Environmental Justice Assessments

1. Background

1.1. Environmental Justice

The study of environmental justice is derived from the broader field of social justice. Social justice aims to examine differences in communities of people based on intrinsic community characteristics such as race, economic status, gender, and the myriad of other social characteristics, which lead to some communities being disadvantaged and others gaining advantages. In environmental justice the focus of these advantages and disadvantages is on environmental factors which range from urban systems, community planning and natural spaces.

The United States EPA defines environmental justice as follows (2021):

> *Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys:*
> - *The same degree of protection from environmental and health hazards, and*
> - *Equal access to the decision-making process to have a healthy environment in which to live, learn, and work.*

Furthermore, just institutions can be defined as ones that will ensure the following (Johnson, 2021):

- *That people can participate in the institution and have the ability to influence decisions where environmental policies or interventions affect them.*
- *That people have access to the resources they need for life.*
- *That there is an equitable distribution of environmental goods and bads.*
- *That there is a recognition of local culture and norms.*

These are good ideals to strive for, but which nonetheless tend to be problematic to apply in the real world. One of the biggest issues is “sacrifice zones”, which are geographical areas (neighborhoods, communities, regions, or countries) in which environmental bads are concentrated (Shepard, 2012). These concentrations are not due to random chance, but purposeful decisions from institutions saying that the people living in those places can and should be sacrificed for the “greater good”. Finally, climate change is exacerbating these issues between the advantaged and the disadvantaged communities.

1.2. Terminology

To begin examining the differences in communities either quantitatively or qualitatively some standard terminology is useful. Due to the variety of environmental justice applications and the many interested parties there is no single agreed upon definition of many of these terms. Different researchers tend to apply the terms to their work and will mold the definitions to fit their specific topic. In dissecting this body of work two sets of terms are found to be particularly useful: risk and vulnerability, and mitigation and adaptation. In the broadest sense both risk and vulnerability refer to the potential for loss or

damage (Cutter, 1996). Mitigation and adaptation both refer to addressing and reducing losses or damages and are generally used in reference to climate change.

1.2.1.Risk and Vulnerability

Risk is the collection of environmental conditions that threaten morbidity, mortality, loss of livelihood or other detrimental condition on people in a certain location. This includes both an understanding of environmental hazards and their frequency of occurrence. The hazards fall into two categories, either a natural hazard due to processes inherent to Earth, or a human-made hazard due to processes enabled by people (Table 1). Human-made hazards can be further broken down into mechanical hazards, which are ones directly related to tools people use, and societal hazards, which are ones directly related to the function of society.

	Low Frequency	**Medium Frequency**	**High Frequency**
Natural Hazard	>7.0 Earthquake	Extreme Temperatures	Heavy Rain
Human-Made Mechanical Hazard	Nuclear Plant Meltdown	Contaminated Drinking Water	Air Pollution
Human-Made Societal Hazard	War	Government Systems	Racism

Table 1: Examples of natural and human-made hazards at different frequencies

Vulnerability is the collection of individual characteristics about a person or community of people that determines how they can respond to a risk. This is generally covered by demographics and economic status, but can include other characteristics such as age, mental and physical health and language spoken.

An important note for both risk and vulnerability is that they have spatial and temporal dimensions. So, when conducting any research on either, the location and the timeframe are essential.

1.2.2.Adaptation and Mitigation

Adaptation and mitigation describe actions that societies can take to deal with problems. Adaptation refers to actions that address the effect of the problems (The Climate Reality Project, 2019). For example, in climate change research an adaptation solution is build taller flood walls to reduce the likelihood that rising sea levels will threaten communities. Mitigation refers to actions that address a root cause of the problem. So in the example, a mitigation solution would be to plant more trees to absorb and store carbon dioxide which in turn would lessen the greenhouse effect which is warming the oceans causing sea level to rise.

Both types of solutions are important when considering environmental justice. Actions can be taken both to address the effects people are feeling from environmental bads in their communities and to address the changing climate as a whole. What is important to consider is that some communities will require more actions to be taken than others due to their historical disadvantages. What solutions are chosen should also be with regard to the voices of the community.

