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Socioeconomic Vulnerability: Qualitative Findings from Climate Change Data in California

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Abstract

Climate Change has existed as an important focus in the science community for decades, however relevant literature often focuses on environmental viewpoints more so than those of a socioeconomic perspective. In 2023, an increase in severe weather and unexpected weather events across the United States shed light onto the shortcomings of our preparedness and mitigation techniques. Particularly in California, flooding, sea level rise, and drought conditions have led to high rates of population displacement, economic inequality, and health/safety risks. These events pose the questions as to how climate change and its related natural disasters can potentially affect the average California resident in terms of housing displacement, economic loss, and personal health safety concerns, how the income level of particular areas affects their overall vulnerability to climate change, and what possible sociological mitigation techniques could apply to California based on regional climate effects. Using a qualitative approach, this research reviewed secondary data through scholarly peer-reviewed sources. These articles were derived from online databases such as Sage Journals, JSTOR, and ScienceDirect, in addition to government published information from the U.S. Census Bureau, Federal Emergency Management Agency, Environmental Protection Agency, and the U.S. Department of Agriculture. Upon synthesizing the sources, the results found highlight several common themes that suggest low income families in California are far more likely to face health and safety risks as a result of drought, flooding, and other natural disasters. Additionally, the economic support systems, both government relief and personal insurance, are more likely to adequately cover damages and rebuilding for higher income families. With

these findings, there are several aspects of disaster mitigation that need attention in California, such as reformed drainage systems and transportation in urban areas, and better access to healthcare and support for rural communities. These notions of change are more important now than ever with the increase in severe weather in California, and the implications of this study aim to support regional initiatives and provide leeway for viable support systems to be established in preparation for these events.

Introduction

Climate change has been a topic of debate for several decades on platforms relating to politics, macroeconomics, and history. As such debates persist into the present day, they are typically centered around the environmental toll of related disasters and scenarios, rather than the individualized impacts that occur on a social level. In recent years, the politicization of climate change, along with an increase in severe and unexpected weather events across the United States has brought a much broader audience to the issue. Dating back to hurricane Katrina in 2008, not only did the immediate trauma of the hurricane devastate New Orleans, the social and economic toll was incredibly long lasting (Fussell, 2015). With the disaster relief and rebuilding efforts on display for the nation following hurricane Katrina, the lack thereof highlighted the overarching issues behind both the risks faced by different parts of the city, the inequality of assistance received, and the overall social toll it took on survivors (Fussell, 2015).

With the extensive economic and social damages seen during this period there is cause for concern, as scholars predict natural disasters and climate change related issues to only become more common (Fussell, 2017). These climate change related events experienced by coastal regions are not exclusive to hurricanes, however. Problems such as sea level rise, floods, and drought are much more commonly seen results of climate change in California (Befus, 2020;AghaKouchak, 2014). Over the next century, sea level rise and its subsequent flooding of ‘wetland territories’ is predicted to displace or cause damage to coastal infrastructure worldwide, with low elevation coastal

areas such as and around the San Francisco Bay Area being some of the most at risk (Befus, 2020). In addition to potential water table hazards, there is the common topic of drought from the other end of the climate spectrum. With the problem of drought in California, the scarcity of fresh water to support both the California residents, as well as California's massive agricultural industry will see impacts on the health and economic wellbeing of many families (AghaKouchak, 2014). Within the concept of scarcity of resources, this capstone will follow the framework of conflict theory due to its focus on income inequality and resource distribution.

