University of Zurich[UZH]

Refugee perceptions of the role of climate change in their migrations to Europe

GEO 511 Master's Thesis

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30.09.2022
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Photo taken by author: Mavrovouni Refugee Camp, Lesvos, Greece

Abstract:

Forced migration and climate change are two of the most pressing issues humanity faces today, that will continue to need addressing in coming decades as they are predicted to grow in scale. Migration can be viewed as an adaptation response to climate shifts, and there can often be a direct link as in the case of storms or drought; however, it is extremely difficult to accurately quantify the role climate change is playing in these movements as there are complex factors at play. More often than not, climate is only one reason (of many) why people leave their homes, or it is a subtle contributor to wars and tensions that cannot necessarily be proven. This research aims to fill in some of the gaps in understanding the climate-migration nexus, i.e. if climate change is a contributing factor in forced migration, and to what extent refugees believe this to be the case. There is a plethora of literature based on expert opinions and abstract predictions as to the amount of climate refugees there truly are or will be in the future, but this study aims to get the refugee perspective on the matter. This mixed methods analysis will dissect and try to gauge what percentage of refugees in Europe believe climate to be a reason they left, how it played a role (water scarcity, agricultural difficulties, heat waves, etc…), in which regions (Middle East, North Africa, Sub-Saharan Africa…) it was most a factor, and if it continued to play a role on their journeys to Europe. The study will then go deeper on these reasons, examining the discrepancies between refugee perceptions and scientific projections, and take a case study approach with certain interviews that have the depth to do this. This will be conducted remotely and in person in Greece. The study aims to utilize a broad sample size of many nationalities to get a general idea of how prevalent "climate refugees" are among the refugee populations of Europe, by their own definition.

Results of this study found that 93% of interviewees did not believe climate change had played a role in their migration, but alternatively 59% also believed that climate change is a reason people migrate from their country in general. Perceptions of climate change impacts in the regions of the Middle East, Sahel, Sub-Saharan Africa, and the Horn of Africa found that most of the interviewees did believe climate impacts were affecting their country, and were sometimes leading to migration, often in conjunction with other social and political factors. The perceptions often aligned with the physical science data, although not always, and sometimes there was opposition, while other times data and certainty was lacking. Changes in precipitation, water scarcity, and agricultural difficulties were the primary impacts mentioned, and associated with migration. Other impacts and drivers are discussed in the paper as well. This study provides interesting insight into climate migration perceptions of the refugee population in Europe.

Photo taken by author: Mavrovouni Refugee Camp, Lesvos, Greece

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Photo taken by author: Moria Refugee Camp post fire, Lesvos, Greece

1.0 Introduction

"Climate refugees" have gained more attention from the global community in the last decade, with politicians, the UN, and the media beginning to talk about this demographic more and more. The UNHCR has increasingly had climate migrants on their agenda and is considering how to redefine their asylum policies under international law; news outlets are writing more and more about climate refugee waves in the future and currently, to fear monger and gain sympathy for those struggling with the effects of climate change in the global south, and it is having the effect of influencing the general public's perception of the impact of climate change on migration. Likewise, politicians feel pressured to address these subjects and populations. It is a term that is used often; however, it is not a legally accepted term. In fact, it is very difficult to prove if someone is a "climate refugee" (Arenilla, 2020)(UNHCR, 2018).

From the physical science perspective, the data on climate related impacts can be studied and quantified – for example, increased precipitation, melting glaciers, water scarcity, heat waves – although even this data and these projections have a lot of uncertainty – but in relation to migration the impacts are not so quantifiable. Migration is distinctly social and human, and requires a nuanced understanding. The field of climate change research is distinctly objective and scientific. Both aspects of understanding are crucial for future predictions of climate forced migration, to anticipate and mitigate future impacts both on a local and international scale. While not easily quantified, migration is undeniably interconnected to climate change and will continue to be more so in the future, and thus needs to be understood within the scientific realm. In fact, research on climate refugees remains a field of study with many gaps. This is why this interdisciplinary study is important (Hoffman, 2021)(Gemenne, 2011)(Migration Data Portal, 2022).

1.1 Study Structure

The first section covers the basics of climate change and migration, including latest data and projections, as well as terminology.

The second section explains the climate-migration nexus, current data, research and understanding, importance of this relationship.

The third section is the research objectives, which covers existing research, literature review, research gaps, perception meaning and uses for this study, study purpose and scope, importance, and research questions and expected outcomes.

The fourth section is the methods, which includes a general overview, ethical considerations, sampling methods, and analysis methods.

The fifth section contains the results, which moves from an overview of all responses, into the regional analyses, comparing the physical science data to the interview responses, and then into the case studies for three different countries.

The sixth section is the discussion section, which answers the research questions, as well as covers extra analyses that did not fall under the research questions, research difficulties and considerations, suggestions for future research, and contribution to the field.

1.2 Climate Change Terms

Since preindustrial times anthropogenic CO2 emissions have increased atmospheric CO2 by 50%, causing the global temperature to rise by 1.01 degrees so far. This has caused a multitude of problems around the globe, and is projected to dramatically worsen over the coming century. "Increasing magnitudes of warming increase the likelihood of severe, pervasive, and irreversible impacts" (IPCC, 2022). These effects include more intense storm damage and loss of life, food system collapses due to seasonal changes, rainfall changes and droughts, lethal heat waves, loss of biodiversity, polar ice cap and mountain glacial melting, and sea level rise. Effects of climate change are frequently being felt the most by those who have done the least to contribute to the harm, notably in developing countries of the Global South. In terms of how this relates to humans, the following terms will be used (IPCC, 2021).

Terms

Resilience

In the context of disaster risk reduction, the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (IPCC, 2021).

Vulnerability

Within a migration context, vulnerability is the limited capacity to avoid, resist, cope with, or recover from harm. This limited capacity is the result of the unique interaction of individual, household, community, and structural characteristics and conditions (IPCC, 2021).

Adaptation

In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2021).

Hazard

The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources (IPCC, 2021).

Risk

In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards. Hazards, exposure and vulnerability may each be subject to uncertainty in terms of magnitude and likelihood of occurrence, and each may change

over time and space due to socio-economic changes and human decision-making (IPCC, 2021).

1.3 Migration Terms

The UN estimates there were 89.4 million people were living in displacement, 26.4 million refugees, 4.1 million asylum seekers, and 281 million international migrants in the world total in 2020, the last figure of which is 128 million more than 30 years ago. This is the highest number of refugees ever recorded, and is the latest available estimate. While this still represents a small percentage of the global population, international migration and displacement continues to grow every year, and almost definitely would have grown even more, were it not for the COVID-19 pandemic. Europe holds the largest number of international migrants, with 30.9% of the global international migrant population. The majority of international migrants are male, and the gap between genders has continued to increase in this trend over the last 20 years. The Mediterranean has consistently reported the highest number of migrant deaths of any region, as people take irregular routes to reach Europe (McAuliffe, 2022).

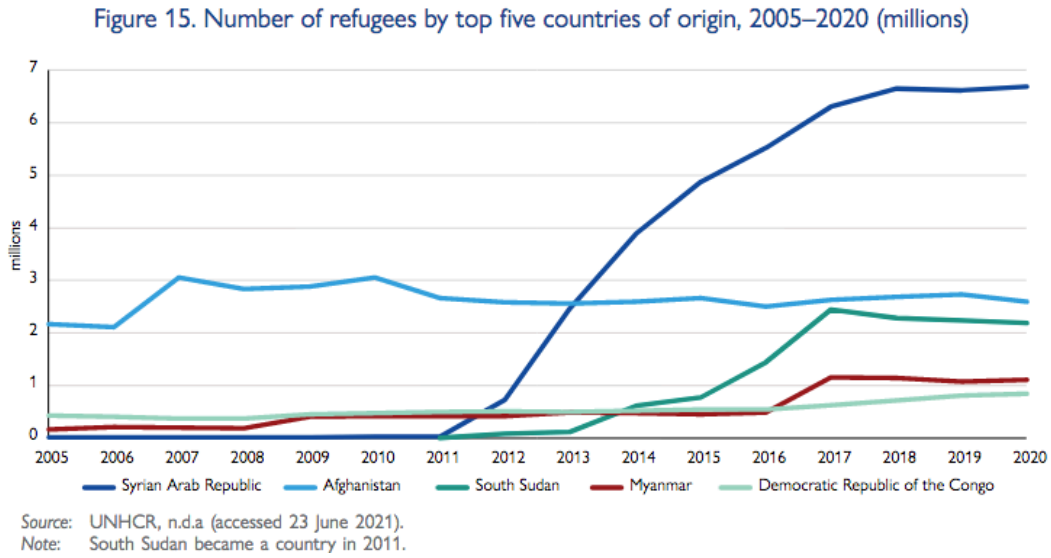

Figure 1: Chart showing the top five countries of origin for refugees (IOM World Migration Report, 2022)

The vast majority of these refugees also hail from the Global South, and while some countries have had steady migration flows for a long time, other countries have taken off in recent years, such as Syria, South Sudan, and the DRC. Migration is a complicated legal minefield, and for the uses of this report, the following terms will be used (Sironi, 2019)

Terms

Migrant

Any person who is moving or has moved across an international border or within a State away from his/her habitual place of residence, regardless of (1) the person's legal status; (2) whether the movement is voluntary or involuntary; (3) what the causes for the movement are; or (4) what the length of the stay is. (Sironi, 2019).

Refugee

Persons recognized as refugees, by a State or the United Nations High Commissioner for Refugees, on the basis of objective criteria related to the circumstances in their country of origin. (Sironi, 2019).

For the purposes of this study, the terms "refugee" and "migrant" will be used interchangeably, and the term "asylum seeker" will not be used. This is because the asylum status of all interviewees for this study was not questioned in the interview process. However, at some point, all "refugees" or "migrants" in this study were (or still are) asylum seekers, seeking refugee status in Europe. Hence all of the interviewees are also migrants who have crossed international borders.

Asylum

The grant, by a State, of protection on its territory to persons outside their country of nationality or habitual residence, who are fleeing persecution or serious harm or for other reasons. Asylum encompasses a variety of elements, including non-refoulement, permission to remain on the territory of the asylum country, humane standards of treatment and eventually a durable solution (Sironi, 2019).

Displaced persons

Persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, either across an international border or within a State, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters. (Sironi, 2019).

Forced migration

A migratory movement which, although the drivers can be diverse, involves force, compulsion, or coercion (Sironi, 2019).

Country of origin

In the migration context, a country of nationality or of former habitual residence of a person or group of persons who have migrated abroad, irrespective of whether they migrate regularly or irregularly (Sironi, 2019)

**These definitions are to give a general idea of the migration terminology used in this thesis. They are not exhaustive, and these terms and definitions are constantly shifting and can be used in different ways be different agencies. These definitions are from the IOM, who states that these are not necessarily the legally recognized meanings of the words, but are the colloquially agreed upon uses for the words in many research contexts.*

Photo taken by author: Moria Refugee Camp post fire, Lesvos, Greece

2.0 Climate-Migration Nexus

The decision to migrate is almost always multicausal, which makes it a difficult subject to research and prove direct links. For example, there may be a water shortage somewhere that is making life difficult, but there may also be ethnic discrimination or conflict, and together these factors are enough to make someone leave their country, or these two factors are influencing each other and worsening each other. Or increased floods destroying land and livestock may make farmers migrate to bigger cities for work, and then economic struggles in the city may force them to migrate to another country. To add to this complexity is the range of climatic factors that could impact a person's decision. Sudden onset events such as a hurricane or locust devastation could force people to move immediately, usually internally, but over time they are forced to migrate to another country. Slow onset events such as drought and agricultural degradation are harder to prove, but could over time force people to cross border migrate (De Longueville, 2020)(Gemenne, 2011)(Hoffman, 2011).

The effects of climate on conflict and migration can be subtle, for example: drought and soil degradation in Kenya led to increased labor migration, but it was only temporary; forest fires in the US led to an increase in "intent to migrate"; water scarcity in the Sahel led to increased migration of pastoralists, which led to clashes between pastoralists and farmers over resources; flooding in Pakistan led to an increase in rural-urban migration, and later to violent conflict between migrants and non-migrants; and desertification in Nigeria led to an increase of labor migration of farmers, which later led to ethnic conflict between farmers over land (Burrows, 2016). Historically people have been migrating in response to environmental stressors for a long time, however it may no longer be possible to look to the past for clues on how climate will influence migration in the future; one example being the Sahelian population, which has traditionally used the Savanna as a reprieve from dry years and agricultural difficulties, migrating there for economic or family reasons, but with land degradation creeping into the Savanna this migration pattern is no longer plausible (Grolle, 2015).

In summation, *the range of timescales, diversity of climate change impacts, and multicausal nature of migration* makes this nexus a very tricky one to research. However, it is a widely agreed upon fact that climate change does impact migration (Migration Data Portal, 2022). The intersection of hazard, risk and vulnerability, which influences resilience in the face of climate change, is an important relationship to understand. When climate hazards present themselves to a population, other socio-economic, cultural, and political factors must be assessed in order to understand the level of risk and vulnerability, and a holistic study approach is needed in order to understand a person's, community's, or country's resilience in the face of climate change (IPCC, 2022). This is important to understand because this influences their ability to adapt, and options for adaptation, and one major way people adapt is to migrate (De Longueville, 2020). It is difficult to identify the influence climate change has as a stabilizing or destabilizing factor, especially in regards to conflict, and how these factors all interact (Burrows, 2016).

The tables below show the complex nature of climate migration, (Figure 2) including the relationship between environmental hazards, ecosystem services, and mobility drivers, and (Figure 3) the relationship between climate change and its impacts on human systems, including displacement.

