presenting them as victims unable to help themselves? With the goal of the interview being to highlight the ways in which, despite the ongoing aggressions and layers of oppressive systems Palestinian educators, advocates and youth are resilient and steadfast, it was important to honor their struggles while also honoring their agency to self-determine their future. Empathy *also* took on the role of protection and care; while sharing the collective's work, developments, setbacks and struggles was the intention - revealing their individual identities was not something of necessity. Their identity in connection to their work is theirs to reveal when they see fit, and with this in mind the collective and I discussed keeping their organization's name private and instead referring to them as 'a collective of Palestinian educators and advocates' and within the organization of the paper, referring to them as 'Interviewed Palestinian Collective Member'. When referencing their developments or partners, no identifying names or

titles would be utilized; rather the general descriptive terms, such as ‘student’, ‘project’, ‘obstacles’, ‘youth’ for anonymity and protection of all parties involved.

Because the collective members are in Palestine, while I reside in the United States, interviews were conducted over Zoom and within a group setting. Interviews were conducted at a time that worked best for them and their work schedules, also keeping in mind that their commute would take several hours as they passed through military checkpoints. One participant had to leave the interview early, as their journey home from work would take 3-hours instead of the mapped distance of 45-minutes, due to these checkpoints. The exchange of this lived reality of injustice in the middle of our interview emphasized the barriers they expressed students and educational frameworks in Palestine must navigate. Prior to the interview itself, the interviewees and I confirmed that while the interview would be recorded for referencing of conversation points and clarity of reflections cited, only their words would be utilized within the paper. No images or footage from the recorded call would be shared within the paper, any subsequent presentations, nor with other people, parties or institutions. Ensuring the collective felt safe, respected and protected was important to this paper’s ethical considerations, and allowing them to guide this process spoke once again to the importance of agency and self-determination when listening to the narratives of an indigenous culture. Considering the Interview Methodology was used to reveal honest experiences of the collective, the structure of the interviews shifted from that of a Structured Interview Methodology, where the interviewer asks a similar set of questions to the interviewees and records their responses, to one of a Semi-Structured Methodology. Impassioned, participants chose to speak on certain topics more than others, bringing in examples and considerations of their own. Considering again I wanted this interview to act as a ‘channel’ one could tune in and listen to, I welcomed the shift to a Semi-Structured Methodology.

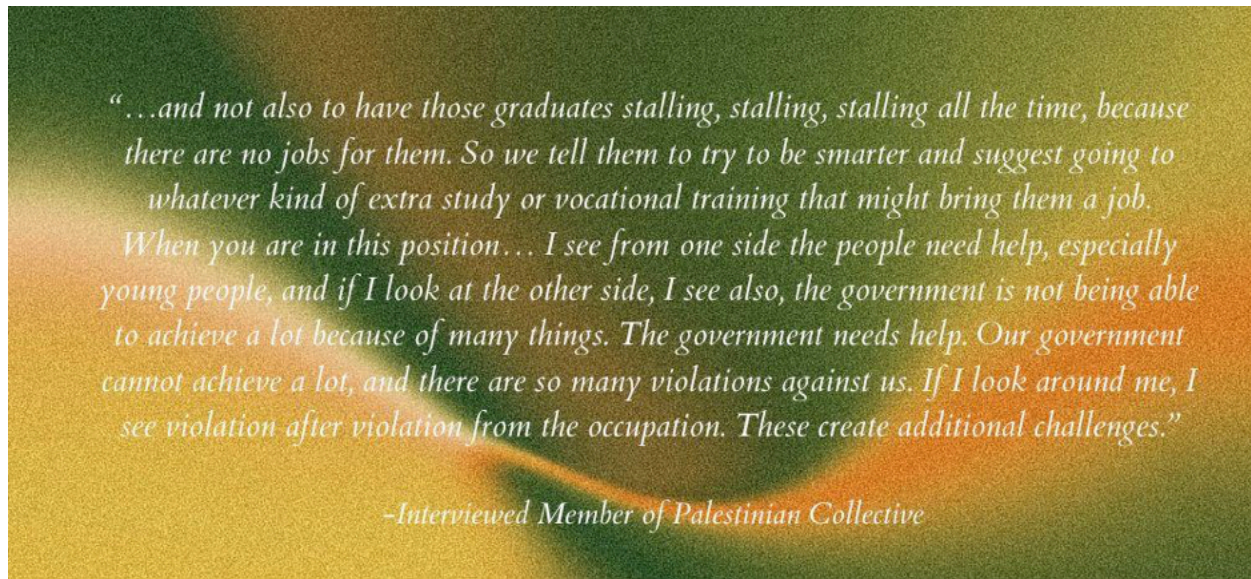
Results and Discussions

Celebrating the Collective’s Voices:

The interviews with the collective were a joy and an honor; having the opportunity to listen to their accomplishments, struggles and commitment to their youth is something to celebrate. In respect to the time and words they shared, the findings and reflections of this paper are positioned to build international bridges of solidarity, acting as its own form of advocative support for experiences of Palestinian, educational advocates under occupation and injustice. Quotes shared throughout this discussion section highlight interventions the collective has utilized when working with the youth population and navigating educational obstacles namely : 1) storytelling 2) creating projects that service their community and engage in capacity building efforts as well as learning tools to build entrepreneurial skills and finally 3) utilizing technology to connect their stories with the global community.