2. Motivation
    2.1. Why is this important for our community?

As known by the University of Illinois, Champaign-Urbana community is now becoming an ideal place to live and work. Being not just about academics, Champaign-Urbana community also puts its aim on future sustainability.

It is easy to say that sustainability is one of the most important issues in the community. As we all know, Champaign-Urbana community is now owning a quick pace of development, so that our prime goal is to keep the development pace, then

making sure the pace could be long ensured.

It is needed for us to guarantee the community having a bright future, so that we need to develop new sources to catch the pace of the world. As the trending of the world is environment-protection, the council process should be first changed. Compared to the old council and government working process, steps into an environmental-favor lifestyle are strongly recommended. For instance, paperless and internet-based services provided to people living in the community should be published as early as we can. This will not only be time-saving for residents and also beneficial to prevent off style steps.

It is also urgent to publish rules to enforce environmental protection guidance. As people are educated to protect the environment, it is sad to see the lack of environment-protection guidance. Based on the survey of people living in the United States, there are a large group of people who don't know what to do in their basic lives to protect the environment. It is needed for the council to talk with residents and let them know the importance of sustainability. It is not just the council, but also the stuff that most people believe.

As the community is working with University of Illinois, cooperating between school departments with the community council is needed. It is wise to hear from academic ways, and also the cooperation can show a good sign of sustainability recognition. We all know that the academic side of the community is a benefit compared to other communities, so that the development of the academic community needs a strong sign of sustainability. In other words, a sustainability environment is able to support strong academic developments

Making residents feel safe and being protected, could be one of the most important factors of sustainability. If residents cannot feel safe, the future of the community will be harsh. By cooperating with the college/school police department, students will be well protected. Also, it is required for the council and the police department to provide a better training service to officers. A safe and well-protected living environment will be beneficial for residents to make their living choices.

For residents, another important issue for their home choice is living expenses. A good sign of sustainability is the reduction of living expenses and also better life standard. It is not ideal to quickly build large equipment to fully change the way residents live, but the community council can think about other ways of sustainability. Replacing outdated equipment can be the most effective way for the community. It is wise to stand in the shoes of people who are living in the past, due to the reason that they are more experienced. However, by the development of the society, more efficient and less fuel consuming machines are made. By replacing old equipment, the less fuel and expenses will be made, and also residents will save a large amount of life expansion bills.

The other reason why sustainability is important, is the role people stand in the community. It is required for the community council to hear from residents, and also cope with issue listed by the residents. Sustainability also means the good contact between the council and people. If the relationship becomes healthy, the council work will be efficient and convenient. As the development of the community, the council should also clarify its role in the community. By pointing out the community's problem and then try to find the most efficient way to solve it, the council then will perform its ultimate use.

There are some risks about the sustainability of our community. Which way should we go? For instance, questions like "Should we build more factories to get more economic interest, even though it may harm our environment" emerges. It is true that building industries like factories will bring a large benefit for a community's economy. However, just pursuing economic benefits but ignoring environmental issues will be hard for the community's future. In other words, for sustainability. An economic development of the community is the most responsible solution for today's situation. However, we cannot say that we would stop building all polluted-based industries. Instead, we will try to find ways to find a balance-to find a way to balance the environment and also the economic development.

For the living standard, it is urgent for the community to provide a better one. The part of living standard of the community should include various parts. For example, the entertaining services provided to the people who live in the community. A better standard of sustainability is not just about living, but also should include ways of entertainment for residents to find the lifestyle they want. By building sustainability of the community, the council should find more ways to expand the entertaining services. This will be the way we get new residents and also a good way to keep our current people. By building proper entertaining services, people will then build groups that have identical interests. This is a good way to make people satisfied with the community and then having a better standard of life.

For the future of sustainability, we should work with the country. It will be good for the council to talk with the state to get the more immediate way of the country development. It is not easy to find a balance of sustainability, but a good cooperation with people, state, and the country will be good for community managers to select a better option, for the community to have a bright future.