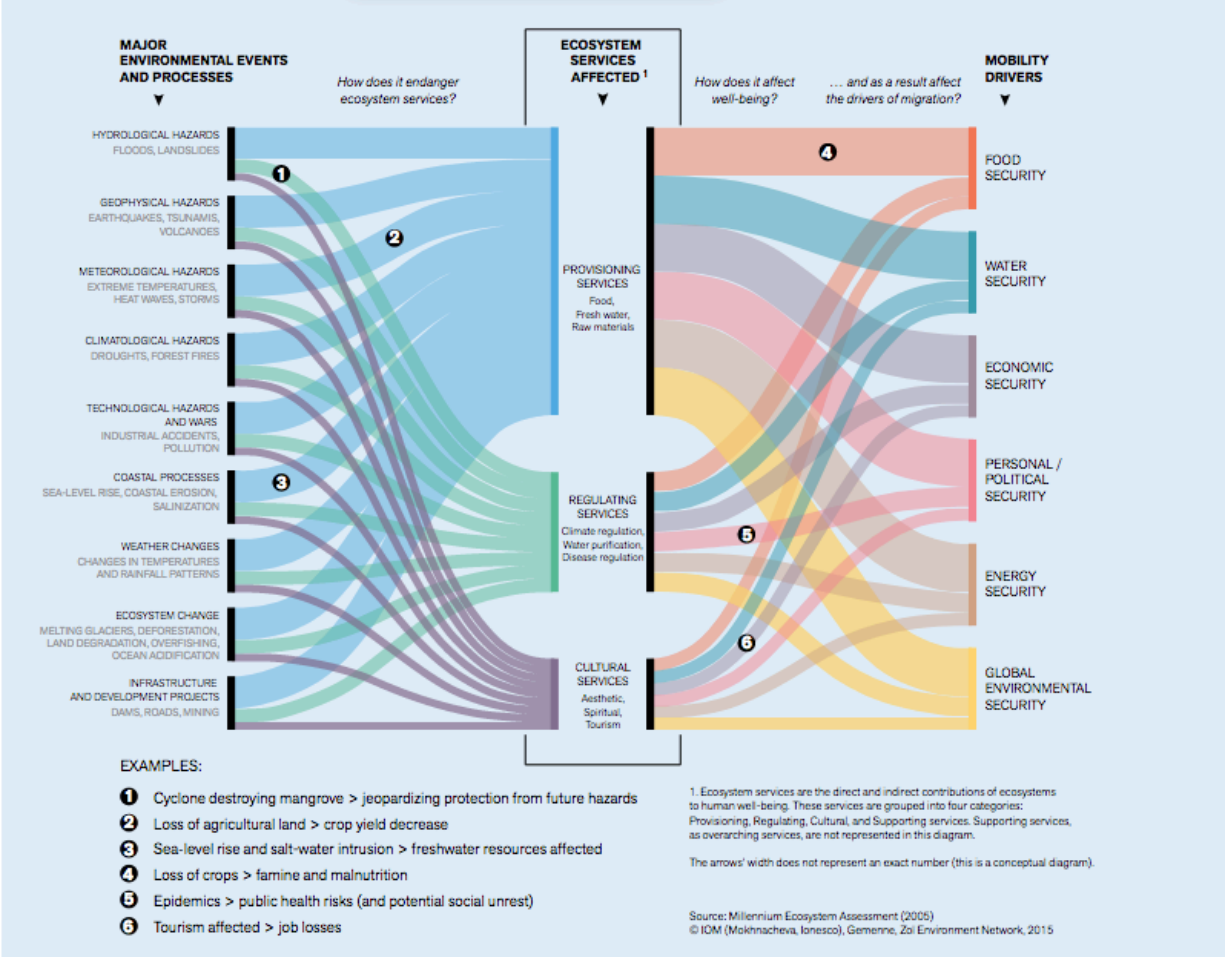

Figure 2: A chart displaying the complex relationships between environmental processes and mobility drivers (IOM World Migration Report, 2022)

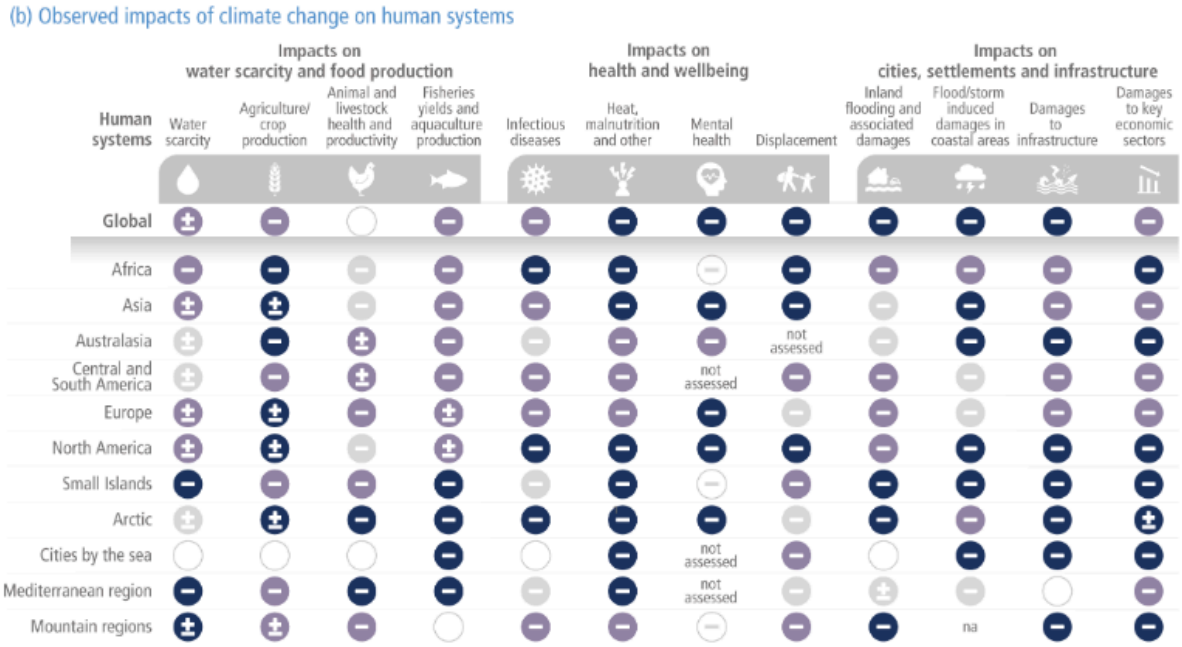

Figure 3: Chart showing the negative or positive climate change impacts in various systems, the darker circles indicating high confidence, and the lighter circles indicating more uncertainty (IPCC Sixth Assessment Report, 2022)

Migration decisions happen on different scales as well, from micro-level to macro-level, or from an individual level to household, community, and societal levels, and it is an accumulation of these factors that determine each person's reasons to migrate. A lack of data on these different scales, both temporal and spatial, especially in low income and hard to reach communities, presents challenges to researching the climate-migration nexus. Traditional narratives argue that climate change is a blanket forcer for large migration waves, but newer frameworks suggest that there are feedbacks, lag-times, as well as adaptive capacities and resilience of communities that play a role in migration decision making. And at times climate change can act as a limiting factor for mobility as opposed to a driving factor (Simpson, 2021)(Parish, 2020). Studies have also been done on whether migration should be viewed as adaptation, as it is understood that it is a measure of the hazards, risk, exposure, vulnerability, resilience of a place that determines whether forced migration happens. Can it also be considered a failure to adapt? In one study from Burkina Faso migrants did not make up the income lost from agricultural hardship by migrating, and there were also harmful effects on health; if adaptation had been done on a local scale instead of migrating, there may have been better outcomes. Alternatively, positive views of migration in hindsight were also found, and migrants were able to support families back home during hard times (Vinke, 2021).

Traditional migration theory breaks down motivators into five categories, including drivers for leaving (climate change, war, economic instability, etc…), drivers for arriving in new country (better opportunities, political stability, etc…), network factors (community

support, financial backing, knowledge, etc…), national policies (hindering or encouraging movement), and personal goals and motivations of the migrant (Burrows, 2016). One study argued that climate risk assessment is too divided into silos, and risks are being missed. When evidence is collected across sectoral, temporal, spatial, and response-option boundaries the risk assessment often looks different than if there is no interdisciplinary collaboration. Government and institutional responses are also important factors in the climate risk. One example is water agencies' investment plans – this study found that many plans were sustainable when looking at climate change alone, but when coupled with socioeconomic factors they actually increased vulnerability in the future. The usage of risk, vulnerability, and climate hazards are also often dependent on author and there is not a coherent framework for measuring climate risk (Simpson, 2021)(Burrows, 2016). A running argument amongst the literature is that an interdisciplinary and cooperative effort is needed between researchers (Simpson, 2021)(Parish, 2020).

3.0 Research Objectives

3.1 Existing Research

Over the last ten years researchers have been working to improve methodology for climate migration research. NGOs, agencies, and academics have been trying to find better ways to measure comparative data across regions, predict future trends with multi factor models and simulations, and identify where social and environmental data meet. Difficulties still remain. It is nearly impossible with current methodologies to prove that climate change is the driving factor in migration, when socioeconomic, political, demographic, cultural and personal factors also play a role (Migration Data Portal, 2022)(Gemenne, 2011)(Hoffman, 2021). The only times climate migration can directly be proven are during natural disasters which immediately lead to evacuation and migration. Most of the big migration data available only tracks the amount of people who have migrated that year and does not account well for longer more drawn out migrations, such as moving from country to country over the course of years. Cross border migration is also not as well studied as internal migration, and most cross border disaster displacements are only measured in case studies. While internal migration is more prevalent than cross border migration, both are important to understand. Large-scale climate data is also used often, but in many regions there is no station data (Hoffman, 2021). The gap between the vast scale of climate data and research and the local decision making that goes into migration leaves a gap in understanding (Parsons, 2021).

Smaller scale disasters in remote regions are often underreported, and the reliability of data varies between regions as well. Macro scale studies vastly outnumber micro scale studies. As well, preventative and predictive data on how conflict is linked to disasters, both slow and sudden onset, is scarce, and again difficult to prove. The fluid definition of sudden and slow onset disasters also can create ambiguities in research findings. Long-term studies are also scarce, and the temporal data is important for modeling future projections. Although, long-term studies (5-10 year time frames) were shown to prove less of a causal relationship between climate than short-term (less than 1 year) time

frames (Hoffman, 2021). This is likely, however, due to the lack of data on long-term relationships between climate and migration, and with more research this may be disproven. One study on the threshold for climate migration found that there is a standard pattern, also found in other studies on climate-society interactions, of 21.78 degrees Celsius being the threshold, and days higher than this in temperature produce more migration and lower productivity around the world. This temperature threshold will increasingly be pushed with climate change, so this study argues this is evidence that migration will likewise increase (Owen, 2020).

Political drivers of migration are obviously very important to analyze as well, and are well known factors. However, the understanding of how climate change fuels conflict and instability is not well understood. Some studies have found that it is largely influenced by political preparedness, how the government handles food and water infrastructure and supply, agricultural policies and investments, and the level of trust in the government. The Syrian war is a well-studied scenario, where many suggest it was partly determined by climatic factors (Parish, 2020). By investing heavily in domestic agriculture and increasing irrigation along the Euphrates Basin, as well as an increase corruption in the water sector, the Syrian government withdrew more water than was sustainable, leaving the country in a vulnerable position with a large population dependent on agriculture by the time the 2007-10 drought hit. Additionally dams were built in Turkey, and more groundwater reserves were drained in Syria, as well as overgrazing, furthering desertification and land degradation. Cuts in government subsidies left farmers highly vulnerable to drought, which it is thought to have exacerbated the conflict that followed the droughts (Feitelson, 2017). Drought is also thought to be a driver of the "Arab Spring," (Karami, 2019).

Interesting interactions such as this are commonly found in the climate migration nexus. For example, a study in Malawi found that adaptation to climate change in the form of increased irrigation during an exceptionally dry season ended up exacerbating water scarcity long term, leading to conflict, insecurity, and migration. Compounding the water scarcity, it was found that soil erosion, food insecurity, crop failures, and subsequently high costs also fueled the conflict. This shows that climate stressors do not always immediately lead to migration, and many communities will choose to adapt rather than migrate, but in this case the threshold of the stress overcame the ability to adapt, and actually drove the locality to conflict (Parish, 2020). Cultural and historical context is also important in understanding if climate drivers will lead to conflict. One study found that the level of adaptive capacity determined whether drought would lead to conflict – naturally, if resources are low and ability to adapt is low, the stress between parties will increase. That said, there was little evidence of drought directly leading to conflict, rather it led directly to migration, which subsequently led to conflict as the host countries became overwhelmed (Feitelson, 2017). Policies on the side of the receiving countries are also a determinant in understanding migration flows (Parish, 2020).

3.2 Research Gaps

All of this leaves a gap in our ability to predict the consequences of climate change on migration for the future and also how we could adapt to this. It is agreed amongst researchers that more research is needed to understand how climate and migration interact (Arenilla, 2020). The stark divide between the scientific community and the social science community is harmful to the field of environmental migration research, and a bridging of these two disciplines is valuable (Hoffman, 2021). A meta-analysis of all existing climate migration research found that, "Self-reported, subjective measurements tend to produce different results as compared to analyses based on objective climate data," indicating that a combination of the two methods may give the most accurate results (Gemenne, 2011).

Research has suggested that slow onset climatic events are more likely to increase migration than sudden onset events (McAuliffe, 2022). However, these slow onset drivers are the most difficult to research and prove, and this field of study thus has huge gaps in knowledge. While sudden onset disasters such as storms, and sudden migration resulting from this can be quantified and the relationship proven, when it comes to slow onset migration drivers, research methods are not so clear. Most studies that have been done are qualitative case studies, but there are not many comparative studies (Gemenne, 2011). Drought is the most well studied slow onset climatic driver in regards to migration, and the best estimates from the IOM are that from 2008-2020 over 2.4 million new displacements were caused by drought (McAuliffe, 2022). However, other slow onset drivers present a large gap in data, and even the data available often does not give the complete picture. To compound this, there have been more studies trying to predict future climate migration trends than research on past or current trends (Hoffman, 2021). While it is important to predict future trends, it will likely be inaccurate without a complete understanding of past trends as well.