Drama was utilized on an interpersonal level within their own community as a way to strengthen communication skills and practice telling their storytelling, creative, and emancipatory outlets ([Ramahi,2015](#)). In strengthening these tools, the collective then assisted students in connecting with the civil sector of their communities. In doing so they engaged with potential jobs they could have or learned what

they needed to study to strengthen their employment opportunities, while also addressing issues within the community that needed support. Through these actions, the collective expressed that students learned how to help themselves and not solely be dependent on the systems around them, while also learning how to strengthen their community around them. Additionally, in gaining these skills, it then made them more confident to talk about their experiences and needs during technology based, intercultural and international communications with students in other countries. The other students in return learn about the ways Palestinian youth are trying to establish self-determinacy and the reasons they are struggling to do so.



In addition, by showcasing projects they have created, they also communicate to students in other countries the power of advocating for oneself. In return this mobilizes youth in other nations to support Palestinian youth endeavors, while also learning how to mobilize for themselves. The collective voiced that human interaction is a form of education in and of itself, and by interacting with others - sharing stories and experiences - we inevitably learn from one another and we carry less stereotypical beliefs of others. A more detailed explanation of this idea can be read through collective's words directly shown below:

“You know, I think... I think human interaction is a kind of education. And for people like us, like Palestinians, Palestinian people. We know we just have schools. and I know that when people get to know more about the situation in Palestine. There will be moving only one way, which is pro Palestinian. Because I remember one of the projects we were doing with the Palestinian and European universities. Scholars from England, actually, for the first time, they came to Palestine, and I remember when they saw the checkpoints and the siege of the Palestinians, and how they've been treated by the Israelis. They were getting really mad about the situation. And I know that those people until now they think one of their mission in the world after this finding is to enlighten their people about what is going on in Palestine... So you are educating people not necessarily to tell them what to say or what to see, actually just show them the reality. And I think Palestinians are always one of their best strength is to show the reality, because we don't hide anything exactly. It's it's the opposite. We've haven't been visible enough and it's not by choice. We are educating more people about the the situation here, and then the more this happens, the better life is. And, actually, it's not only a Palestinian issue, I mean, stereotype or stereotypical ideas are happening everywhere, and the more you learn about the other people, the less stereotypical person you would be.”

-Interviewed Member of Palestinian Collective

My findings did confirm the notion that Palestinians, despite all the troubles they must navigate, learning is still a strong passion of theirs. It is worth noting, that of the Levant region, Palestinians have one of the highest rates of graduation, with the highest marking of grades and scores ([Irfan, 2023](#)), while simultaneously having community consensus data noting the highest levels of unemployment. Therefore, the lack of job security post education, is not an indicator of lack of education, rather it highlights larger social and environmental system failures that cannot provide a sustainable life for Palestinian youth. Anne Irfan's piece in the Columbia University Press titled, *Why Palestinians Are Known as the World's "Best Educated Refugees"* notes that per the 2018 Palestinian Central Bureau of Statistics, "Palestinians have one of the highest literacy rates in the world... Particularly but not exclusively in the Middle East, Palestinians have long had a reputation as high-performing graduates, often proficient in at least two languages" ([Irfan, 2023](#)). Specifically, "The percentage of educated women in Palestine is one of the highest around the world with a 99,6 in 2020 for completion in primary and upper secondary" ([The General Union of Palestinian Teachers, 2023](#)). In interviewing the collective, they echoed these sentiments noting:

“...reflecting on what is being said. Actually, the literacy rate, if you go to statistics, you'll see that the Palestinians have a very good scores... And going back to an important point about the inability of governments to cope with all these challenges and fill the gaps of employment actually, some institutions, including private universities have started to take the role. To take on the responsibility to fill some gaps through education, the challenges and burdens through several initiatives to help marginalized people who have lost job opportunities become more educated through online programs that we use as tools”.

-Interviewed Member of Palestinian Collective

Why then, do I make the argument that despite having high levels of education and determination to learn, sustainable frameworks of education are difficult to achieve in Gaza and the West Bank?

On October 12th, Educational International shared a report about teachers in Gaza and the West Bank. The report noted,

Almost 200 teachers from Jerusalem, West Bank and Gaza strip were involved in the training during the summer of 2023. Palestinian women continue to be some of the most educated women in the Middle East-North Africa (MENA) region. While women's academic participation is indeed measurable, they are not reaping the benefits of education. ([The General Union of Palestinian Teachers, 2013](#)).

The intention of this report was to introduce a case study that was to be performed to increase the presence of Palestinian women in unions and positions of leadership, engage with their women led organizations to mobilize more Palestinian, female youths to join and to identify barriers in education and leadership in the The General Union of Palestinian Teachers (GUPT). It sought to bring more equity and leadership to Gazan and West Bank society. As of October 17, 2023 the organization published an updated note stating,

This article and the activities described were written before the most recent escalation of violence in the area. In recent days GUPT has reported that many teachers have been killed in Gaza, and schools have been destroyed. Access to water, electricity, fuel, and food has been cut off in their communities. ([The General Union of Palestinian Teachers, 2023](#)).

It is unclear if this project is able to proceed, or is on an indefinite hold...

Learning New Methodologies & Situating their Experiences in Existing Literature:

By utilizing the Semi-Structured Interview Methodology to understand practices of the collective, I in return discovered two new forms of methodologies: the drama methodology and the Iserve Methodology - both utilized by the collective and Palestinian youth. The Iserve methodology is especially interesting because in strengthening the youth's capacity, they also find ways to directly help their community. The collective explains:

"...We've been educating kids also to be better citizens.