Since movements and arguments established on an environmental basis usually attract polarized and biased opinions, this capstone aims to carry out an unbiased analysis of the social risks of climate change on regions throughout California. Furthermore, this research set out to answer the research questions as to what ways climate change related natural disasters affect the average California resident in terms of housing displacement, economic loss, and personal health safety concerns, as well as how the income level of particular areas affects their overall vulnerability to climate change. In addition, this research aims to answer the question as to what possible mitigation techniques could be applied to Northern California to support in a sociological capacity. Whether the effects of climate change in California are gradual occurrences like drought and sea level rise, or sudden disasters such as floods, researchers predict these tragedies and conditions to be only the beginning. Data for this research was collected through secondary peer reviewed research and databases in an effort to make a correlation between areas most exposed to climate disaster and the socioeconomic groups found in these areas. Using data from peer reviewed sources, as well as

government databases such as the Environmental Protection Agency, the U.S. Census Bureau, and the U.S. Department of Agriculture, this capstone aims to accept or reject the hypothesis that households of lower social and economic status, and urban areas will be among those who are more vulnerable, and more likely to suffer the worst effects of these disasters. Furthermore, I hypothesize that the impacts of climate change will have both gradual and spontaneous effects on California citizens depending on socioeconomic status.

Literature Review

Overview

Relevant studies on climate change have existed for quite some time, and oftentimes depict potential threat risks in relation to climate change effects and disasters. Overall, studies have shown an increase in climate change related events in this time, and with it has come diversified effects to countless people (Koubi, 2019). Using existing literature as it pertains to climate change, particularly in the United States, I identify the relevant social theory and themes that coincide with the socioeconomic side of climate change impacts. First, I will interpret and relate the findings of this study to conflict theory and review the relevance to climate change impacts. Then I will discuss the common themes associated with climate change effects, including environmental hazards, population displacement and resilience, and effects on health and wellbeing.

Theoretical Framework : Conflict Theory

While social theorist Georg Simmel studied the effects of conflict between members of society, Karl Marx (1848) studied the root causes that brought about conflict in the first place (Conyers, 2011). Conflict theory suggests that these societal conflicts arise due to the ingrained inequalities within our social structure, particularly in regards to the distribution of resources and power. In California, the impacts of climate change have the potential to exacerbate these inequalities, particularly for marginalized and low-income communities. Karl Marx's conflict theory also argues that there is a limited amount of resources within our society and members of society are in a constant state of 'conflict' over these said resources. Since conflict theory coincides with the competition over resources, the relationship can be seen between socioeconomic conflict and the scarcity of goods, lack of resources, and lack of services that results from gradual climate change trends, in addition to sudden changes as a result of natural disasters (Xu, 2016).

In California, some of the main impacts of climate change can be seen over a broad number of regions and industries with the increased frequency and severity of natural disasters such as floods and droughts. These disasters disproportionately affect low-income communities who often lack the resources and political power to effectively respond to and recover from these events (Brouwer et al., 2018). This can lead to a widening gap in social and economic inequality, as marginalized communities are left with fewer resources and opportunities to rebuild and recover. For example, climate

change impacts are expected to have significant impacts on the agricultural industry, which is a major industry in California. Rising temperatures and changing precipitation patterns are likely to reduce crop profits, which in turn can and will negatively affect the livelihoods of many farmers, particularly those who rely on small-scale and subsistence agriculture (Cannon & Muller, 2019);(Koubi, 2019);(Shenyue, 2020). In addition to conflict over resources, water shortages could result in conflict between stakeholders, residents, business owners, and conservationists (EPA,2017). This could lead to further economic disparities between those who can afford to adapt to these changes and those who cannot.

Overall with the concept of conflict theory, it is able to provide a useful framework for understanding the potential impacts of climate change in California. The historically unequal distribution of resources and power within the state means that marginalized communities are likely to suffer the worst impacts of climate change, thus resulting in a wider gap in social and economic inequality. Furthermore, conflicts over natural resources are likely to increase as a result of climate change, which could lead to further tensions between different groups. It is essential that policymakers and stakeholders take these factors into account when developing strategies to address the impacts of climate change in California.

Heightened Risk in Environmentally Hazardous Areas

Within the scope of climate change, it is important to look at both the causes and effects of certain scenarios. One of the more prominent findings is that of population distribution

and its relation to the severity of natural disasters. In the United States, many large urban populations and cities tend to live near coasts, or relatively near to large sources of water such as rivers and dams. In these areas, economic centers and human population are at a higher risk of climate related disasters like flooding (Gasper, 2010). While climates on the west coast of the United States do not typically see hurricanes to where flooding would be an unforeseen disaster, climate change still poses risk for sea level rise and excessive precipitation, which a large number of coastal cities would be impacted by (Shirzaei, 2018).