These studies also tend to use large-scale satellite climate data, when in reality the choice to migrate is made on a very local scale. This is important because if people are perceiving a change in climate which impacts them negatively, then even if the observational climate data says there is no change or impacts in a certain region, it may not be accurate or give a realistic idea of what is affecting people on the ground (Hoffman, 2021)(Gemenne, 2011). As well regions can be so diverse within a single region that trying to use large-scale climate data to analyze local and rural climate can even be inaccurate (Migration Data Portal, 2022). Another study conducted in Cambodia concluded that the current basis of climate migration research, which often compares population shifts with physical science data, fails to study the phenomenon at the community level, and understand the social causes of migration in conjunction with climate change. They suggest it has become of more interest lately to study subjective perceptions "as a measure of resilience, risk perception, and risk management." While most of these studies compare perceptions to climate data, few studies look at the role of perceptions in migration (Steynor, 2019)(Parsons, 2021).

It follows logically that those on the ground in these regions would be the most knowledgeable about the problems they are facing, and especially those that have taken the migration routes to Europe would be knowledgeable on the reasons for migration, both for themselves and for others they have traveled and lived with (Steynor, 2019). A study investigating why migration numbers "don't add up" cited one reason as: "Research on environmental migration is mostly conducted from industrialized countries. Yet most of these movements take place in developing countries, where local expertise is insufficiently mobilized. Too many estimates and predictions are produced without any supporting evidence from empirical studies. Quantitative research needs to be complemented with and tested against qualitative research, and local research capacities urgently need to be developed… The inclusion of questions related to the perception of environmental changes… would be another major step in this direction" (Hoffman, 2021)(Gemenne, 2011).

3.3 Perception

With that said, perception can be a tricky and unreliable thing as well. "Environmental perception encompasses both direct experience of the environment and indirect information from other people, science, and the mass media, which are in turn mediated by individual values, roles, and attitudes" (De Longueville, 2020). Perceptions of climate impact also are related to perceived adaptive capabilities, which in turn influence whether someone believes they can leave a situation that has become too much of a stressor. Migration is costly, both financially and socially, and to understand why people resort to this as an adaptation strategy we need to understand how they perceive the risk and their own vulnerabilities. "Also subjective factors, like perceptions, well-being or place-attachment, are significant when trying to understand why some people stay and others leave in the face of adverse climatic events" (Koubi, 2016).

For example, when it comes to rainfall, a farmer may perceive that it is decreasing because his crops are failing; however, the rainfall may still be "normal" by meteorological definitions, or the statistical mean. Events that may not be considered "drought" by scientific definition may still be called drought years by farmers who use the term for any kind of imbalance of sun and water that is not favorable for the growing season. And while precipitation patterns changing may be perceived, farmers can attribute this to a decrease in rainfall, when in reality rainfall is becoming more intense with longer dry spells in between events. Agricultural difficulties would still arise from water scarcity and lower soil moisture in this scenario, so it makes sense that farmers would perceive less rainfall, but the climate data would not confirm this (Henry, 2003)(Koubi, 2016)(Brussow, 2019). In another example, farmers who utilize more water for their crops would also perceive more of a water scarcity problem than those who use less, so livelihoods are important influences in climate change perceptions as well (Parsons, 2021).

One study in Burkina Faso found that local farmer perceptions of changing temperature correlated well with the temperature data; however, the rainfall data did not match

perceptions at any of the study sites. At one site the locals perceived a decrease in rainfall, while the data showed significant increases in total annual rainfall as well as rainfall intensity. At all sites the intensity of changes in rainfall patterns were considered much more significant by the locals then by the data, which considered it non-significant (Henry, 2003). A similar study in Tanzania showed that local perceptions saw annual rainfall as decreasing, but the data did not confirm this, but there was agreement on a change in rainfall patterns (Brussow, 2019). Perceptions also may vary across a region due to perceived impacts; for example, one study in Africa showed that livestock farmers have higher revenues with higher annual temperatures, while crop farmers have lower revenues with higher annual temperatures. In this case, the crop farmer may perceive more climate impacts than the livestock farmer (Koubi, 2016). A study in Cambodia found that the highest correlation between climate data and perceptions was in temperature data and perceptions, while the lowest was in drought data and perceptions. However, the perception of drought was found to be the most important when it came to migration, whereas temperature was not so influential (Parsons, 2021).

Further understanding of perceptions of vulnerability to climate change involves the perceptions of the social and financial "cost" of migration for the individual. From an economic view, migrants may assess the financial value of staying verses going to a new place, or the decision may be taken as a household, to increase survival outcomes and diversify incomes. Other places may have more of a culture of migration than others, with knowledge networks to utilize. And in other cases it is purely a survival mechanism in response to conflict or hazards. Environmental stressors can also decrease life satisfaction, either financially by affecting livelihood, or in other ways, to reach a threshold where leaving makes more sense than staying (Steynor, 2019)(De Longueville, 2020). Community awareness can also play a large role in perceptions of the individual, especially in areas where academic and media information about climate change is unavailable (Steynor, 2019)(Parsons, 2021). One study in Tanzania found that experiencing a monetary loss due to a climate related shock such as flood or drought in the last 5 years significantly increased " intentions to adapt," while those with large social networks were also more likely to adapt, and those who upheld traditions were found to have fewer "intentions to adapt." The majority of farmers also adopted short-term adaptation strategies that could be changed each year to adjust to different climatic stressors, rather than long term adaptation strategies (Brussow, 2019). While these compounding factors can be used as an argument against the reliability of subjective perceptions, and historically have been why climate perceptions have not been used in research – in Ethiopia, for example, a study concluded that farmer perceptions of climate change were highly correlated with socioeconomic factors – many studies have confirmed that perceptions are highly accurate and correlate well with climate data also. Nonetheless, perceptions cannot be a replacement for climate data and trends (Parsons, 2021).

One study of migration theory came to the conclusion, "If the environment has a major impact and adaptation is unlikely to succeed, the costs of migration are lower than the costs of staying at a given location, and, hence, migration becomes an adaptation strategy

to environmental change…. migration decisions are likely to be affected to a large degree by individual perceptions of environmental change, rather than environmental change identified objectively with ‘‘scientific risk analysis, performed by experts, of system characteristics of the physical or social world” (De Longueville, 2020). In Africa especially there is a gap in literature on how climate risk is perceived and how adaptation and migration decisions are made (Steynor, 2019). An understanding of an individual’s or community’s perception of adaptive capability, including restraints, institutional support, and knowledge, as well as the perception of climate impacts can better explain how climate and migration intersect (De Longueville, 2020)(Koubi, 2016)(Brussow, 2019).

3.4 Purpose

This study aims to gather an analysis on the general trend of climate knowledge and perceived climate impact amongst cross border refugee populations in Europe. The demographic studied is a typical sample of the refugee populations seeking asylum in European countries, namely those who have migrated from Africa and Asia. Their perceptions of the extent to which climate change impacts their countries is compared against the physical science data available, as well as the relationship of those drivers to migration decisions. This study addresses one of the main research gaps in the climate migration field, which is that of refugee perceptions, and how that compares and contrasts to the physical science data (Hoffman, 2021)(Gemenne, 2011). Since much climate change data is acquired on a large scale, and predictions are made based on models, a gap remains where the knowledge of the most vulnerable populations can provide valuable insight into how climate change is and will affect migration from these vulnerable regions (Migration Data Portal, 2022). This study uses a content analysis and compares the content of a series of refugee interviews to the latest climate data from the regions they are fleeing, focusing on the demographic of those who have already fled to Europe.

3.5 Study Scope

Figure 4: A map of the most common migration routes to Europe (BBC)

This study focuses on the demographic of refugees and asylum seekers who have migrated to Europe from the southern hemisphere, including Africa and the Middle East.

It limits the demographic to those who have arrived via illegal migration routes, and are seeking asylum in a European country. The study was primarily held in Greece, both in Athens amongst the illegal and asylum seeking population, and on Lesvos island, off the coast of Turkey, where Europe's largest refugee camp was held before it burned down in late 2020. Now there is a new refugee camp, with a smaller but ever changing population size. People arrive to these islands via small rafts floating across the Aegean Sea at night, or by foot or vehicle on the land border. These are often dangerous pathways and people arriving are met more often than not by hostile attitudes from authorities and locals on the Greek islands. These hotspots became common areas where asylum seekers remain for years awaiting a decision on their status, after EU securitization policies were put in place in 2016 (Fotaki, 2022). Interviews were also conducted remotely with asylum seekers located in other European countries, but they had all passed through Greece at some point.

The origin regions for the analysis are divided into the Middle East (Afghanistan, Iran, and Syria), the Sahel (the Gambia, Burkina Faso, Nigeria, and Guinea), Sub-Saharan Africa (Ivory Coast, DRC, and South Sudan), and The Horn of Africa (Somalia). These groupings were decided by climatic zones and interview responses. There is a broad scope of study for the regions, but it gets more narrow going into the case studies, which focus on Somalia, Iran, and the Gambia. Stories and accounts are also evaluated on an individual scale.

3.6 Research Questions

- How does climate change influence migration from a refugee perspective?
- Do refugees believe climate change is a reason people need to migrate to Europe?
- How does climate change affect the countries people are fleeing from?
- How do perceptions compare with the physical science basis and predictions?

3.7 Importance

This study is important because it is unique in assessing both the physical science data from origin countries, and also the perceptions of refugees in Europe. There have been previous studies in countries comparing data to perceptions of climate change, but not often in the context of migration to Europe, and not often from the perspective of refugees in Europe. This is an important demographic to understand because the Mediterranean hosts some of the most contentious migration pathways in the world (McAuliffe, 2022), and those who are coming to Europe this way need a voice, to understand their reasons for doing so. Climate data alone, or migration data alone, do not do a complete enough job of assessing the climate-migration nexus here, as there are layered reasons that go into a decision to migrate (Parsons, 2021).
Understanding the climate-migration nexus is crucial for being able to anticipate migration waves and put the right policies in place to manage them humanely and equitably (Arenilla, 2020). Especially considering the displacement capabilities climate change has already demonstrated and will increasingly continue to have in the future

(McAuliffe, 2022). There has been growing academic research on these trends as well, in order to truly understand the relationship between climate change and refugee diasporas (Gemenne, 2011)(Hoffman, 2021). A review of methodologies of studies of climate migration suggested some ways to mitigate research gaps, and suggested, "Comparing narrative accounts to the scientific data on climate change impacts and adaptation gives meaningful insight into the climate-migration nexus (Zapata-Barrero, 2018) (Praag, 2021)." That is what this study aims to do.

3.8 Expected Outcomes

Expected outcomes include comparisons between the climate science data available and refugee perceptions of climate change in the specified regions, an analysis of the relationship between climate change and migration based on interview responses, and an analysis of risks, impacts, resilience, vulnerabilities and adaptation in a few select countries based on the interviews. This analysis will show a general trend of refugee perceptions of how climate change is perceived, if it is believed to be affecting the countries from which migration is stemming, if it is a cause of migration, and how it is a cause of migration. Deliverables include charts, tables, and graphs depicting the relationship between climate change perceptions in different regions to migration, as well as a discussion of this topic.

4.0 Methods

General

This study was interdisciplinary in nature, examining the physical science basis of climate change, it's impacts and adaptation strategies, as well as the social aspect of these topics, especially migration and human perspectives. This research utilized the methodology of snowball sampling, semi structured episodic interviews, and mixed-methods qualitative and quantitative data analysis. Qualitative research can give insights into the human experience, and provide nuance to a scientific study that quantitative data often lacks. In this case, the scientific basis for climate change and adaptation to climate change were reviewed in the context of human migration. To provide deeper understanding of this, a qualitative analysis of narrative experiences of refugees in Europe was conducted; this provided knowledge that cannot be found in the physical science literature.

The quantitative method investigated the answers to survey style questions. The chosen methods for qualitative data analysis were matrix and content analysis, which slim down the bulk of the transcripts into more relevant and manageable sections and categories, to then analyze further. Key topics mentioned (such as water scarcity, flood, agriculture, etc…) were noted, the frequency of mentions, and relational mentions to migration. Finally, case studies of individual countries combined all aspects of the data collection and analysis. Graphs, charts, and written summaries are used to consolidate the results.

4.1 Ethical Considerations

The biggest concern in studies involving vulnerable populations is how to ensure you are not doing any damage by conducting your research. In a book written by (Galis, 2022), he discusses the moral dilemmas he faced while conducting research and interviews with migrant populations on the Greek islands:

Several questions arose: how did the way they perceived me influence what they told me? How should I assess the quality of information, given that the subject is in a vulnerable position? What should my role be, not as a fragmented (sometimes a researcher, sometimes an activist, sometimes neither) subject but as a whole, to their requests whatever these were? Was it wrong of me to digitally connect with these people? Wrong for whom and for what? Was it politically, socially, or research-ethically wrong?

This passage brings up several good points, as for myself I was digitally connected with many of the people I interviewed, and on friendly terms with them before the research started. However, there is an inherent power imbalance in relationships like these, which needs to be acknowledged. I discussed these questions with a couple of close refugee friends of mine before starting, and the only person who seemed to think there might be any moral problems was myself. One friend said he often declined interviews because the researchers would come to the island, ask their questions, and then leave and never contact the interviewees again. He said in my case, however, since I was already in regular contact, he had no problem with helping, and with asking his friends to help also.

Before starting I asked myself some questions about what negative impacts I could have, and tried to address them before hand (Müller, 2021)(Zapata-Barrero, 2018). How would my position as a white American and academic impact the way the interviewees answered and responded to my questions? Would they feel pressured or be hoping for monetary compensation, and would this impact how they responded? Would people feel used? Since this study does not directly help any of the migrant populations and is only for my academic gratification – does this qualify as a good enough reason to conduct the research? Would my questions bring up old traumas? (Galis, 2022). There are also cultural differences to consider, and especially as a female interviewing single men, I needed to be careful not to offend or give the wrong impression (Flowerdew, 2015). This was only an issue of concern when meeting in person usually, though, and not much of an issue remotely. And lastly, one concern was that people would feel embarrassed or pressured to lie if they did not have much knowledge on climate change (Slootman, 2018).