We have a methodology, we call it Iserve. This, Iserve methodology - we make them use their theoretical background to go to marginalize places, areas where they assess the needs. And they design interventions, and then they implement initiatives from their own, depending on their background - academic background. And this, I think we've been working with this service methodology for 7-8 years. And it's working really perfectly well with us, because it helps the students help themselves. And it helps that community as well. And I think we need always all the time to be innovative in what whatever kind of capacity building."

-Interviewed Member of Palestinian Collective

These engagement efforts of connecting student to community → student to community problems → student to intervention(s) and intervention(s) to community, speaks to Paulo Freire’s belief that oppression and oppressors work to divide the local community to perpetuate problems. Freire states,

In "community development" projects the more a region or area is broken down into "local communities," without the study of these communities both as totalities in themselves and as parts of another totality (the area, region, and so forth)—which in its turn is part of a still larger totality (the nation, as part of the continental totality)—the more alienation is intensified. And the more alienated people are, the easier it is to divide them and keep them divided. These focalized forms of action, by intensifying the focalized way of life of the oppressed (especially in rural areas), hamper the oppressed from perceiving reality critically and keep them isolated from the problems of oppressed women and men. ([Freire, 2005, pg.140](#)).

Yet, through this Iserve Methodology, we see how the collective and youth are able to navigate the obstacles of the occupation and figure out ways to continue and build capacity, not only for themselves but also for other Palestinian community members as well.

All these interventions and ways of engagement, pose the question - what is the main obstacle to sustainable educational frameworks for Palestinian youth?

At the start of this project, the suggested understanding was the occupation of Palestine was not limited to only physical land - but also occupation of systems, resources and social interactions ([Dana, 2017](#)) ([Ives et al, 2019](#)). After spending time with the collective and listening to their stories, as well as, placing their experiences within existing literature and present day educational circumstances of Gaza and the West Bank, the findings of this paper confirm that the occupation of Palestine is the main obstacle, prohibiting the establishment of sustainable educational frameworks that are determined by a free, and self-determined Palestinian youth population.

The collective communicates this finding through their own experience and words by noting:

“I would like to add . . . questioning the possibility of achieving sustainable/authentic development in a land under occupation; I believe that independence and genuine sovereignty are pre-conditions to any kind of meaningful development.”

-Interviewed Member of Palestinian Collective

Situating their Experiences in Present Day Governance

This belief is not limited to only Palestinian values of justice and their advocates; the right of education and self-determination is a human right belonging to all on an international level of justice. The Universal Declaration of Human Rights, Article 26 states, “Everyone has the right to education. . . Education shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms.” ([United Nations UDHR, 1948](#)). The United Nations Sustainable Development Goal #4 focuses on ensuring equitable, quality education is afforded to everyone, with Target 4.7 highlighting,

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development” ([United Nations Department of Economic and Social Affairs, 2015](#)).

“So I've been working...I don't know on these kind of activities forever. Actually, I don't know how many years? Maybe 20 years? I've been in the development field including many educational activities such as capacity building and institutional capacity building. But despite all this you know.. I'm not a teacher, I'm an activist. And I run projects that advocate for the right of people to for a quality education, I think right now. If you go from a humanitarian or a legal background education is right. And it's a basic right. And it's entitled to all people without any conditions. And even if you go from a development prospect you have the SDG's.. SDG 4 talks about quality education. So this is that development agenda for the whole world for the years 2020 to 2030. So quality education should be guaranteed to ever to everybody. Now being in a in a place like Palestine makes the situation even more important and more pressing, because, you know, there are other things happening..”

-Interviewed Member of Palestinian Collective

The idea of sustainable education and self-determination are inexplicably linked to one another ([Delegates to the First National People of Color Environmental Leadership Summit,1991](#)), as self-determination is the foundation to self-sustainability. This self-sustainability allows the individual, the collective and the community to build together and for one another, without the pressure of being dependent on an outside presence that may exert its dominance, power - or in the case of Palestine - an occupation. Additionally, to alleviate the pressures of the occupation Palestinians must then become dependent on foreign aid scholarships, governments and programs to supplement their resources and needs. These resources and needs are then never fully fulfilled and systems are left in a perpetual state of instability because their stability always rests on the willingness of others to give ([Ives et. al, 2017](#)). Within the lens of education, this was expressed during the interviews as well. Given that interview participant’s identities were kept private, they were more free to discuss their experiences with apartheid, genocide and occupation; they

could critique the occupation more freely because these exchanges were not intended to provide them monetary funds, where their speech has to be limited and their outlook palatable for donors. Given that many of Palestine's monetary resources come from nations outside of Palestine, there is a limited ability to provide critique; the colonized can only criticize their colonizers so far if they are still dependent on them. Fanon recognizes this duality of dependency and yearning for independence as he discussed 'formerly' colonized nations and Europe stating, "The formerly colonized territory is now turned into an economically dependent country. The former colonizer, which has kept intact and, in some cases, reinforced its colonial marketing channels, agrees to inject small doses into the independent nation's budget in order to sustain it." ([Fanon, 1963, pg.120](#)).

Situating their Experiences in the Present Day Crisis | What Can We Do?