In terms of income and demographic, a large percentage of the 'young non-white' population was found in higher seismic hazard zones in California's San Francisco Bay Area, with these zones also containing a higher population density and concentrated urban developments (Wang, 2022). In the case of flooding throughout commercial and residential areas, low-income communities in flood risk areas tend to have less sufficient drainage and infrastructure to support the area in the event of a flood, in comparison to higher income communities (Rahimi, 2020). With businesses alike, large corporations of course will be able to cover their damages, but smaller and less profitable businesses will be faced with greater economic strain. With a study conducted on San Mateo County communities in California, existing financial strain and potential damage and rebuilding costs due to future coastal flooding puts over half of the local households at risk of bankruptcy or displacement (Bick, 2021).

Aside from the economic factors of the disaster-prone areas, immediate relief is also more hazardous in urban centers with a typically low income demographic. Statistics show safer evacuation statistics in higher income areas with a concentrated

population, compared to those of the latter (Shenyue, 2020). These include events such as fires, floods, and earthquakes. As well as the immediate effects following disastrous events such as floods or earthquakes, an additional factor is the upheaval and reconstruction of prevention systems in place, such as new waterway restriction and earthquake relief organizations (Moser, 2008). However, lower income communities are unable to reconstruct these types of systems as well as higher income communities, if even at all, which can often lead to worse outcomes in future disasters (Moser, 2008).

Support, Stability, and Resilience Following Disasters

One of the most common results of climate change disasters such as floods or fires is that of population displacement. In a 'post-disaster' setting, it is highly likely for communities to be displaced for an extended period of time, if not forever if the region becomes uninhabitable, or if the financial burden is too much to rebuild (Fussell, 2014). In the wake of hurricane Katrina for example, most households were displaced for a minimum of a month, while some were displaced for a recorded 9 months (Frey, 2007). In this case, the majority of these residents were black, with census data showing that ¾ of the black population was displaced and for a longer period of time, compared to ½ of the white population (Fussell, 2010) .

However, in California, the communities at risk can vary between high and low income, based on the economic foundations and structure of the area. In coastal areas, these same risks of flooding and erosion from gradual sea- level rise are predicted to pose a threat in the coming years (Revell, 2011). Due to the heightened potential

severity of disasters in these areas, a communities' ability to cope with the aftermath of a disaster varies among economic levels.

Lower income households are less likely to have home insurance or other subsidies that would fully or adequately cover losses and damages (Wang, 2022). A large factor in recuperation is assets, and studies show that assets play a significant role in recovery and reconstruction (Moser, 2015). Based on the resilience of economic groups, those at greater risk of loss only grow the inequalities between themselves and those of higher economic status (Markkanen, 2019).

Effects on Health and Wellbeing

Among the vast number of factors relating to climate change, one of the most important, and one of the most pressing is the issue of health risks. Climate change is predicted to be a leading cause of health concerns in the near future, and many of these risks will disproportionately affect lower income households and minorities. In a study conducted on the current health implications of climate policy in California, the rates of 'heat-related emergency room visits' in the San Joaquin Valley were between 17-28% per 100,000 people, compared to other areas that averaged 11% (Ganesh, 2018). In areas like these, with a particularly high population of lower income, often migrant agricultural workers, additional medical concerns are prevalent from things like fluctuating weather and respiratory hazards (Ganesh, 2018). While conditions related to heat are a concern, there are also the risks related to natural disasters that come as a product of climate change.

Typically, in regions of low economic background, already prevalent issues faced by the population become exacerbated in the event of a climate related disaster, such as food and water scarcity, loss of industry/jobs, displacement/homelessness, as well as any of other personal illness or health conditions (Gasper, 2010). The consequences of these climate change effects can be a serious factor in the inequality of disadvantaged people to access nearby healthcare (Lang, 2016). In particular in areas like California's San Francisco Bay Area, when it comes to climate change induced hazards, there are often issues with transportation networks, affecting those who rely on public transportation more. One example being the heatwave induced power outages earlier in 2022, which can include transportation and access to healthcare related services. In addition, studies have shown health services are located disproportionately between high and low-income areas, resulting in unequal access to healthcare, both generally and especially in times of disaster and overload (Lang, 2016).