With these questions in mind, I made some rules before starting (Müller, 2021). The people I interviewed first were close friends of mine who I am in regular contact with and felt very comfortable asking. They were likewise happy to help any way they could. There were a couple of friends who declined because they felt nervous speaking about their

home countries, and I assured them I understood completely. They helped me to recruit some of their friends, and normally they asked their friends privately if they would like to help, or if they could give me their phone number, before their friends were in touch with me at all. This way their friends could decline without feeling any unintended pressure from me. All interviewees would remain anonymous, and I would only use their origin countries as indicators in the text. This I told them before starting. I would not ask about any personal stories unless they freely offered them, and I would make it clear that my focus was only on the climate in general. I ensured everyone that it did not matter if they knew nothing about climate change, that I was interested in knowing that also. I always made sure to say that if they did not want to participate it was totally fine, and some people did say no, normally out of shyness and perceived lack of knowledge on the subject, and I did not pressure them a second time. For those who said yes, I explained that it is a university project about climate change and migration, and I was interested in their perspective. I never interviewed anyone who is currently living in a refugee camp, or in a situation where his or her basic needs are not met. I only interviewed people who have a relatively stable situation and enough free time. I asked permission to record the conversation beforehand, and made sure to get oral permission before clicking record. I also offered, if anyone was interested, to send them the thesis when I was finished.

Although this research is arguably adding to the redundant and abundant research that has already been done on migrant populations, and is not helping these populations directly (Galis, 2022), I would argue that it is always valuable to give a voice to vulnerable populations (Zapata-Barrero, 2018), and that in doing this study care was taken that no harm was done.

4.2 Sampling

This sample was collected using the Snowball Method (Flowerdew, 2015)(Zapata-Barrero, 2018), using contacts from previous work in the refugee camp on Lesvos, and also in Athens, Greece. I also used some contacts from NGOs and friends in other European countries, including the UK. From the contacts I knew, which were primarily former colleagues and friends, I expanded the circle through their friends, and in this way got the chance to interview a diverse set of people.

The sample was a majority, but not all, single men, as this is the largest demographic in the refugee settlements. There are refugees from many countries who flee to Europe, and the nationalities in this sample are not a complete representation of the refugee population in Europe. However, the sample size of 25+ interviewees should negate any redundancy and provide a good representation of the population (Slootman, 2018)(Zapata-Barrero, 2018).

In the case of Afghans who spent most or all of their life in Iran, I included them in the Iran category, as this was the country they had to flee, and also where they had the most

knowledge and experience. So "Country of Origin" represents the country that the interviewees first left from to start their journey to Europe (Zapata-Barrero, 2018).

Country of Origin	Number of Interviewees
Syria	4
Burkina Faso	4
Afghanistan	4
Iran	4
The Gambia	3
Somalia	2
Ivory Coast	1
Nigeria	1
Democratic Republic of Congo	2
Guinea	1
South Sudan	1

4.3 Data Acquisition

One of the benefits of the semi structured interview for research purposes is that it allows room for complexities and clarification – as opposed to the questionnaire or more structured questions, which can be more stifling. Especially for this research, semi structured interviews were the appropriate method as it is a complex subject, spanning several countries and situations. There were also language barriers and knowledge gaps, which needed addressing in the course of the interviews, which could not have been solved if using a survey alone. Additionally, a conversation allows for topics or ideas to be raised that the interviewer may not have thought of before that can be interesting for the study. The semi structured style leaves room to change the questions slightly if needed, so that the interviewees understand the meaning, or if the interviewer needs to educate the interviewee about the subject matter in the questions as the conversation progresses; this allows for some improvisation, whilst still maintaining the integrity of the research (Flowerdew, 2015), (Steigemann, 2019), (Müller, 2021) (Zapata-Barrero, 2018).

Episodic interviews were conducted for this study. "Episodic narrative interview is a method that provides a targeted window into the experiential aspect of social concepts and issues; it helps us to uncover the layered reality of difficult-to-see social phenomena by way of storytelling" (Mueller, 2019).

Interviews were conducted in person, at cafes and homes, often over a coffee or meal, and others were conducted remotely on Whatsapp. Most everyone had a high level of English proficiency. For those who struggled with the questions, a translator was used – always the friend who connected us –in this case for Farsi, Arabic, French, Moore, and Mandinka.

For a couple of interviews, online translation applications were used to clarify questions, but this was mostly avoided due to the lack of accuracy these applications can tend to have. Many of the interviews were conducted completely in English, and all interviews were partly in English. Every interview was either recorded, or voice messages and written messages were used in Whatsapp to record all of the answers. The average interview lasted around 30 minutes, with a lot of variation in times (Praag, 2021), (Flowerdew, 2015).

4.3.1 Interview questions

The follow up questions in italics indicate flexibility, so these were often different in each interview. The last two questions offered a survey style Yes/No response, but also allowed for in depth discussion, so they served two purposes here – for the quantitative and the qualitative analysis.

How has climate change affected your home country or other countries you have lived in along your journey?

Is there more or less rain than in years before?
Is there enough water for people?
Do farmers have any issues now that they didn't used to?

Was climate change one of the reasons you had to migrate to Europe?

Is it one of the reasons you feel you want to leave Greece?

Do you think climate change is a reason people migrate to Europe?

How about internal migration?

(Flowerdew, 2015) (Praag, 2021)

4.3.2 Difficulties

One difficulty encountered during the study was a lack of awareness or understanding about climate change among the people interviewed or among those asked to be interviewed. Many people declined to be interviewed because they felt that they knew nothing about the topic, or felt too shy to speak about something they only knew a small amount about. Those who were happy to be interviewed sometimes spoke about the weather rather than the climate. This was fine in many cases, because I could follow up their description of weather with asking how the weather has changed over their lifetime, which often led to insightful conversation about climate change. However, in some cases, there was a clear misunderstanding, and many people spoke about their weather preferences, for example why they liked warm weather rather than cold, and topics such as these. One interviewee also asked me if not liking the weather was a reason people could claim asylum. In conversations like these, I tried to avoid leading the interviewee into answering how they thought I might want them to, but I did explain the basic principles of climate change and why I studied it in university (Flowerdew, 2015). I asked more specific questions, about how the water situation is in their home country, or how it

is for farmers (Praag, 2021). In some cases, people who at first thought they had no knowledge of the subject, as they spoke, discovered they knew more than they thought. For example, they spoke of rivers in their home cities that had dried up over the course of their lifetime.

4.4 Data Analysis

4.4.1 Quantitative Analysis

This part of the analysis is a simple bar graph analysis of the answers to the Yes/No questions divided by country:

Was climate change one of the reasons you had to migrate to Europe?

Do you think climate change is a reason people migrate to Europe?

Combining qualitative and quantitative is a good way to get a broad picture of the findings, as well as investigate the nuances of the subject. By using quantitative analysis on the partial survey questions, objective large-scale patterns can be found. This is a good supplement to the more subjective aspects of qualitative research. The two epistemological perspectives tackle the research questions from different angles, giving a well-rounded study analysis (Slootman, 2018).

4.4.2 Qualitative Analysis

The qualitative analysis furthers the study with transcription of the interviews, coding of key topics mentioned (water scarcity, agriculture, rainfall pattern changes, flooding, heat, etc…), and graphing the number of mentions each of these topics receives and from which countries and regions. It then investigates the relationship between these factors and mentions of migration (Steigemann, 2019). After this follows a discussion of the results and it's relation to the scientific data and future projections on climate change in these regions (Praag, 2021)(Zapata-Barrero, 2018).

"Content analysis is a research tool used to determine the presence of certain words, themes, or concepts within some given qualitative data (i.e. text). Using content analysis, researchers can quantify and analyze the presence, meanings and relationships of such certain words, themes, or concepts" (Columbia Public Health).

"Matrix analysis in qualitative analysis is simply the cross-matching of an x-axis (one set of categorical elements) and a y-axis (a second set of categorical elements) for the purposes of data reduction, display, synthesis, analysis, and interpretation. Using bullet points of succinct information, the cells of a matrix are informative and comparative. Viewers can see an immediate visual comparison of information across research questions, categories of participants, or other designated classifications of data" (Averill, 2022).

These methods are most often used for interview based qualitative research. They consist of transcribing the interview material, editing it into manageable sections, coding key phrases and topics mentioned, and transforming that data in a visual presentation of meaningful data and relationships, as well as a discussion of the results (Averill, 2022). This study uses conceptual and relational analysis; the former counts the number of mentions each coded topic gets, and the latter counts the number of co-occurrences of coded topics (Columbia Public Health). In this case these topics are climate related phenomena, and co-occurrence with the mention of a need for migration, sorted by country of origin or region.

4.4.3 Transcription

Transcription from audio recordings is standard in qualitative research, especially with interviews. For this study I did the recordings on my phone, and transcribed myself without the help of software. The transcriber typically has the freedom to decide what to include in the text, and how naturalized or denaturalized (edited verses verbatim) the transcription should be (McMullin, 2021). In this study, I used denaturalized transcription, with irrelevant parts cut out, and notes added for clarity. I did not include body language or other non-verbal cues in the notes (Steigemann, 2019). They maintained the original grammar and exact wording, but include a few parentheses to clarify meaning. The meaning was clarified before transcription, during the interview – often by hand gestures, follow up questions, or google images. The … is used to mean something was cut that was not useful or meaningful to the study, often unrelated conversation or long pauses, or if a translator was used. The brackets [ ] show my question to the interviewee, to clarify their answer.

4.4.4 Coding

After editing the text into only relevant material, the text was coded manually by topics mentioned. I chose 11 topics or "codes" (heat waves, cold spells, wildfires, change in precipitation patterns, change in seasonal patterns, floods, water scarcity, land change including deforestation and desertification, agricultural difficulties, pollution, and pests/disease), which were mentioned relating to climate change, and measured the frequency of mentions in the text. These are displayed in the pie chart in the results section. The frequency of mentions were then analyzed by region, into 4 regions and climatic zones (Middle East, Sahel, Sub-Saharan Africa, and Horn of Africa). The analysis was then run again to see how often a mention of migration accompanied a climate change mention, which are summarized in a table, by region. A flow chart displaying the relationship between the climate change codes and migration codes was then made, as a singular example of the complex relationships uncovered in the interviews (Steigemann, 2019)(Averill, 2022).

4.4.5 Physical Science Comparisons

Lastly, comparisons were run between the latest IPCC trends and projections and the interview perceptions. Datasets and models were used to see how the physical science data and projections compared to the perceptions of those who lived and fled these

countries. A comparison chart was made comparing IPCC regional synthesis data to the interview responses; the perceptions from each country were “averaged” across responses, which I assigned either “low confidence” medium confidence” or “high confidence” just like the climate data, and then averaged for each country. Analyses were run using datasets CRU-TS, GPCC, and ERA5, adjusted for different months, regions, and variables depending on the region and the focus of the interview answers. CMIP6 and CORDEX Africa models were used to analyze projections in the different regions, also adjusted for different variables, region, and baseline data. The most conservative future scenarios (RCP 2.6) were mostly used, which would require a very stringent CO2 budget going into the rest of the century; however, for the uses of this study the projections most similar to the current situation in these regions seemed appropriate. Other scenarios were also used for comparisons.

4.4.6 Case Studies

The final part of the qualitative analysis is a case study approach for different countries (The Gambia, Somalia, Iran), going more in depth on how climate change is influencing these countries, what else is influencing vulnerability, and what adaptation strategies are available for these countries. This includes how climate change is fueling or interacting with conflict, instability, or unemployment, and lastly, if or how it forces people to migrate all the way to Europe, and what adaptation options there are to avoid migration. The narrative accounts are valuable here. These case studies allow for a deeper dive into the drivers of climate migration, including the socioeconomic and political situations that force people to migrate, and why people choose migration as an adaptation strategy.

5.0 Results

5.1 Overview

This study first and foremost aimed to investigate the perception refugees in Europe have of the role climate change plays in migration, including their own migration. The vast majority of interviewees (93%) did not believe climate change had played a role in their migration, but the majority (59%) also believed that climate change is a reason people migrate from their country in general. While further investigation into personal stories in some cases revealed that climate change did in fact play a role in the interviewees having to migrate…since it was not their initial perception, it was marked as a no. The following figures depict the data from the interviews:

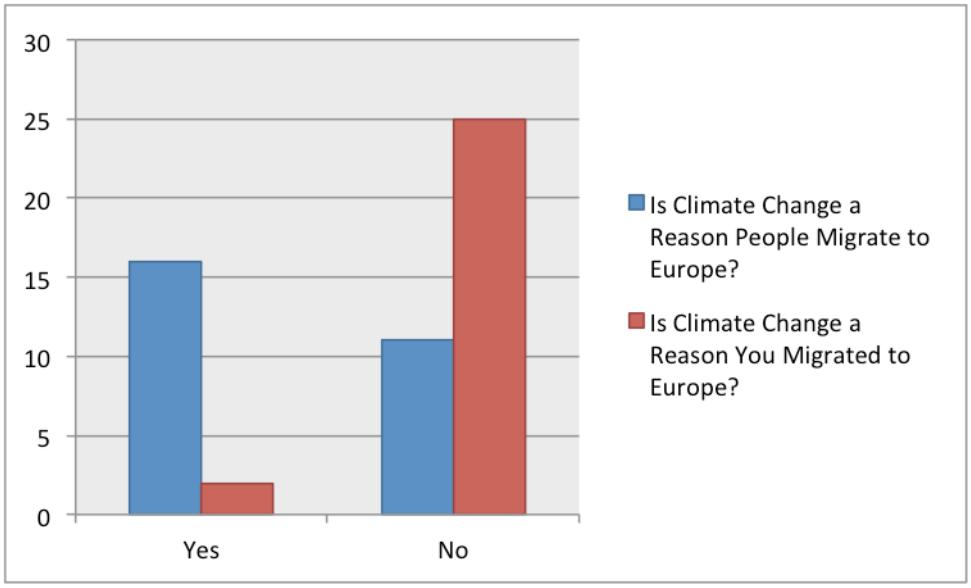

Figure 5: A bar graph displaying the interview responses to *Is climate change a reason people migrate to Europe?* And *Is climate change a reason you migrated to Europe?*

Is climate change a reason people migrate from your country of origin?