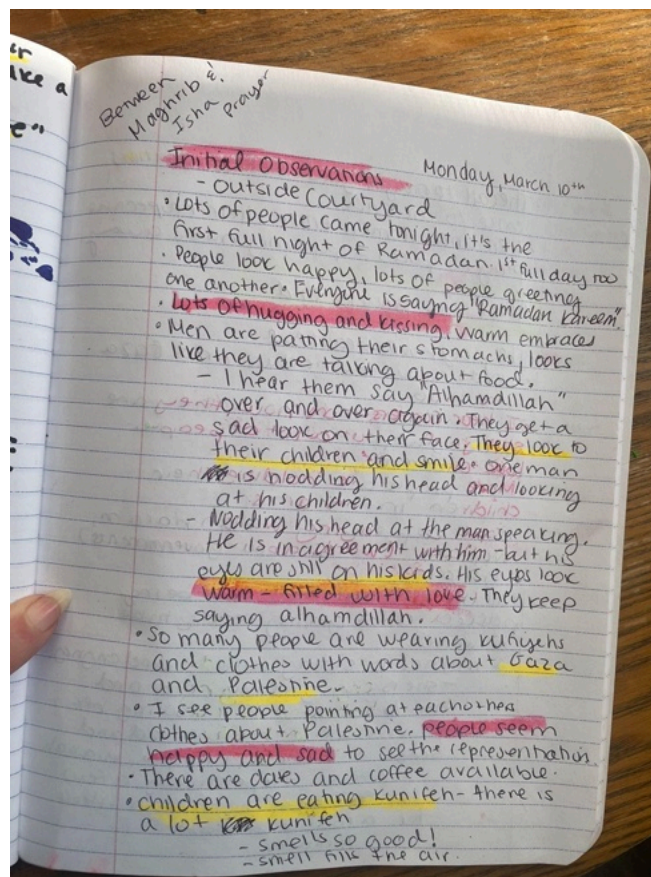
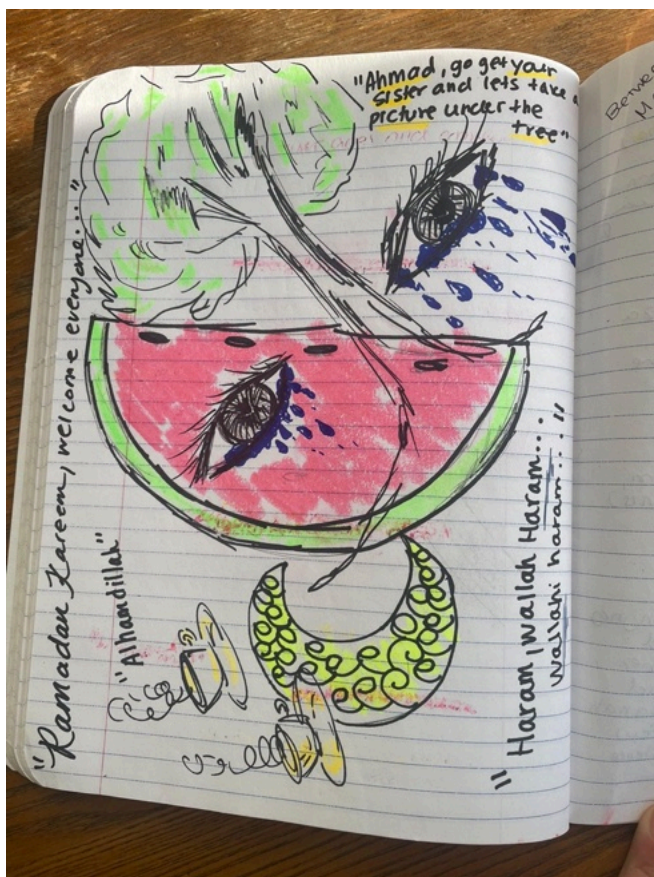
The long-term impacts of occupation's repressive actions have spanned decades in Gaza and the West Bank, culminating in the present day crisis discussed within the news piece titled, *UN report reveals 212 Gaza schools 'directly hit' by Israel since Oct.7*, which states, "UNICEF report says 165 of the 212 schools that received a "direct hit" are in areas where Israeli military expelled and forced Palestinians to flee their homes", noting students have not studied in school for the last six months ([TRT World, 2024](#)). During the interview, one participant noted, "Right now in Gaza, tens of tens of thousands of students are without any kind of education, because their schools and their universities are totally destroyed" (Interviewed Member of Palestinian Collective, 2024) - but then went on to explain how the collective created an online tool where 2,000 students from Gaza are now able enroll and watch recorded courses, whenever they get access to the internet - expressing that despite this not being a sustainable intervention in the long term, it is better than not having access to any education in the present.