3. Literature Review

3.1. With research about environmental justice assessments
3.2. Research about other tools that map environmental justice

Need a definition of "method"

In our literature review of how other organizations addressed the spatial variation in environmental risk and vulnerability, we came across several methods which we will layout in this section. It was interesting for us to note the diverse methods and the apparent lack of documentation clearly and quantitatively defining the calculations. It appears to be a call on the parts of the creators on how to best tailor their method, potentially to focus on the community.

Our research has found ## (two?) categories of methods: simple indicators and weighted indicators. The difference mainly comes into play in the final step of the method, where the data is combined into the final score.

3.2.1. Simple indicators

3.2.1.1. EJSCREEN (CITATION)

The EJSCREEN is a tool to developed by the … for … the goal of the tool is to calculate an EJ Index which describes the …

The EJSCREEN uses 11 environmental indicators which quantify the potential environmental risk as a percentile score .

The EJSCREEN uses 6 demographic indicators which quantify social vulnerability as a percentile score and calculates a demographic index as the average of two of the indicators: low-income and minority.

- Low income
- Minority
- Less than high school education
- Linguistic isolation
- Individuals under age 5
- Individuals over age 64

The EJ (environmental justice) index is created by the simple multiplication of three items: (1) a chosen an environmental indicator (1 out of 11), (2) the demographic index, and (3) the population count.

3.2.1.2.

3.2.2.Weighted Indicators

The following is a summary of what I understand for the methodologies for both of these tools:

- CalEnviroScreen:
    - Four indicators are created based on percentile data collected from census tract data: (1) exposure indicators, (2) environmental effects indicators, (3) sensitive population indicators and (4) socioeconomic factor indicators.
    - These four indicators are then combined into two components: (1) pollution burden (from (1) exposure indicators and (2) environmental effects indicators) and (2) population characteristics (from (3) sensitive population indicators and (4) socioeconomic factor indicators).
    - to combine, by summation, the indicators for pollution burden, the environmental effects indicator was weighted at 0.5 the value of the exposure indicator because the CalEnviroScreen creators considered the environmental effects indicator to make a smaller contribution to the pollution burden than the exposure indicator.
    - to combine, by summation, the indicators for population characteristics, each of the indicators was weighted equally.
    - The scaled component scores are then simply multiplied together to create a final CalEnviroScreen Score.
- ILSFA
    - Three variables are created (1) exposures, (2) environmental and (3) socioeconomic. Each of these are a simple averages of each of their component variables.
    - The exposure variable and the environmental variable are added together. In this some the exposures variable is weighted by 0.67 and the environmental variable is weighted by 0.33.
    - The ILSFA score is created by simply multiplying the sum exposure variable an the environmental variable by the socioeconomic variable.

3.2.3.Indicators

4. Data

In order to develop a quantitative analysis of environmental justice a lot of good quality data is required. One of the qualities that makes data good in this research is it's spatial scale, in this case the smaller the scale, the better. This is important because at any spatial scale larger than an individual or a residence, whether it be a zip code, census tract or city block, is an average of multiple people who may or may not have different characteristics. When they are averaged together, their specific needs can be lost to the average. So, in considering an environmental justice plan at the city level the spatial scale of the data needs to be at a level where individual differences in communities can be identified so they can be addressed.

The biggest issue with developing a dataset for this research is determining what data fits in the scope. There are many data points that may be useful to gather for this kind of research, but is it really feasible to gather them all? Either the set will become too large to be manageable or data points will be required that have not yet been collected. This can be because researchers are still developing analyses of individual and environmental characteristics that have an effect on environmental justice.

The datasets listed here are definitely non-inclusive of the data that is available in this community. And not all of these datasets were thoroughly examined to create the final maps. These additional datasets could be included in future work in this area.

4.1. Asset Limited, Income Constrained, Employed (ALICE) Report

This data set is developed by United Way which is a non-profit organization which "fight[s] for the health, education and financial stability of every person in every community" (United Way, n.d.). The ALICE dataset determines the threshold bare minimum income a single individual or a family of four needs to cover six basic needs: housing, child care, food, transportation, health care, and a basic smartphone plan (United Way, 2020).