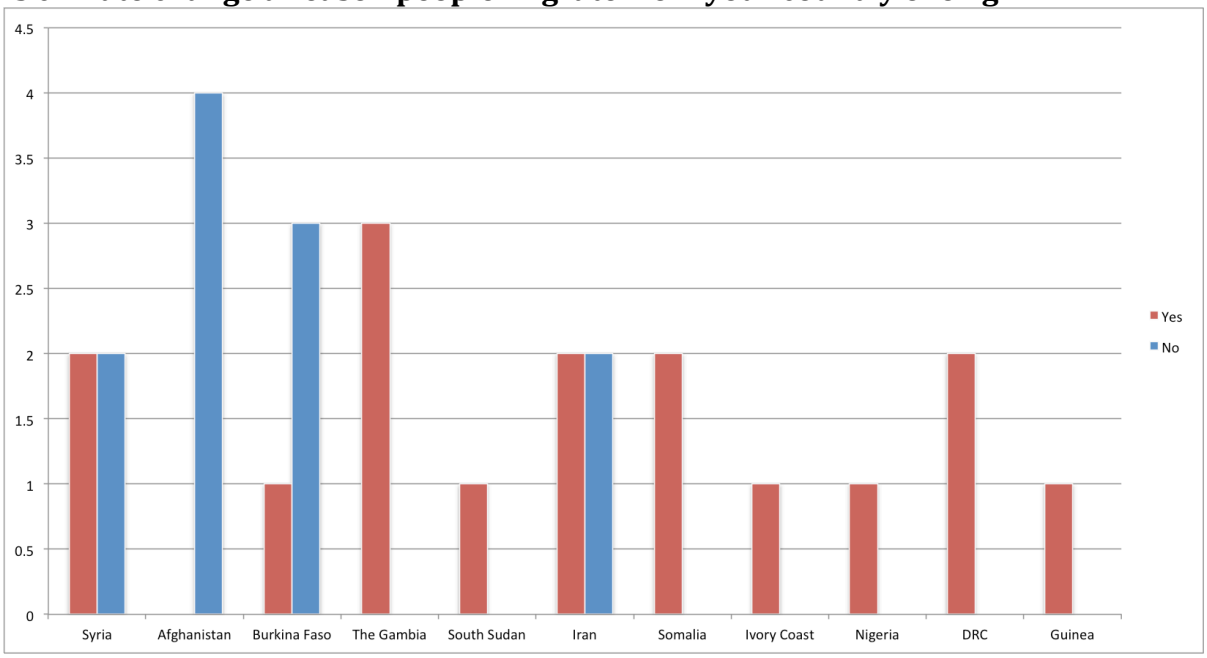

Figure 6: A bar graph displaying the interview responses to *Is climate change a reason people migrate from your country of origin?*

The responses as to whether people migrated from their country because of climate change were varied and rather equally split between yes and no. While many of the interviewees believed climate change was affecting their country, they believed the bigger reasons for migration were more in regards to conflict and unemployment. Of course, the argument can be made that these are indirect effects of climate change. This study just aims to look at refugee perceptions, however. While many of the interviewees did not know the term "climate change," they understood when asked if the "weather had changed over their lifetime." Some interviewees believed that people did leave because of climate, but they did not think it was a reason for international asylum seeking because they did not think that was legal – which can be true – so some of those who said no did admit that changing weather made people migrate but that it was not a reason to seek asylum in Europe (McAuliffe, 2022)(UNHCR, 2022). Some of the responses below highlight these complex answers more clearly, as a yes/no survey can only provide limited information.

One interviewee from Burkina Faso when asked [Is it a reason people leave?] said,

"I don't think so. If it was like its not raining, we are not leaving because of that. If we leave because of that it is like we leave for economic reasons. It is not like that, it is because of the conflict."

This answer can be explained in that he further explained that he did not believe that climate change could legally be a reason people could seek asylum, even though he said it is true people do migrate because of the climate, notably changes in rainfall. Others

from Burkina Faso also did not believe that it could be a reason for migration, or even know that the climate was changing at all. An interviewee from Afghanistan explained,

"Afraid to die 100% reason people leave. But the Taliban take away water and food. So maybe 50/50. They stole all the food, and… they explode the (wells) so no water in the houses. Because now most people leave about food, about water, about die. This one mixed together 50/50. But not about the weather, about the Taliban."

Another said, "There are lots of reasons (people need to leave Afghanistan), maybe one of the reasons climate change. Mostly the war."

While these interviewees acknowledge that climate change can be a factor influencing migration, they also know that the war is obviously a major factor influencing migration as well, and it can be difficult to define exactly how much climate plays a role. They definitely believed a lack of water and food were worsening the effects of the conflicts in the region, either by the Taliban hoarding resources, or by climate change drying up rivers and agriculture struggling. That said, they did not think people left Afghanistan because of climate change.

Those from Syria, another country with obviously severe conflict and war, had similar answers although they also mentioned seasonal changes that were affecting their country. Again, while it may not have been their personal reason for migrating, they acknowledged that it can be a factor for some people, even people that they know,

"(Climate change) is not a reason that prompted me to migrate, I have a completely different story. But I know many people at the present time have migrated to other countries because of the lack of electricity in Syria, the lack of water, and the severity of the cold or heat at the present time."

Two Syrian friends when asked (Is it a reason people migrate?) answered, "No, no no. People leave because of the war. I don't think the refugee leave their countries because the weather is changing."

His friend then added, "I don't think refugee come here because of the weather or something. But yeah it has changed, because this year there came crazy snow, like a lot, but rain not, just snow. A lot more than (other) years. (Snow) doesn't usually come."

The other interviewee then agreed, "This year is more cold, not like the last years. Not a reason for migration, but the weather has changed in Syria."

The responses from Syria were 50/50 whether people leave because of climate change or not. While the interviewees had not been affected themselves to an extent of migration, they knew that people in their countries were.

100% of those from the Gambia, Somalia, DRC, Ivory Coast, Nigeria, and Guinea said that people do leave their countries because of climate change, but again it is a complicated response and people also leave for war and other conflicts. They also commented on neighboring countries, for example one interviewee from the Gambia noted that Mali and Niger were experiencing migration from climate change.

An interviewee from South Sudan said, "Our people migrate mostly because of nonstop war. (But also) flooding, and most recently locust infestation."

And an interviewee from the DRC said, "For the DRC, it's not a country currently (where many people leave because of climate change), but other countries are, West African countries."

Iran was also 50/50 in whether people left because of climate or not, but all of the interviewees said that climate change is affecting Iran, just not always that it was leading to migration.

In summation 33% from the Middle East region, 67% from the Sahel, 100% from Sub-Saharan Africa, and 100% from Horn of Africa said that climate change is a factor. These responses indicate that although the interviewees might not have personally been forced to migrate by climate change, they are aware for the most part that it is happening and that it is a reason people migrate.

5.2 Content analysis

The content analysis revealed the following distribution of climate change mentions in all of the interviews. These were the responses when asked how climate change is affecting their country. So these mentions are not necessarily a direct link to migration.

The content analysis is then further broken down by region to show the distribution of climate change mentions per region, compared to IPCC past trends and future predictions by region. This only includes factors that were mentioned in the content analysis from the interviews. Naturally, there may be and likely are more impacts from climate change in these regions that were not mentioned in the interviews.

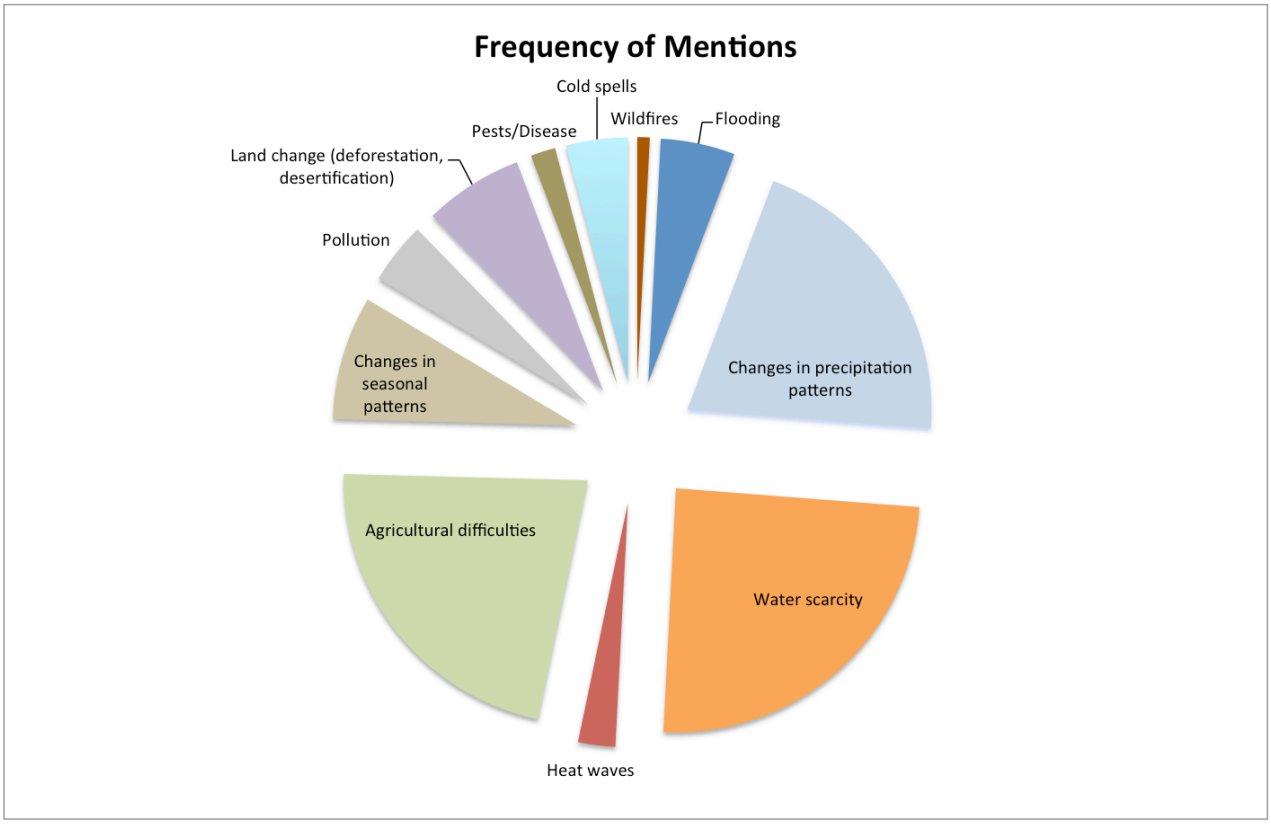

Figure 7: A pie chart displaying the distribution of mentions of each climate change effect in the interview transcripts

The majority of the climate impacts felt by interviewees in their countries and perceived to be influencing migration were slow onset events. This included the top three mentions, which were water scarcity, agricultural difficulties, and changes in precipitation patterns. Changes in seasonal patterns were mentioned frequently as well, followed by land change (deforestation, desertification). These are all slow onset events. Flooding, pollution, cold spells, heat waves, pests/disease (including locust infestations), and wildfires were mentioned in decreasing order. These could all be considered sudden onset events, although flooding when referring to sea level rise is slow onset. Cold spells could fall under seasonal changes, which cumulatively would be slow onset, similarly to heat waves. And long term pollution exposure risk as well as disease vector risk is a questionable category in regards to slow or sudden onset. This selection of factors comes from the interview transcripts, as these are the factors that were mentioned.

5.3 Middle East

There is generally medium to high confidence that the main risks to this regions are heat, drought, and aridity, which will in turn negatively affect agriculture and create more water resource conflict. This is a region which is naturally hot and arid and dependent on a delicate balance of water resources (Lelieveld, 2012)(UNDP, 2022)(Caretta, 2022). This tracks with the responses from interviewees about stresses facing their region, and agricultural difficulties and water scarcity were the two primacy

impacts mentioned. One study found that drought was not a major driver for conflict in the Middle East, however it did lead to economic hardship and large scale migration (Feitelson, 2017). However when it comes to the physical science data there is uncertainty between datasets such as CMIP5 and CMIP6 and a high amount of spatial and seasonal differences, which gives low confidence to model projections in this region (Caretta, 2022)(Mirzabaev, 2022). The following sections go into this data more in depth.

Mentions of climate impacts from interviewees in this region were of agricultural difficulties and water scarcity the most, followed respectively by changes in precipitation patterns, changes in seasonal patterns, cold spells, pollution, heat waves, land change and wildfires. This is depicted below in the pie chart.

Observed trends and future projections from the IPCC regional synthesis compared to perceived risks and impacts from interviewee transcripts are depicted below. The top row goes by country, as an average of responses about the impact (yes affected, medium affected, or not affected or unsure), and the bottom row shows the observed trends and the future projections from IPCC data in the region.