Hearing these stories and reading news can often feel defeating. As an advocate, I find myself asking, what can I do? How can I help? - but it is in turning to the community in need and letting their voices guide me that solutions presented themselves, directly by and from the people I am looking to advocate for. In my mind, and perhaps others do this as well - I created the role of being an advocate and helping make change something monumental and difficult to attain. Yet, sustainable change comes from engaging with the community, building dialogue ([Friere's, 2005](#)) and cementing the solidarity so that its goals, intentions, movement cannot be shaken. The collective gave such example of this in the story below:

"You know, I think... I think human interaction is a kind of education. And for people like us, like Palestinians, Palestinian people. We know we just have schools, and I know that when people get to know more about the situation in Palestine. There will be moving only one way, which is pro-Palestinian. Because I remember one of the projects we were doing with the Palestinian and European universities. Scholars from England, actually, for the first time, they came to Palestine, and I remember when they saw the checkpoints and the siege of the Palestinians, and how they've been treated by the Israelis. They were getting really mad about the situation. And I know that those people until now they think one of their mission in the world after this finding is to enlighten their people about what is going on in Palestine... So you are educating people not necessarily to tell them what to say or what to see, actually just show them the reality. And I think Palestinians are always one of their best strength is to show the reality, because we don't hide anything exactly. It's it's the opposite. We've haven't been visible enough and it's not by choice. We are educating more people about the the situation here, and then the more this happens, the better life is. And, actually, it's not only a Palestinian issue, I mean, stereotype or stereotypical ideas are happening everywhere, and the more you learn about the other people, the less stereotypical person you would be."

-Interviewed Member of Palestinian Collective

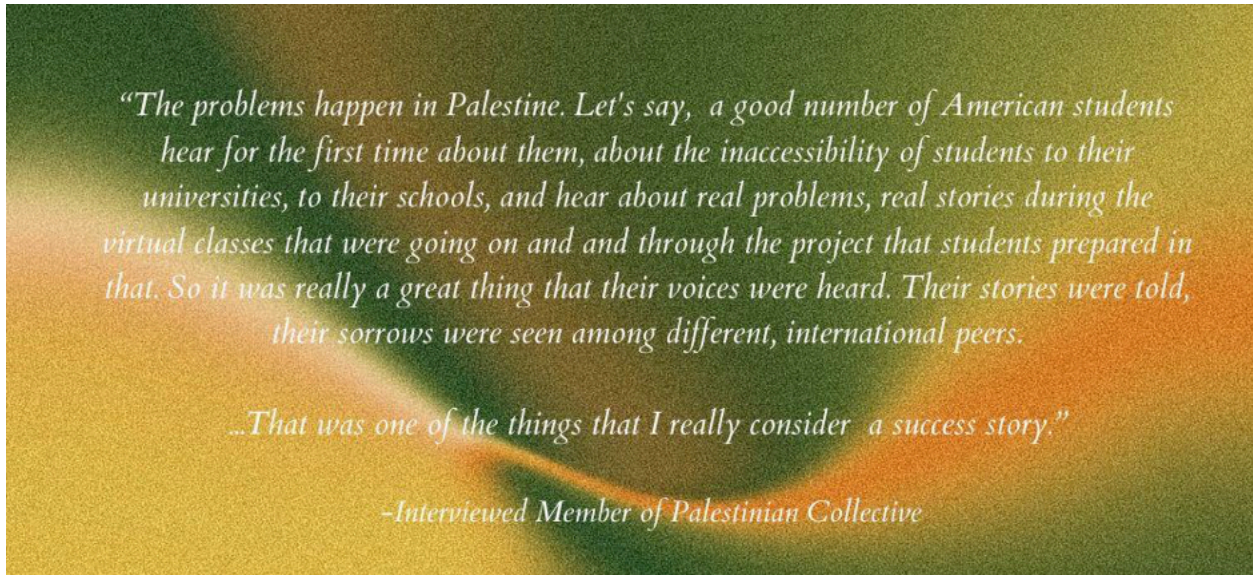
Using the Palestinian collective's methodology of creativity and art is also something to consider when developing one's framework of advocacy, knowledge gaining and solidarity building. Throughout the research process, I attended a prayer at my local mosque during Ramadan and during the ongoing aggressions against Gaza. Instead of coming right before the prayers and leaving right after, I came earlier and stayed a bit later observing the exchange of the community - many of whom were showing solidarity for Palestinians - whether in food, clothes, or words. In the spirit of the collective's artistic methodologies, I wrote down observations and my feelings. I drew images and colored - allowing my own sense of emotions for the moment and empathy for this community to wash over me. In my process of deep observations and reflection, I found grounding in my own solidarity with Palestinians and strength in my own resolve to continue advocating for their right of sustainable education and self-determination. The practices of the collective, although local to them, impacted me from afar - creating another example of capabilities to foster local to global solidarity building.



Coupled together, education and self-determination communicate to the immediate local, and then larger global community that a nation has developed resilient systems that will support its future generations, namely the youth population. This paper and through extension, the interviews with the Palestinian educational advocates and activists centers these beliefs through first hand lived experiences. Their stories emphasize the importance of advocating for all people's justice. Advocacy and accountability work in

tandem with one another, and this paper takes the position that through the continued access to quality and equitable education, frameworks of self-determination and sustainable development - just communities in Palestine may thrive. And as such, in order to uphold these educational value systems, we are invited to both: acknowledge the interdisciplinary systems of oppression that impede Palestinian youth's right to education, while also turning towards Palestinian educational advocates to guide us towards solutions that will best serve their youth and their future communities.

By investing in Palestinian's youth right of self-determination, we are directly investing in their right to learn, free of violence and oppression.



Concluding Summary and Next Steps

From the beginning to end of this research paper, I sought to better understand the lives of Palestinian educators, advocates and organizations and the ways they engage with their youth community. In doing so, I hoped to reveal stories and experiences from a collective who has worked with numerous students for years under an occupation, navigating the limitation of resources and turning them into opportunities for innovation. While the Palestinian values of resiliency and innovation are to be applauded, it is important to emphasize that this innovation was born out of a steadfast commitment to resisting oppression. This determination to claim agency and ensure a space for them is not lost, while steadfast in practice - is not sustainable forever. Sustainability does not simply imply prolonged existence, meaning the quantity of years in existence... but also considers the quality of that existence. Education, like all resources for Palestinian youth, should not simply exist. It should be made sustainable to provide them tools to enrich the lives of their community, and therefore themselves.