Household Survival Budget, Champaign County		
	SINGLE ADULT	2 ADULTS, 1 INFANT, 1 PRESCHOOLER
Monthly Costs		
Housing	$544	$829
Child Care	$–	$1,263
Food	$174	$526
Transportation	$340	$679
Health Care	$162	$689
Technology	$55	$75
Miscellaneous	$150	$458
Taxes	$227	$515
Monthly Total	$1,652	$5,034
ANNUAL TOTAL	$19,824	$60,408
Hourly Wage	*$9.91*	*$30.20*

Figure 1: Calculation of the ALICE budget for Champaign County (United Way of Champaign County, 2021)

The dataset then calculates the number of households are below the ALICE threshold.

- Spatial Scale: Zip Code
- Most Recent Time Available: 2018

4.2. CDC/ATSDR Social Vulnerability Index

This dataset is developed by the Center for Disease Control (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR). The goal is to quantify the "negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters, or disease outbreaks" (Agency for Toxic Substances and Disease Registry, 2021). The social vulnerability index is a score calculated from 15 different social factors as reported from the census. The index is also broken into four themes: socioeconomic status, household composition/disability, race/ethnicity/language and housing/transportation.

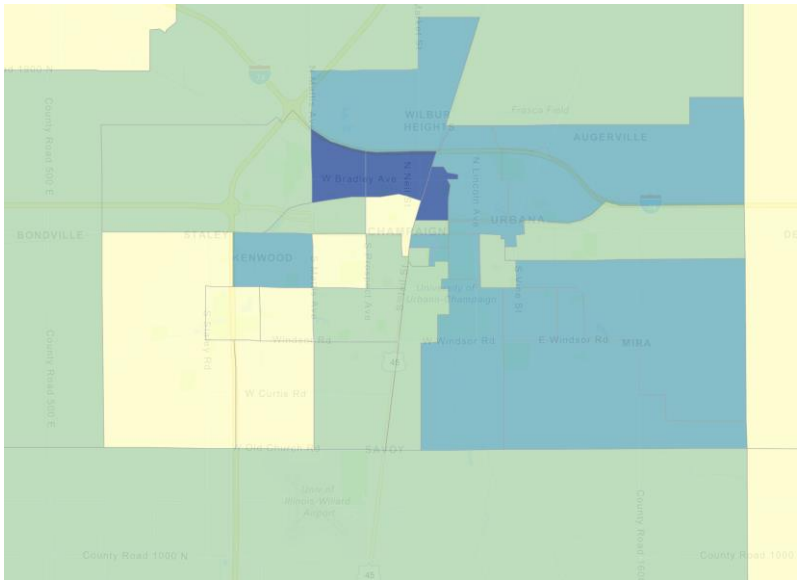

Figure 2: Social Vulnerability Index mapped at the census tract level for the cities of Champaign, Urbana and Savoy

Figure 3: Data legend for map in Figure 2

- Spatial Scale: Census Tract
- Most Recent Time Available: 2018

4.3. Champaign GIS

4.4. City of Champaign Trees

4.5. Satellite Data

5. Single issue Maps
   - 5.1. Water quality
   - 5.2. Extreme heat
   - 5.3. Daniel
   - 5.4. Jason
6. Combination total environmental justice Maps
   - 6.1. our indicators

Commented [1]: Daniel

6.2. our final score combination methodology
6.3. our Maps
7. Direction for Future Work

Due to the importance of this work, great care should be taken to develop accurate environmental justice assessments. Therefore, this research should be continued and expanded upon in several ways:

1. Data Gathering
   i. Additional Data Sets
   Many more data sets can and should be collected to get a clearer picture on the risks and vulnerabilities in the communities.

   ii. Spatial scale
   The spatial scale for data sets should be minimized to the extent possible to focus on particular communities.

   iii. Time scale
   Changes in data sets over time should be noted so that the effect of any actions taken can be tracked.

2. Final Score Methodology

   Additional work should be done to understand methodologies others in this area of research have used to develop final score calculations.

3. Qualitative Information

   Qualitative information should be collected so that the voices of the community can be heard and their needs and wants specifically addressed.

At the end of the day, this work should bring together the diverse risks and vulnerabilities of our community in order to develop a plan for mitigation and adaptation solutions to be put in place.

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