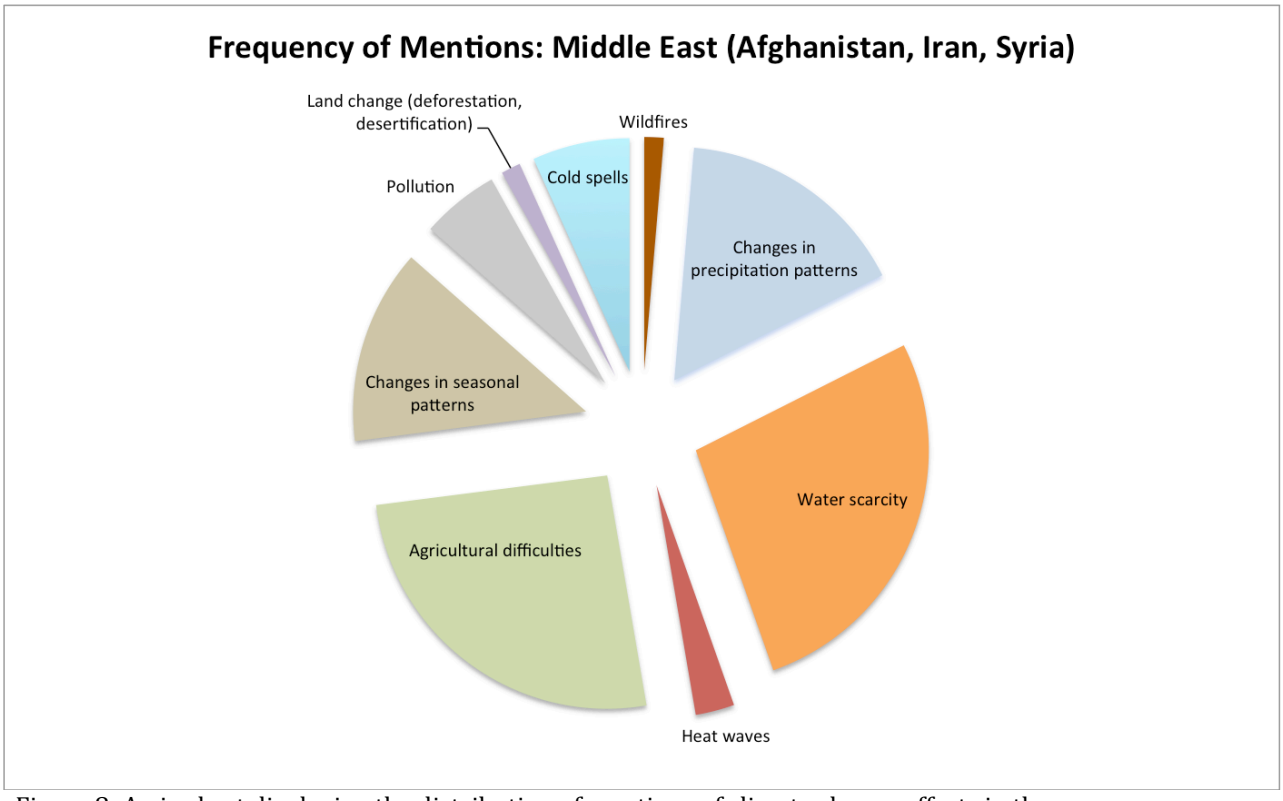

Figure 8: A pie chart displaying the distribution of mentions of climate change effects in the interview transcripts from interviewees from the Middle East

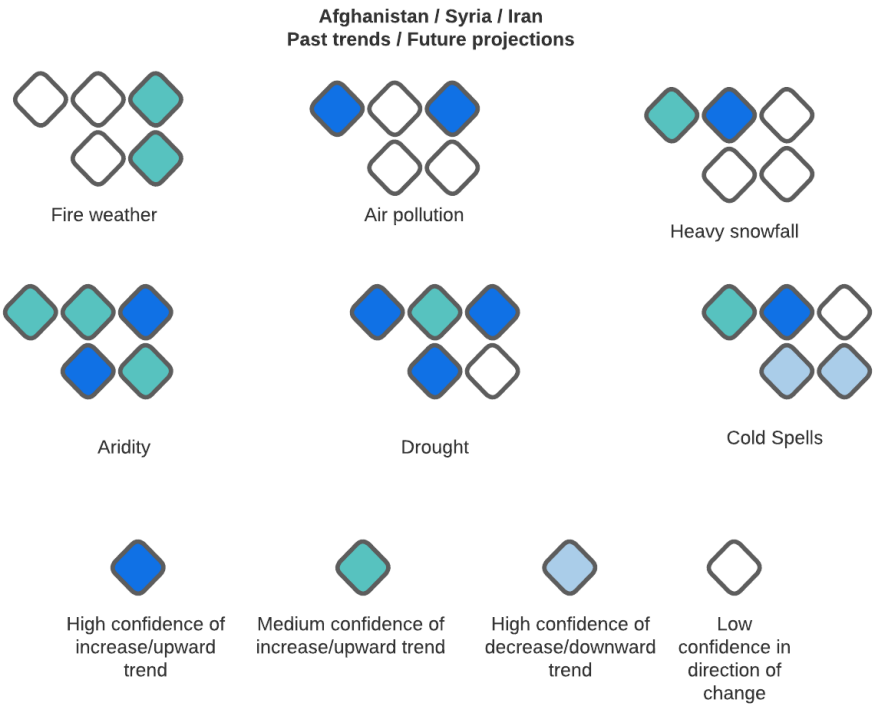

Figure 9: A comparison of interview responses from interviewees from Afghanistan/Syria/Iran (country diamonds in order, top row) against IPCC Atlas data (bottom row) including past trends (bottom left diamond) and future projections (bottom right diamond) for the strength of confidence in various climate change impacts (IPCC Atlas Regional Synthesis, 2021)

5.3.1 Precipitation and water

This region is already characterized by being hot and arid, with many regions containing desert, many regions depending on an agricultural subsistence dependent on minimal rainfall, and the mountainous regions depending on glacial melt. The Helmand River basin between Afghanistan and Iran has extremely high water stress already at baseline (UNDP, 2022), and the Middle East region is considered the first in the world to "effectively run out of fresh water," (Lelieveld, 2012). A deficit of water resources is observed across the entire MENA region, and water shortages are felt in all countries in this region (Ajjur, 2021). Water levels in lakes are expected to decrease by up to 45% by the end of the century, and river flows are expected to decrease. There is high confidence that aridity has increased in this region, but with some spatial and seasonal differences, as seen in Afghanistan and Iran. Many parts of Iran showed no significant trends in aridity. There is medium confidence that aridity will increase in the future (Mirzabaev, 2022)(Shaw, 2022)(IPCC Atlas, 2021). Models consistently project an overall drying

trend in this region, “which will impact major river systems and downstream water resources and food production,” (Lelieveld, 2012).

There is also high confidence in observed increases to agricultural and ecological droughts in this region. With an increase in summer temperatures and mean temperature in general, there will be an increase in evapotranspiration, furthering ecological and agricultural drought towards the end of the century with medium confidence (Mirzabaev, 2022). Evapotranspiration is projected to increase all across the MENA region, causing an imbalance of water resources (Ajjur, 2021). Confidence in broad generalizations of drought projections over this region were low to medium however, due to large variations of precipitation and temperature data, and future projections of drought have low confidence of direction of change (Mirzabaev, 2022)(Shaw, 2022)(IPCC Atlas, 2021). The following figure displays the decreasing rainfall trends from the region:

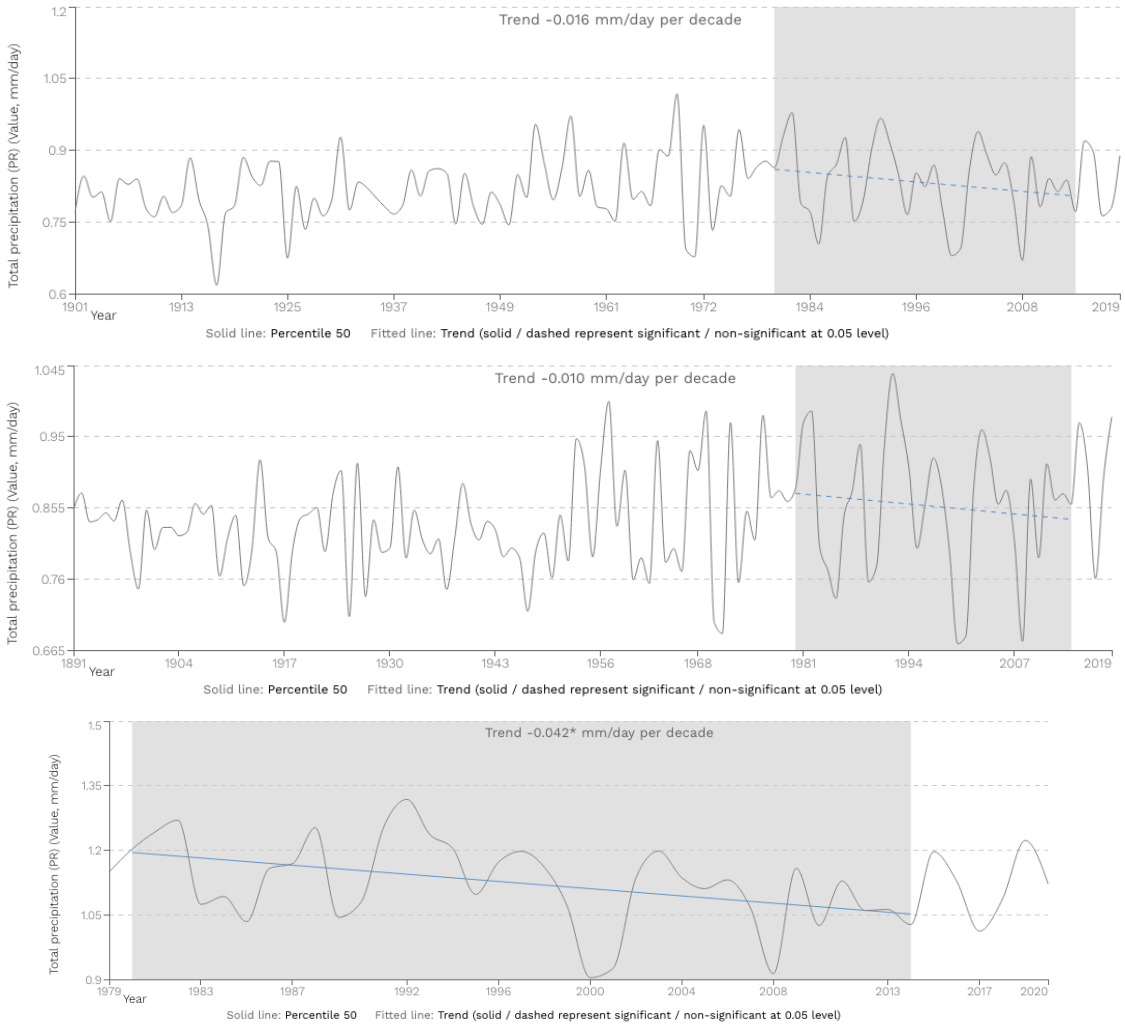

Figure 10: Observations from CRU-TS, GPCC, and ERA5 datasets (respectively shown from top to bottom) showing trends in annual rainfall amount from 1961-2015 in West Central Asia/Middle Eastern Region (IPCC Atlas, 2021)

Observed trends and future projections of glacier mass changes in the high mountains of Asia and the Middle East show continuing decline in glacier mass and area in the coming century (high confidence). GlacierMIP projections indicate that glaciers in the High Mountains of Asia lose 42 ± 25%, 56 ± 24% and 71 ± 21% of their 2015 mass by the end of the century for RCP2.6, RCP4.5 and RCP8.5 scenarios respectively. The Middle East likewise would lose 68 ± 32%, 83 ± 19% and 94 ± 13% of glacial mass. While the short term increase in meltwater would offset deficits felt by increasing drought and aridity, the effect would not last long term as glacial reserves run low (medium confidence) (Shaw, 2022)(Adler, 2022).

Interviewee responses in this region aligned well with the physical science data, and were focused on water scarcity, highlighting lakes and rivers which had dried up in their lifetimes, entire cities which had been abandoned due to a lack of water, decreasing tourism to places which were once beautiful due to the water features, wells which needed to be dug deeper and deeper in order to find water, sinkholes due to a lack of groundwater, and farmers being forced to move in order to continue farming due to a decrease in water. While there were many mentions of water scarcity from climate change from interviewees in this region, one interviewee from Afghanistan explained,

"Kabul has a famous river, in the center of Kabul you see the river. 30 years ago, you go there and you see full of water, but now, nothing, dry…and very dirty."

Groundwater reserves drying up were a common theme, as well as lakes and rivers drying up. Rainfall decreases were mentioned, however it did not seem as important as the others. While the physical science data did not precisely match with perceptions, there is high correlation between responses and data. According to the interviews, these water scarcity difficulties have led farmers, as well as entire cities to migrate due to lack of irrigation water and drinking water. Poor government handling of this crisis and frustration was also cited as a reason for migration. Transboundary disputes over the Helmand River were also mentioned by a more than 3 interviewees as a source of water scarcity and contention between Afghanistan and Iran. Water scarcity was cited as a cause for migration by interviewees, mainly in Iran, but also in Syria and Afghanistan. Especially in regards to the water dispute between Iran and Afghanistan, this tension paired with ethnic conflict has led to migration to Europe. Overall, the physical science data aligns well with responses from the region, and climate drivers were recorded as being reasons for migration to Europe, both directly and indirectly.