On my end, further work on this topic would entail continuing to collaborate with the collective by supporting their projects and work and by stepping further into my own role as an educational advocate. One of the interventions the collective shared was connecting with a global audience to tell their stories, so in

return the global community could help advocate for their youth's right to self-determination. With the ongoing violence in Gaza and the West Bank, the whole system of education, both in practice and in infrastructure is becoming increasingly destroyed without any clear end in sight. In consideration of this, it is my opinion that those within the global educational community and those who are global, sustainable educational advocates must come together and support various Palestinian educational collectives. By learning from them, providing them the platform to share their stories, and helping them push for their liberation, we become active participants in the establishment of sustainable education that can be adapted for other communities, including our own. To help in strengthening my advocacy I also plan compiling a glossary of terms and ideologies related to the Palestinian resistance to occupation, the vocabulary used to convey their educational needs and culturally specific words such as *sumud* that are best understood when used in the context of their own language. This interactive glossary will also be a tool for future educational advocates to situate the definitions more clearly within the context of the Palestinian experience and perhaps even motivate them to start their own form of advocacy. However, for the purposes of this paper, the definitions noted at the beginning of this paper, served as a starting point to acquaint any readers with phrases that may be new to them.

Sustainable educational frameworks take into consideration, in my opinion, not only the ability to access education but to be able and feel connected to it, to experience joy within it, and to feel safe experiencing it. These tenants of education are just as valuable as having access to a curriculum itself. What I have found out is the methodologies of drama, storytelling, and connecting with society both locally and globally have brought forth so many beautiful projects and accomplishments for the Palestinian youth. The collective's driving point in creating these projects and utilizing these methodologies was greatly driven by the goal of ensuring children in Palestine had - both an outlet to express their lives within occupation, but to also make themselves strong members in their community and lives.

I would, however, like to pose the closing thought of - what amazing creations could and would the Palestinian collective be able to make with their students if sustainable frameworks of education were the foundation of what they were working off of - not occupation, not apartheid, and not other systems of injustice? What could the future for Palestinian youth look like then?

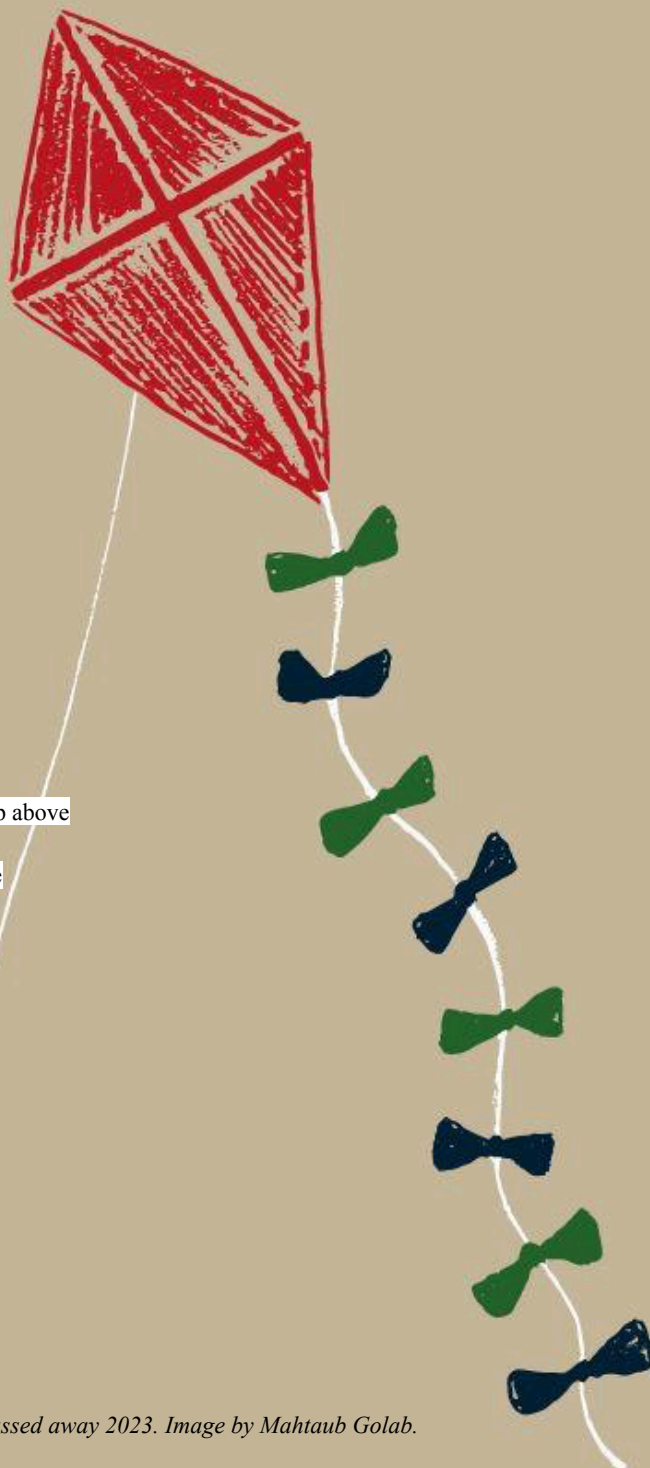
Dedication

This research is dedicated to the lives of all Palestinian children. May they wake up soon to a world where they can live and learn, with joy and in safety. I would like to end this paper with a final dedication to the Palestinian poet, Refaat, who was killed on December 6, 2023 by the occupying military. He was a teacher, a writer, a poet, and he always urged his students to write their own poems... to tell their own stories. Here is one of the last poems he shared with us all.