As a result of climate change, these types of disasters are predicted to become more common and more severe (McMichael, 2006). In the event of a natural disaster such as earthquakes, floods, hurricanes, or severe drought, studies of migration have highlighted the fact that those who can't afford to move are forced to bear the hardships (Silva-Rodríguez, 2021). Thus, not only are the underprivileged communities put further into harm's way during the disaster, they are also faced with hardships after the fact as well with their lack of access to equitable healthcare. Studies show that the groups most vulnerable to climate change related illnesses are those from low socioeconomic backgrounds, with preexisting conditions or who are simply unable to afford care for injuries as a result of a disaster (Kreslake, 2016).

Summary

Climate change has increasingly become a cause for concern throughout the years as it has been presented with drastic socioeconomic effects including those related to environmental hazards, population displacement and variances in resilience, along with health and wellbeing. The literature review illustrates the tendency for low-income and minority communities to be at a heightened vulnerability for these impacts. In utilizing the concept of conflict theory, a relationship can clearly be seen between conflict and the climate change-induced scarcity as a result of a lack of resources available (Xu, 2016). Along with that, population distribution in coastal areas in the United States is an area of concern in which climate change poses a risk due to possible rises in sea levels and excessive precipitation.

It's important to note that while disaster-prone areas have the potential to impact its entire population, low-income communities are likely to experience more drastic effects due to the lack of sufficient resources and infrastructure, placing them at a heightened risk for displacement and hazardous relief compared to higher-income demographics (Moser, 2018). Variances in the extent of a community's ability to cope with the aftermath of a disaster are seen throughout economic levels, placing an emphasis on the significance of assets and resilience for recovery and reconstruction. Due to the inequalities regarding access and affordability of healthcare, lower-income communities and minority groups are also predicted to be disproportionately impacted by health-related risks as a result of climate trends (Lang, 2016). This further signifies the need for

a community-based approach to climate change, along with addressing the needs of vulnerable populations on a social level.

Methodology

This capstone project used a qualitative approach based on a meta-analysis in order to analyze and review data related to climate change impacts in California, and how it pertains on a social level to residents of California. Data was collected through secondary peer reviewed research and databases in an effort to make a correlation between areas exposed to climate disaster and the socioeconomic groups found in these areas. In addition to secondary research from JSTOR, Sage Journals, and ScienceDirect, information and maps were derived from government databases such as the U.S. Census Bureau, the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), the Palmer Drought Severity Index (PDSI), and the U.S. Department of Agriculture (USDA).

Through the course of data collection the primary focus was on information from 2018-2023. Information derived from these years aimed to provide insight more relevant to the current climate, as well as modern socio-economics. In addition, peer reviewed articles and research regarding population displacement, environmental risk zones, healthcare trends, and financial repercussions of climate events were reviewed in order to prevent any bias in regard to political or economic agenda. The data was found to revolve around climate related disasters and their aftermath, in addition to economic

models and geographic maps outlining said disasters and the population within these areas.

These disasters include sea-level rise, flooding, and drought. The sources regarding these topics were required to be in English and peer reviewed. Furthermore, they must have included data or synthesis regarding income, geographical context, disaster statistics, financial statistics, population density, population displacement, and relate to the fundamentals of climate change. Data sets and articles that were excluded were that of foreign bases, due to the possibility of vastly different economic systems and geographical climate in areas outside America. However, supporting data from distant U.S. cities was used for context. Also, supporting synthesis articles of the above topics, or similar topics, were included.