5.3.2 Heat

Again, in an already hot region, the effects of climate change are being and will be felt especially in an increase in heat (Lelieveld, 2012). Extreme heat waves are expected to become more frequent by the end of the century, and days over 41 degrees, considered dangerous heat, are expected to increase by 30 days under SSP1-2.6 already by mid century, and 50–150 days under SSP5-8.5 by the end of the century (IPCC Atlas,

2021)(Shaw, 2022). One study found that despite differences in change in rainfall patterns between regions within the Middle East, there was uniformity in the drying trends, indicating that increasing temperatures are the primary cause of drought and aridity (Ajjur, 2021). The following figure (Figure 11) shows a sharp increase in mean temperature, and (Figure 12) shows positive projections for change in days above 40 degrees or extreme heat days:

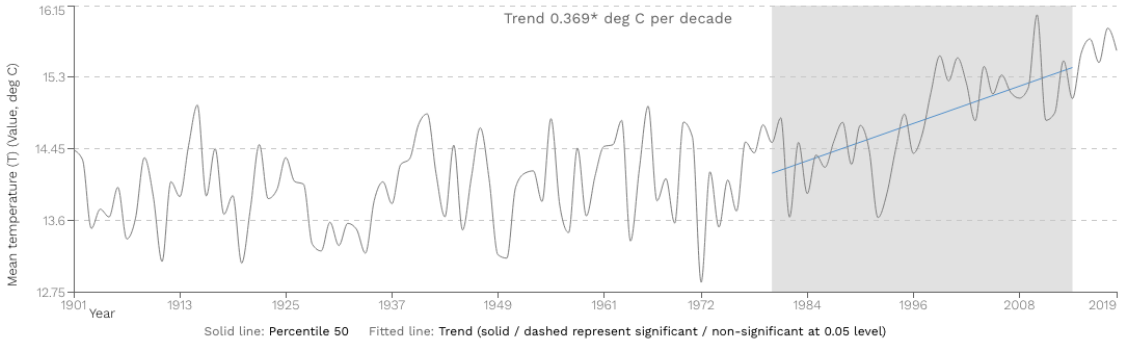

Figure 11: CRU-TS dataset mean temperature from 1980-2015 for West Central Asia/Middle Eastern Region (IPCC Atlas, 2021)

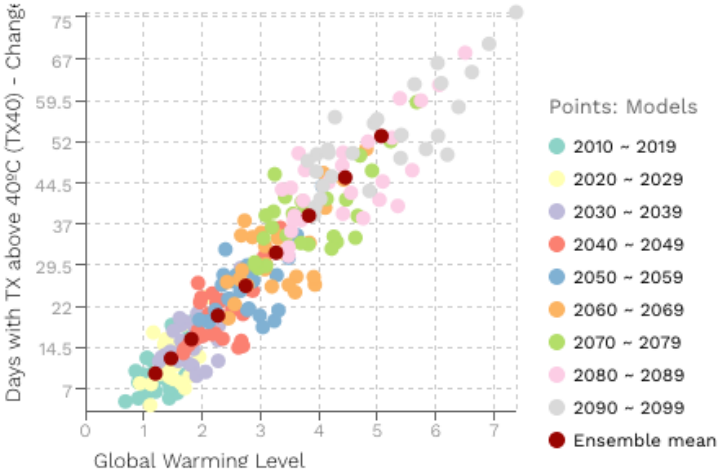

Figure 12: CMPI6 projections for change in number of days above 40 degrees relative to (1995-2014) under RCP2.6 scenario for West Central Asia/Middle Eastern Region (IPCC Atlas, 2021)

Heat waves were only mentioned a small amount by the interviewees, but their responses track with the data, which shows increasing trends. Heat can be inferred to accompany increasingly dry conditions and desertification, however, which was mentioned by many interviewees. Wildfires increasing were also mentioned by an interviewee, which tracks with the IPCC data of medium confidence in an increasing trend in the future; however, there is low confidence in direction of change of past

trends (Shaw, 2022)(IPCC Atlas, 2021). In this case, sometimes the interview responses matched well with the data, and other times there was low confidence in the data so the relationship is not well understood. Heat waves were said by interviewees to lead to migration, mainly with increased dryness and the water scarcity issues faced, which were mentioned in the previous section.

5.3.3 Cold spells and snowfall

One notable climate impact mentioned by the interviewees was an increase in cold and snowfall, especially from those from Syria. The IPCC sixth assessment read, "there is no significant interannual trend of total snow cover from 2000 to 2016 over Eurasia. Observations do show significant changes in the seasonal timing of Eurasian snow cover extent (especially for earlier spring snowmelt) since the 1970s, with seasonal changes expected to continue in the future (high confidence)." While regional specific observations were not available, CMIP6 data and subsequent projections showed a negative change in days of snowfall:

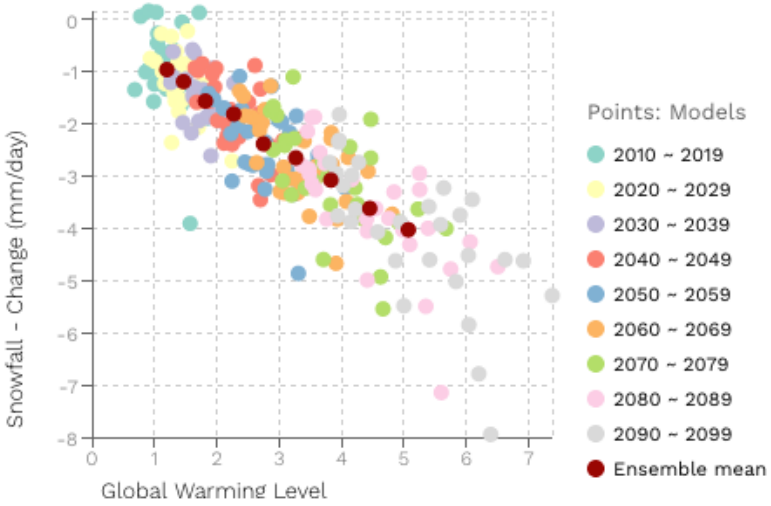

Figure 13: CMPI6 data and projections for change in snowfall (mm/day) compared to global temperature increase for West Central Asia/Middle Eastern Region (IPCC Atlas, 2021)

However, both past observations and future projections for heavy snowfall have low confidence in direction of change. For cold spells, there is high confidence in a decreasing trend, as well as high confidence in a future decrease (IPCC Atlas, 2021). One explanation for this discrepancy between the data and interview responses could be that wars in countries like Syria and Afghanistan are causing fuel shortages for the citizens, hence they do not have heating during the winter as they once did, and the cold is perceived to be more severe. Fuel shortages were mentioned by three interviewees, one in Syria and two in Afghanistan. However, it could be a combination of more intense cold spells and snowstorms and fuel shortages, even though the statistical mean snowfall is decreasing annually, and the mean temperature increasing (Shaw, 2022)(Ali, 2022). Cold

spells and snowfall were not cited as reasons for migration, however, they were cited to cause agricultural difficulties, which were cited as leading to migration, notably in Syria. In Iran, cold and snow were not mentioned by interviewees. In Afghanistan it was mainly the war that was cited as motivation to migrate, however extreme cold and the fuel shortages mentioned previously were said to motivate people to leave the country.

5.3.4 Agriculture

According to the IPCC sixth assessment, GDP and population exposed to high or very high water stress in MENA countries is 71% and 61%, respectively, compared to 22% and 36% in the world. High irrigation requirements and reliance on rainfed agriculture, as well as political instability and poverty exacerbate this risk. The MENA region is also heavily reliant on importing food, making it more vulnerable to climate impacts not just in the regions, but also in other regions. Groundwater recharge is expected to decrease due to decrease flows from rivers, due to decreased rainfall. There is high confidence in a decrease in crop yields due to high temperatures and a reduced growing season. Rain-fed wheat yield is projected to decrease by 2-59% under a 2 degree scenario and upwards. Vegetable yields could decrease by 45% by 2050 under current scenarios, and could even become unviable under warmer scenarios (Bezner, 2022). There is a predicted decrease in rain-fed agricultural lands and grazing lands available due to the drying trends (Lelieveld, 2012).

In this sector, the interview responses tracked nearly perfectly with the data, as there are predicted crop yield decreases and agricultural drought, which the interviewees indicated are a reason for migration. The crops mentioned by interviewees in this region included cotton, wheat, vegetables, and flowers. It was indicated by the interviews that these crops are largely dependent on rainfall coming at the right time, and also groundwater reserves. The farmers were also indicated to be dependent on groundwater for drinking water. Interviewees talked of decreased rainfall and changes in seasonal patterns making it more difficult to be a farmer in this region, forcing people to migrate to other countries. They also spoke of difficulties even getting enough drinking water from the ground, as well as irrigation problems since there is not enough rain. For example, in Syria they had to drive a motorcycle to reach a well to get drinking water now when they had never before, but they could not possibly transport enough water to irrigate their crops this way. This person explained,

“We can bring with motorcycle, water from the earth (groundwater), but not enough to grow, just enough to drink.

And if you ask me about the weather, the weather has changed a lot, from what I know when I grow in this world. It changed a lot, like not like before – the season even they change. Like the winter is not coming exactly on time, and the summer not coming exactly on time. It has changed a lot. Before the flower, when you put it in the earth, she come quick, and she give a lot (of flowers). But because the weather is changing, it don’t come like before. I think like 20 sq m, would give you 3kg before, but now only 1kg.

Before we had 4 seasons in Syria, but now the summer comes longer, and the winter…you don't know (when it will come)."

However, while most interviews mentioned cold shocks also being damaging to crops, the data mentions damaging heat waves more frequently (Bezner, 2022). In Iran, interviewees certainly indicated that dryness associated with increased temperatures damaged agriculture, but in Syria it was said to be the cold spells and unpredictability of seasons, which harmed agriculture and influenced migration. Overall the change in precipitation patterns and water scarcity were the main drivers damaging agricultural production according to the interviews in this region on the whole, which aligns with the physical data. These difficulties were drivers of migration according to the interviews, but so were other social and political reasons.

5.3.5 Pollution

"(In Afghanistan) in the winter, people using for the heater a tire (to burn). The sky's very foggy. A lot of people, especially the children have asthma, can't breath very well. In Iran…they have a lot of factories and it is very terrible for old persons, lots of asthma."

An interviewee from Afghanistan who had also lived in Iran told of this, echoing others from the region who also spoke of bad pollution. Another said,

"When I was in Iran, everything is not good over there. Pollution is everywhere. For example, in the summer you can see the mountains from a far distance, but in the winter it is not possible because the pollution comes down like upside down (inversion). In that time it is difficult for the pregnant women and old persons to come outside…for them it is hard to breath."

Air quality in this region is expected to decrease due to dryness and heat leading to more wildfires, as well as major growth of cities, leading to an increase in mortality (Lelieveld, 2012). Analyses from the IPCC data actually showed projected decreases in particulate matter going into the future, although there was an increase in the past from observed data, and large cities in this region have some of the worst air pollution in the world. For both observed trends and future projections there was low confidence of direction of change, however (IPCC Atlas, 2021). There is a predicted increased risk of vegetation fires and air pollution, which will exacerbate other problems. Additionally this region hosts some major cities such as Tehran, which have degraded air quality already at present and are predicted to worsen (Lelieveld, 2012).

Air pollution was cited in the interviews as a reason for migration due to lowered quality of life and safety for vulnerable populations. It can also be seen as part of an interaction of political and economic hardship, as people are forced to turn to high polluting sources for fuel, and due to stress also from more climate extremes. While pollution was not a major reason for migration from this region, it was mentioned by interviewees as a reason why people want to leave, and an indication of worsening environmental states in these countries.

5.4 Sahel

The Sahel is another region that faces typically hot and dry conditions, but also experiences a monsoon season in West Africa. While climate change is increasing temperatures across the globe, the Sahel has seen the highest increases in mean observed annual and seasonal temperatures (UNHCR, 2022). It is one of the most vulnerable regions in the world to climate change, with a rapidly growing population dependent on rain-fed agriculture for subsistence (Hummel, 2015)(Defrance, 2020). The frequency and intensity of heat waves are projected under all future model scenarios to increase, with air temperatures projected to rise to 2.0-4.3 degrees Celsius by 2080 (very likely), thus worsening other climate risks. A lack of station data and uniform patterns give low confidence to some trends and projections in this region (Defrance, 2020)(Trisos, 2022)(UNHCR, 2022). This region also has a history of seasonal migration like many arid regions, depending on the wet and dry seasons (BRILL, 2019)(Grolle, 2015)(Hummel, 2015).

Interviewee mentions of climate impacts in this region were agricultural difficulties first, followed by changes in precipitation, water scarcity, changes in seasonal patterns, land change, flooding, and pollution, as depicted below in the pie chart.

Observed trends and future projections from the IPCC regional synthesis compared to perceived risks and impacts from interviewee transcripts are depicted below. The top row goes by country, as an average of responses about the impact (yes affected, medium affected, or not affected or unsure), and the bottom row shows the observed trends and the future projections from IPCC data in the region.

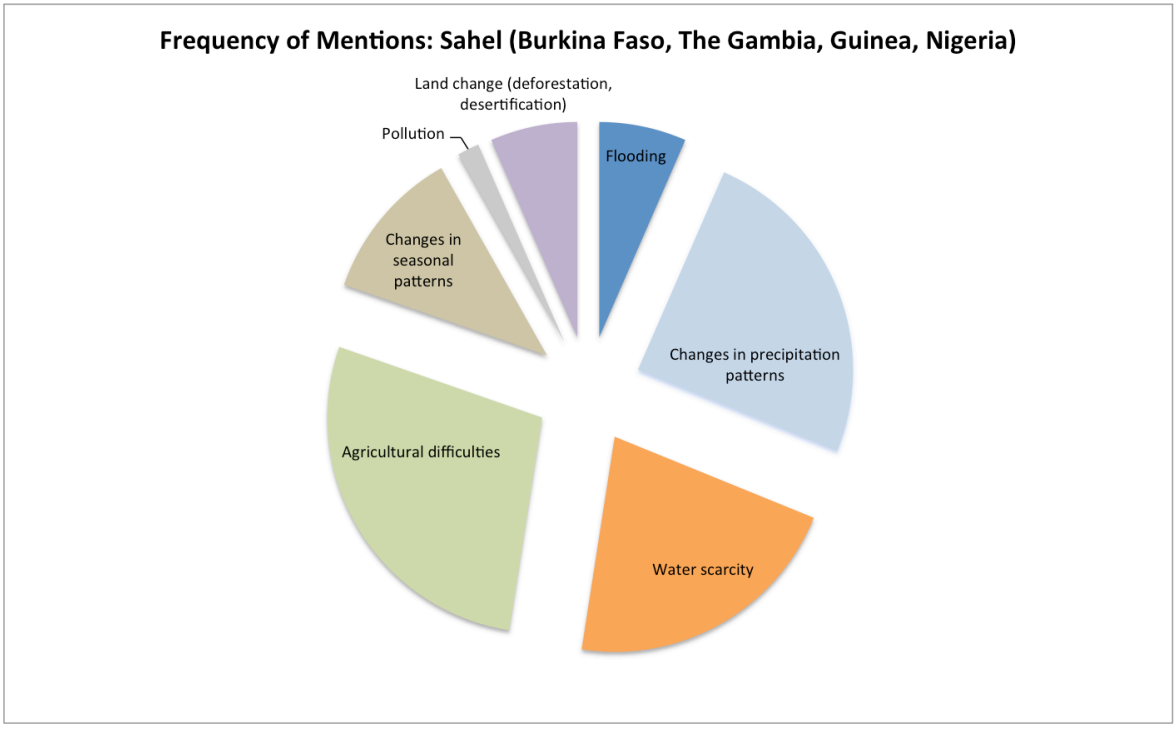

Figure 14: Distribution of mentions of climate change impacts from interviewees in the Sahel