“IF I MUST DIE”

BY REFAAT ALAREER⁴

If I must die,
 you must live
 to tell my story
 to sell my things
 to buy a piece of cloth
 and some strings,
 (make it white with a long tail)
 so that a child, somewhere in Gaza
 while looking heaven in the eye
 awaiting his dad who left in a blaze—
 and bid no one farewell
 not even to his flesh
 not even to himself—
 sees the kite, my kite you made, flying up above
 and thinks for a moment an angel is there
 bringing back love
 If I must die
 let it bring hope
 let it be a tale.



⁴ Poem by Refaat Alareer; born 1979 - passed away 2023. Image by Mahtaub Golab.

Bibliography

Abo Hommos, N. (2013, October). PA Collapse and its Effect on Education .

<https://www.pcpsr.org/sites/default/files/Education.pdf>

Al-Mashharawy. AlJazeera. (2022). Gaza left in the dark - palestineremix. Gaza left in the dark - Palestine Remix. <https://remix.aljazeera.com/aje/PalestineRemix/gaza-left-in-the-dark.html#!/5/>

Albanese, F. (2024, March 25). Anatomy of a Genocide Report of the Special Rapporteur on the situation of human rights in the Palestinian territories occupied since 1967, Francesca Albanese.

<https://www.ohchr.org/sites/default/files/documents/hrbodies/hrcouncil/sessions-regular/session55/advance-versions/a-hrc-55-73-auv.pdf>

Alhelou, Y. (2019, October 31). Sumud: Palestinians' form of steadfastness continues to grow stronger. The New Arab.

<https://www.newarab.com/analysis/sumud-palestinians-form-steadfastness-continues-grow-stronger>

Asaad, Denise. Studies in Philosophy and Education; Dordrecht Vol. 19, Iss. 5-6, (Nov 2000): 387-403. DOI:10.1023/A:1005263010833.

<https://www.proquest.com/docview/821706872?sourcetype=Scholarly%20Journals>

Amnesty International. (2022, February 1). Israel's apartheid against Palestinians.

<https://www.amnesty.org/en/latest/campaigns/2022/02/israels-system-of-apartheid/>

Amnesty International. (2013, June 18). Where are all the students from Gaza?. Amnesty International USA.

<https://www.amnestyusa.org/updates/where-are-all-the-students-from-gaza/>

Amnesty International . (2009, October 27). Israel/Occupied Palestinian Territories: Demand Dignity: Troubled Waters - Palestinians denied fair access to water. Amnesty International.

<https://www.amnesty.org/en/documents/mde15/027/2009/en/#:~:text=The%20water%20shortage%20has%20hindered,health%2C%20work%20and%20adequate%20housing.>

Amnesty International. (2017, August 29). The Occupation of Water. Amnesty International.

<https://www.amnesty.org/en/latest/campaigns/2017/11/the-occupation-of-water/#:~:text=The%20legacy%20of%20Israel's%2050,of%20clean%20and%20safe%20water.>

ANTOON, S. (2023, December). "if I must die," a poem by Refaat Alareer. In These Times.

<https://inthesetimes.com/article/refaat-alareer-israeli-occupation-palestine>

B'tselem Education. (2022). Israeli soldiers and border police officers enter school in Hebron and attack students and teachers. B'tselem - The Israeli Information Center for Human Rights in the Occupied Territories.

https://www.btselem.org/video/20221114_soldiers_and_border_police_officers_enter_school_in_hebron_and_attack_students_and_teachers

B'tselem Education. (2022a). Israeli military closes off West Bank village for 50 ... - B'tselem. B'tselem - The Israeli Information Center for Human Rights in the Occupied Territories. https://www.btselem.org/video/20220222_military_closes_off_wb_village_for_50_days_arrests_students_at_school_and_harasses_residents

B'tselem Education. (2018). Israeli soldiers harassing Palestinian students at entrance to Al-ʿArrub campus for past 6 months. B'tselem - The Israeli Information Center for Human Rights in the Occupied Territories. https://www.btselem.org/routine_founded_on_violence/20180605_soldiers_harassing_students_at_al-arrub_campus

Cornell Law School. (2022). Apartheid. Legal Information Institute. <https://www.law.cornell.edu/wex/apartheid#:~:text=Apartheid%20refers%20to%20the%20implementation,o%20the%20International%20Criminal%20Court>.

Cornell Law School. (2020). Occupation. Legal Information Institute. <https://www.law.cornell.edu/wex/occupation#:~:text=An%20occupation%20is%20the%20work,on%20a%20piece%20of%20property>.