With these articles and data sets, the goal was to accept or reject the hypothesis that climate change impacts will affect lower income areas more than areas with a typically higher income level. By examining the information regarding demographic and geographical data on climate damage and the economic statistics of said damage, the cause and effect of these risk disparities on the community were evaluated, and established the relationship between an area's economic level and their overall risk assessment. Considering the implications of this study, this analysis provided insight to the idea that the best mitigation technique for these future disasters, is simply disallowing land developers to build in disaster prone areas. In addition, this analysis can hopefully support more specific regional initiatives and provide leeway for programs in order to establish viable support systems for these events.

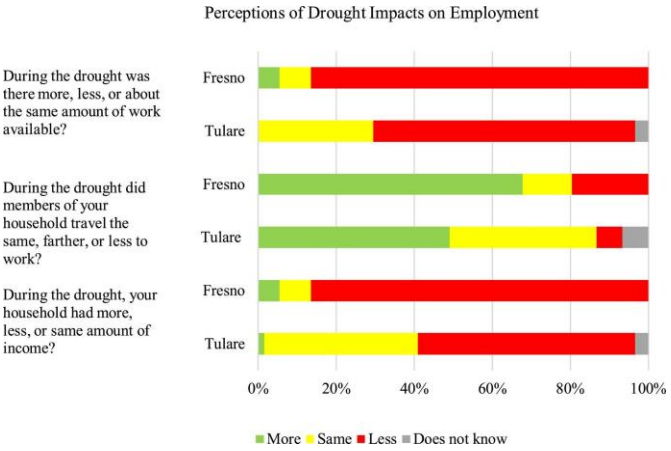
Discussion & Results

Introduction

Climate change and natural disasters have significant impacts on the social and economic well-being of communities in coastal California. This analysis will examine the primary threats of climate change and natural disasters on people living in coastal California, specifically focusing on the effects of drought, high temperatures, flooding, and sea-level rise. The analysis will also discuss potential climate mitigation techniques in which they correlate to California's risk assessment, as well as limiting factors that prevented more substantial results from this study. By synthesizing the qualitative population information, the needs for those typically overlooked can be represented. In addition, this analysis aims to present information in a way that assists in their creation. The data and evidence used in this analysis are sourced primarily from scholarly peer-reviewed studies as well as from government databases such as the U.S. Census Bureau, the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), and the Palmer Drought Severity Index (PDSI).

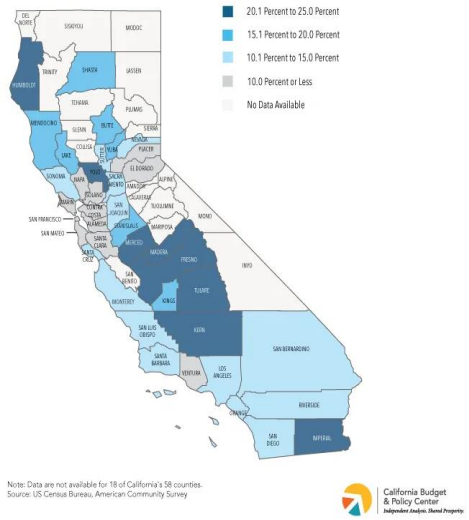
Drought Implications

Unlike other “acute,” or spontaneous disasters, the California drought has been taking its toll on communities throughout the state for over a decade, with the most severe period of drought occurring from 2011 to 2017 (Barreau et al. 2017).This drought caused severe water shortages, agricultural losses, and economic impacts, with the state's economy losing an estimated $2.7 billion in 2015 alone (California Department of Water Resources, 2021). These losses disproportionately affect those who are typically lower-income, migrant workers. (EPA, 2017) As well as agricultural communities, disadvantaged communities, such as low-income and minority communities, are also more likely to be exposed to pollution due to living in areas with poor infrastructure and access to resources that can help them mitigate the effects of pollution. (University of California Los Angeles, 2019) As mentioned earlier, a study conducted on the current health implications of climate policy in California, the rates of ‘heat-related emergency room visits’ in the San Joaquin Valley were between 17-28% per 100,000 people, compared to other areas that averaged 11% (Ganesh, 2018). This is an issue in itself of course, however for low-income rural communities, the amount of facilities is less, and the distance is typically further (Lang, 2016). As a result, these migrant worker groups face greater impacts on their employment and respiratory health as a result of drought (Ganesh, 2018). As seen in the figure below on drought impacts on agricultural employment, most respondents found less work available, distances to work to be further, and income to be less (Greene, 2018).

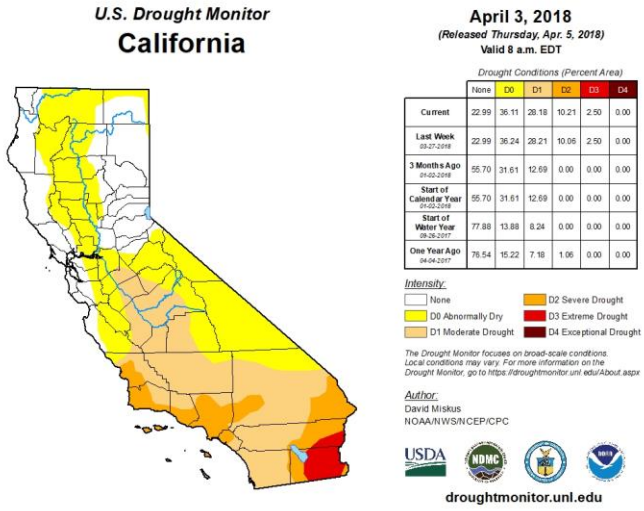


(Greene, 2018)

Both in terms of flooding and drought effects, the central valley of California is an area frequently faced with harsh conditions. Moreso, this region tends to be impoverished, with over 20% of their population living in poverty (Kimberlin, 2019). As seen in the figures below, the poverty levels of counties throughout California correlate to drought severity.



(Kimberlin, 2019)



(U.S. Department of Agriculture, 2018)

Flooding and SLR Implications

In coastal areas around the world there looms the threat of sea-level rise and subsequent flooding. Projections made by the Environmental Protection Agency indicate that sea level rise could rise up to three feet by the end of the century (EPA, 2022). While sea-level rise isn't seen as an 'unforeseen disaster' that will typically leave an area in ruin, it does exacerbate the effects of extreme weather events like tropical storms and excessive rain (Shirzaei, 2018). In a study conducted by Cayan et al. (2017) found that the frequency of extreme weather events leading to flooding has increased by 300% in the past decade. With the increased precipitation, the impact of Sea-level rise on coastal California will increase the risk of flooding, erosion, and damage to infrastructure. (Moore et al., 2018). Furthermore, sea-level rise is also projected to have significant economic impacts, with projections indicating that the total costs of coastal flooding in California potentially rising as high as $17.9 billion by 2100 (Moore et al., 2018).

While many low-income urban and economic centers do reside in flood prone areas, a major argument or counter claim to the idea that low-income families are at more at risk, is that there are also a significant amount of high-income households that reside on the coasts, beaches, and near bodies of water (Revell, 2011). However, the ability to cope with the aftermath of a disaster or flooding varies between income groups. Low-income families are far less likely to have insurance and subsidies to adequately cover the costs of damages, or the chance at a halt in income all together

(Wang, 2022). In addition to high-income households being able to withstand potential impacts, larger businesses will also be more suited to cover their losses, while smaller, family-owned businesses will struggle (Rahimi, 2020). This comes as a result of the tendency of low-income communities to have insufficient drainage and infrastructure to both prevent severe impacts, as well as quickly recuperate (Rahimi, 2020).

This is important, as the West Coast and California especially have most communities and economic centers based near coastlines and major bodies of water (Gasper, 2010). In San Mateo county, a study showed that with existing financial strain, an extreme weather event could put over 50% of residents at risk of displacement, homelessness, and/or bankruptcy (Bick, 2021). Based on the predicted resilience of respective economic groups, those who cannot recover will only end up with more inequalities between themselves and those of higher economic status (Markkanen, 2019).