Dana, K. (2017). The West Bank Apartheid/Separation Wall: Space, Punishment and the Disruption of Social Continuity. *Geopolitics*, 22(4), 887–910. <https://doi.org/10.1080/14650045.2016.1275576>

Delegates to the First National People of Color Environmental Leadership. (1991). The Principles of Environmental Justice (EJ). Principles. <https://www.ejnet.org/ej/principles.pdf>

Ellis, D. (2019). Apartheid. *Israel Studies* 24(2), 63-71. <https://doi.org/10.2979/israelstudies.24.2.06>.

Fakih, L., & Shakir, O. (2023, December 5). Does Israel's treatment of Palestinians rise to the level of apartheid? Human Rights Watch. <https://www.hrw.org/news/2023/12/05/does-israels-treatment-palestinians-rise-level-apartheid>

Fanon, F. (1963). *The Wretched of the Earth*. Graton Courses. <https://grattoncourses.wordpress.com/wp-content/uploads/2019/12/frantz-fanon-richard-philcox-jean-paul-sartre-homi-k.-bhabha-the-wretched-of-the-earth-grove-press-2011.pdf>

Freire, P. (2005). *Pedagogy of the Oppressed*. University of California, Santa Cruz. <https://envs.ucsc.edu/internships/internship-readings/freire-pedagogy-of-the-oppressed.pdf>

George, T. (2023, June 22). Types of interviews in research: Guide & Examples. Scribbr. <https://www.scribbr.com/methodology/interviews-research/>

Gomes, A. Paulo Freire: Review of “The Pedagogy of the Oppressed”. *Harm Reduct J* 19, 21 (2022). <https://doi.org/10.1186/s12954-022-00605-9>

Habashi, J. (2005). Creating Indigenous Discourse: History, Power, and Imperialism in Academia, Palestinian Case. *Qualitative Inquiry*, 11(5), 771-788. <https://doi.org/10.1177/1077800405276809>

Horkheimer, M. (1972). Traditional and critical theory.

https://criticaltheoryworkshop.com/wp-content/uploads/2018/03/horkheimer_traditional-and-critical-theory.pdf

Irfan, A. (2023, August 3). Why Palestinians are known as the world's "Best educated refugees"anne Irfan - Columbia University Press Blog. Columbia University Press Blog - Publishing a universe of knowledge for readers worldwide.

<https://cupblog.org/2023/08/23/why-palestinians-are-known-as-the-worlds-best-educated-refugeesanne-irfan/>

Ives, M. C., Hickford, A. J., Adshead, D., Thacker, S., Hall, J. W., Nicholls, R. J., Sway, T., Abu Ayyash, M., Jones, R., & O'Reagan, N. (2019, January 9). A systems-based assessment of Palestine's current and future infrastructure requirements. *Journal of Environmental Management*.

<https://www.sciencedirect.com/science/article/pii/S0301479718314804>

Shakir, O. (2023, March 28). A threshold crossed. Human Rights Watch.

<https://www.hrw.org/report/2021/04/27/threshold-crossed/israeli-authorities-and-crimes-apartheid-and-persecution>

Moisio, OP. (2013). Critical Theory. In: Runehov, A.L.C., Oviedo, L. (eds) *Encyclopedia of Sciences and Religions*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-8265-8_1642

Oxford Public International Law. (2009). Siege.

<https://opil.ouplaw.com/display/10.1093/law:epil/9780199231690/law-9780199231690-e407>

Ramahi, H. (2015, November). Current challenges and emancipatory alternatives. Rosa Luxemburg Stiftung Regional Office Palestine.

<https://www.rosalux.ps/wp-content/uploads/2015/11/EDUCATION-IN-PALESTINE-CURRENT-CHALLENGES-AND-EMANCIPATORY-ALTERNATIVES.pdf>

Said, E. (1993). *Culture and Imperialism*. Monoskop.

https://monoskop.org/images/f/f9/Said_Edward_Culture_and_Imperialism.pdf

San Jose State University . (2021). Methodology section for research papers.

<https://www.sjsu.edu/writingcenter/docs/handouts/Methodology.pdf>

Stanford Encyclopedia of Philosophy. (2023, December 12). Critical theory (frankfurt school).

<https://plato.stanford.edu/entries/critical-theory/>

The General Union of Palestinian Teachers (GUPT). (2023, October 12). Transforming Unions through digital capacity and female educators leadership. Educational International .

<https://www.ei-ie.org/en/item/28091:palestine-empowering-women-teachers#:~:text=The%20per>

Weidinger, R. (2020, November 19). Polyvocal narrative turns many voices into power. Narrative Initiative.

<https://narrativeinitiative.org/blog/polyvocal-narrative-strategy-turning-many-voices-into-durable-change/#:~:text=Polyvocality%20is%20the%20power%20of,voice%2C%20from%20the%20Latin%20vox.>

UN. (1948). Universal declaration of human rights. United Nations.
<https://www.un.org/en/about-us/universal-declaration-of-human-rights#:~:text=Article%2026,on%20the%20basis%20of%20merit>.

United Nations Conference on Trade and Development. (2023, November). Developments in the economy of the Occupied Palestinian Territory. https://unctad.org/system/files/official-document/tdbex74d2_en.pdf

United Nations. (2015). Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Goals 4. https://sdgs.un.org/goals/goal4#targets_and_indicators

UNOCHA. (2024, April 12). Occupied palestinian territory. Front page.
<https://www.unocha.org/occupied-palestinian-territory>



Thank You For Joining Us & Reading Our MESH Research and Writings!

Sincerely,

-The 1st MESH COHORT