Mitigation Techniques and Systemic Issues

Socioeconomic mitigation techniques are strategies that aim to reduce the vulnerability of communities to these disasters by addressing the underlying socioeconomic factors that contribute to their exposure and susceptibility (Pelling & Blackburn, 2013). This section will explore some of the socioeconomic mitigation techniques that can be used to combat climate disasters in the San Francisco Bay Area, based on the themes found in the literature review of scholarly sources.

Some primary socioeconomic mitigation techniques can include addressing issues related to housing displacement and/or homelessness. Low-income households and those experiencing homelessness are often more vulnerable to the impacts of climate disasters due to their lack of resources. Providing affordable and safe housing options, as well as access to resources such as emergency shelters, can help reduce the vulnerability of these populations (Kern & Ong, 2019). Additionally, improving relocation programs, household subsidies, and the resilience of infrastructure such as transportation and energy systems can help reduce the impacts of climate disasters on vulnerable populations (Siders, 2019).

Another effective socioeconomic mitigation technique is to improve the 'built environment.' The built environment refers to the physical structures that make up a community, such as buildings and infrastructure (Goulden, Chapman, & Raucher, 2018). Improving the built environment in the San Francisco Bay Area could include retrofitting buildings to make them more resilient to flooding, in a similar manner as to how buildings are retrofitted to withstand earthquakes (Siders, 2019). Furthermore, based on the studies of (Rahimi, 2020), better drainage systems being implemented into the 'built environment' can assist in decreasing the damage of flooding and extreme weather. Lastly, improving access to education and information can help individuals and communities better understand the risks of climate disasters and how to prepare for them.

However, implementing these socioeconomic mitigation techniques requires collaboration between social scientists, climate scientists, non-profits, community members, local governments, and more (Borden & O'Connor, 2020). Successful

mitigation strategies must be specialized to the unique needs and characteristics of the San Francisco Bay Area, taking into account factors such as demographics, geography, and economic circumstances (Kern & Ong, 2019).

Limitations

In this study there were quite a few limitations that prevented the ideal results. One limitation is the lack of resources and data available on the specific sample area of the San Francisco Bay Area. Most sources and studies available are focused mainly around other states or regions, or they are presented for a strictly ecological audience. In early 2023, California as a whole, but particularly the San Francisco Bay Area and Monterey county faced an unprecedented amount of rainfall. However, there is not yet any published studies or literature regarding the specifics or data of this event. Since the amount of rainfall was unprecedented, many agricultural communities and businesses faced damages and delays. However, as a major group that faces harm due to the climate is field workers, data and information on this group is rarely available. Overall, the diversity of people and geography in this region make it difficult to make generalizations for the entire area, as each province has a completely different outlook and experience. While all people in a region will experience the same events, their fallout will differ greatly, creating difficulty in finding a consensus when it comes to institutional action. Furthermore, with the complexity of climate change and all the threats it brings, the topic is better studied using expertise from multiple fields such as sociology, economics, and climate science.

Conclusion

In this research, the overall goal was to highlight the key aspects of climate effects that would harm those residing in California on a social level. Upon posing the research questions as to how climate change related natural disasters can potentially affect the average California resident in terms of housing displacement, economic loss, and personal health safety concerns, as well as how the income level of particular areas affects their overall vulnerability to climate change. By synthesizing the sources, the results found highlight several common themes. The common theme throughout the reviewed studies suggest that California has a systemic issue of establishing low income communities in disaster prone areas. With this, low income families in California are far more likely to face health and safety risks as a result of drought, flooding, and other natural disasters. Additionally, the economic support systems, both government relief and personal insurance, are more likely to adequately cover damages and rebuilding for higher income families. With these findings, there are several aspects of disaster mitigation that need attention in California, such as reformed drainage systems and transportation in urban areas, and better access to healthcare and support for rural communities. However, this study was limited in many ways. Primarily, some of the most significant weather events in recorded history were very recent to this study, and as a result there was little data available. Furthermore, with the extensive geographical, economic, and demographic diversity within California, it is difficult to find information on

the marginalized communities that are embedded within some of the most affluent cities in the state. Lastly, future research should focus extensively on the relationship between housing unit prices, development plans, and area demographics to examine the causes and effects of population distribution in these areas.

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