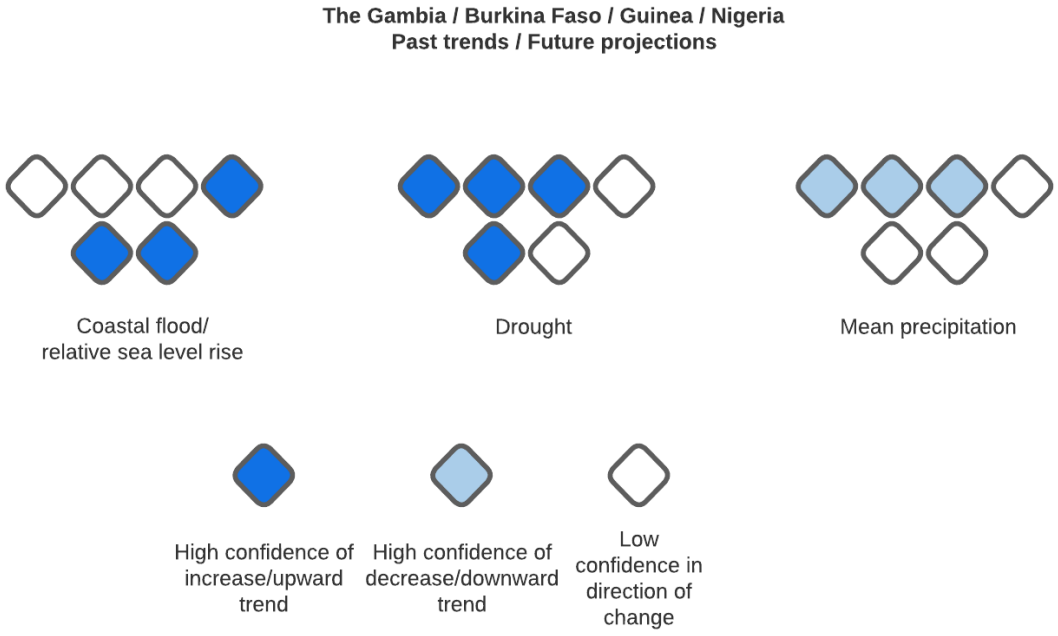

Figure 15: A comparison of interview responses from interviewees from The Gambia/Burkina Faso/Guinea/Nigeria (country diamonds in order, top row) against IPCC Atlas data (bottom row) including past trends (bottom left diamond) and future projections (bottom right diamond) for the strength of confidence in various climate change impacts (IPCC Atlas Regional Synthesis, 2021)

5.4.1 Precipitation

The most "popular" prediction for the region according to one study, is that more erratic rainfall will lead to drier conditions in the Sahel. This was predicted to lead to increase conflict over scarce resources, however little evidence was found of this (Grolle, 2015)(Benjaminsen, 2021). Precipitation data is the most unreliable data in this region due to a lack of meteorological stations. In addition, future models are less reliable than those of temperature, because there is more year-to-year variability (UNHCR, 2022)(Trisos, 2022). Both past trends and future projections of mean precipitation have low confidence in direction of change (IPCC Atlas, 2021). Some studies even suggest that the Sahel has gotten greener since the droughts of the 1970s and 80s, which led to widespread displacement, and were not thought to be caused by climate change (Hummel, 2015)(Benjaminsen, 2021).

Wet season precipitation changes under some models show a range of -20% to +40% compared to present day (Defrance, 2020). The West African region shows a gradient of precipitation decreases in the west and increases in the east, and the Sahel overall shows change in monsoon seasonality (later start and end) with low confidence. This shift has been attributed to a precipitation decrease during the monsoon season (Trisos, 2022)(Caretta, 2022)(Defrance, 2020)(UNHCR, 2022). Increased storm intensity is expected to result from climate change all over the world; climate projections for the Sahel show an overall increase in the number of days of heavy precipitation, though there are regional variations within the Sahel (Trisos, 2022)(UNHCR, 2022). When looking at specifically the rainy season, however, more of a negative trend is observed and projected, as seen in the figures below.

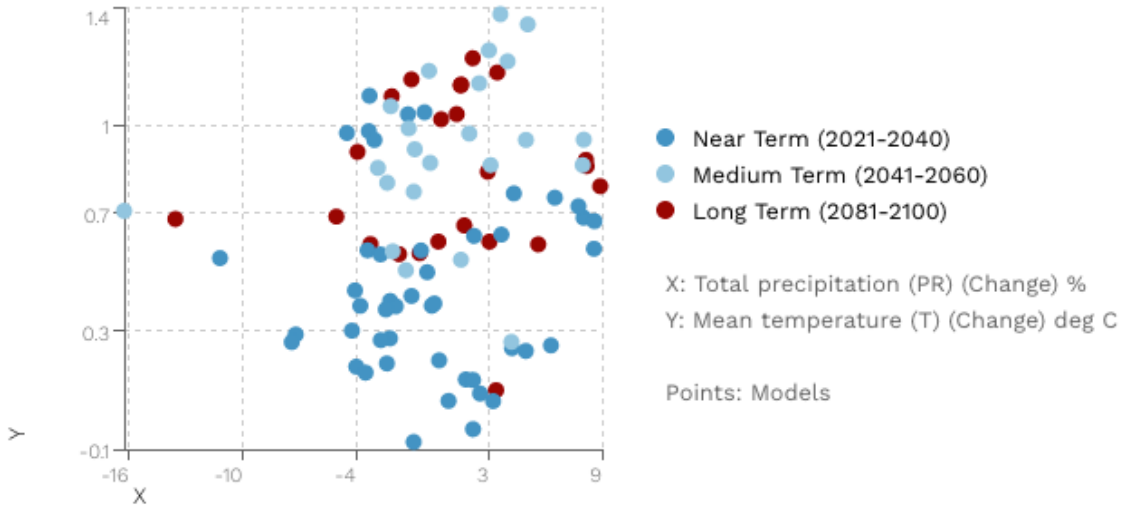

Figure 16: CORDEX Africa model projections showing change in precipitation during the rainy season (April-July) compared to baseline (1995-2014) compared to mean temperature change in the Western Africa and Sahel Region (IPCC Atlas, 2021)

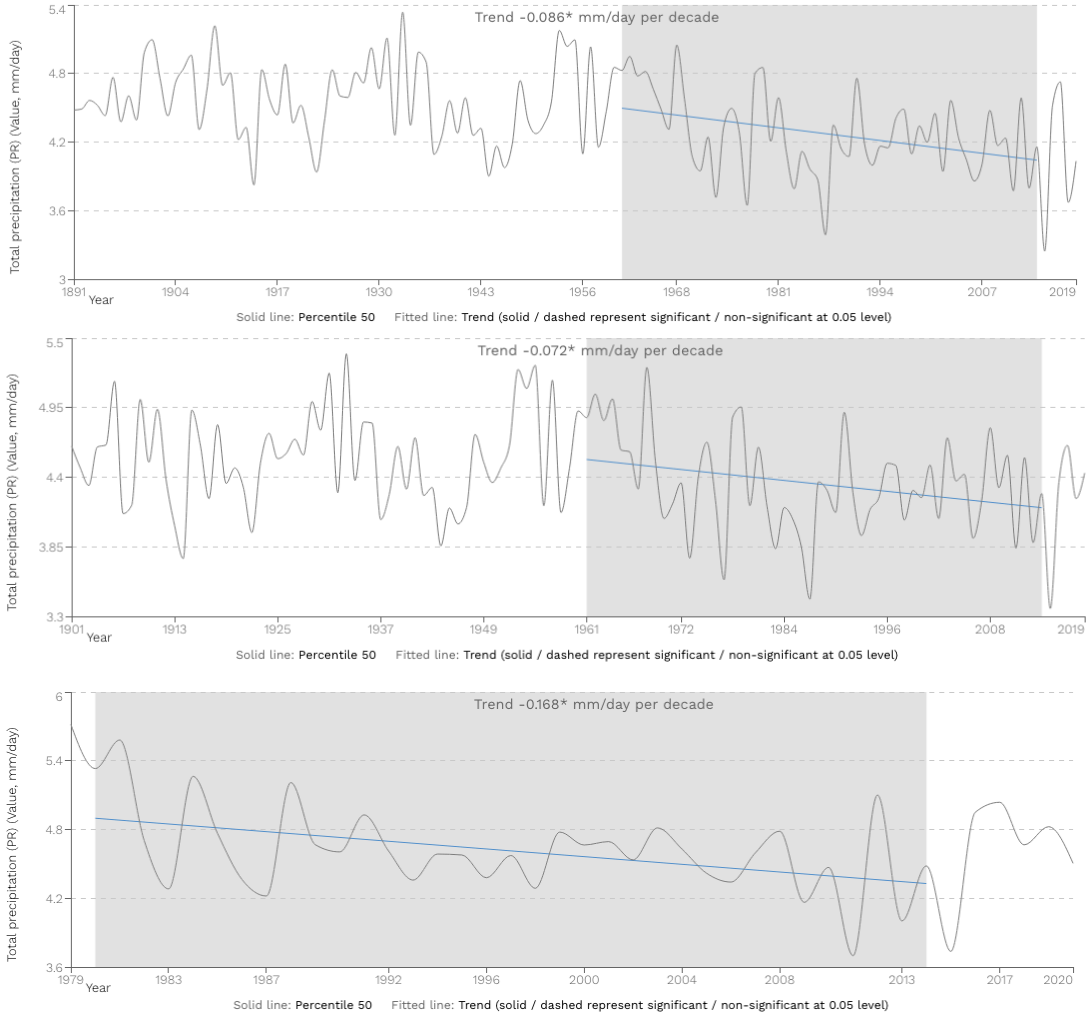

Figure 17: Observations from GPCC, CRU-TS, and ERA5 datasets (respectively shown from top to bottom) showing trends in rainfall amount during the rainy season (April-July) from 1961-2015 in the West African and Sahel Region (IPCC Atlas, 2021)

Precipitation, mainly change in rainfall patterns, seasonal changes, water scarcity, and also flooding, were the most mentioned climate change impacts affecting migration in the Sahel from the interviews. However it was primarily in the context of less rain during the typical rainy season, not more. One interviewee from Burkina Faso stated that sometimes there was too much rain and it killed the crops,

"Sometimes in my country, we get a lot of rain. If we plant some things, like corn, and if it rains a lot it will be finished, like it will kill the corn. Sometimes we have lot of rain, and we want the rain to stop. And sometimes we don't have nothing. Like please we need water for our corn. Because if no water, the corn will be dead. So sometimes we have this problem."

However, the majority of responses indicated that increased variability in rainfall patterns, a decrease in available water for agriculture, and overall drying trends on agricultural subsistence lands were major drivers of migration. These drivers led to famine, unemployment, and conflict in the region, and thus drove people to feel forced to migrate, according to the interviews. The responses align well with the data, and discrepancies can be attributed to uncertainty in the climate data.

5.4.2 Water Scarcity

Water availability projections have high uncertainty in this region. Water availability per capita is projected to decrease under all scenarios, and when accounting for population growth, it is projected to decrease by 76% by 2080 under RCP 2.6. This is not necessarily due to physical science reasons but is also based on socioeconomic factors (UNHCR, 2022). There is medium confidence in decreased summer flows of West African rivers. The IPCC sixth assessment reads, "Recent regional modelling studies project substantial increases in hydrological drought affecting major West African river basins under 1.5°C and 2°C GWLs and RCP4.5 and RCP8.5 scenarios" (Trisos, 2022). However, there is low confidence of this. There is medium confidence in observed long-term declines of soil moisture, which indicates an increase in aridity. In addition, there is medium confidence in increased ecological and agricultural droughts, and high confidence in increasing drought trends overall, although low confidence in direction of change for future projections (IPCC Atlas, 2021). Historically, surface and groundwater availability and accessibility show negative trends due to reduced rainfall, increased temperature, and more frequent droughts (UNHCR, 2022). Even though rainfall may be more intense when it comes, it may be less frequent.

This is in line with responses from the interviewees, who often indicated that changes in rainfall patterns and a lack of water was causing agricultural problems, famine, movement to cities, and unemployment. This is a major reason for internal and external migration from the Sahel, according to interviews and the literature (BRILL, 2019). One interviewee from Guinea told of the struggle of young men from farming backgrounds have, who can find no work and are forced to migrate,

"The water sometimes is very difficult for us there, yes, to find water sometimes is not easy… Maybe 40% people migrate for the climate, because all of the young men its difficult to live there. The problem for many countries in Africa… Sometimes you can see all of their family have died, you don't know what to do, you don't have work…this is the reason sometimes you see people migrate."

5.4.3 Sea Level Rise

While most of the interviewees from this region mentioned a lack of rain and decreasing rainfall events, one interviewee, from Nigeria, did primarily mention flooding in this region and he was referencing a rise in sea level and flooding from the sea, not from terrestrial sources. Flooding was the primary concern he had for the climate impacts felt in Nigeria. He explained that many people have lost their homes due to flooding, and the land is no longer fertile for growing food. This was inferred to be from flooding and also saltwater

intrusion on the land, although it was unclear which he was referencing. This was a major driver of migration according to the interviewee.

Observations in the Gulf of Guinea and Sahel from 1981 to 2014 show increased intensity of precipitation events, and increased frequency of mesoscale storms (Trisos, 2022). Below are projections for sea level rise in the region, which threatens livelihoods as well as homes. There is high confidence both in increasing trends and future projections of rising sea level in this region in the IPCC regional synthesis (IPCC Atlas, 2021). This data aligns perfectly with the interview response from Nigeria.

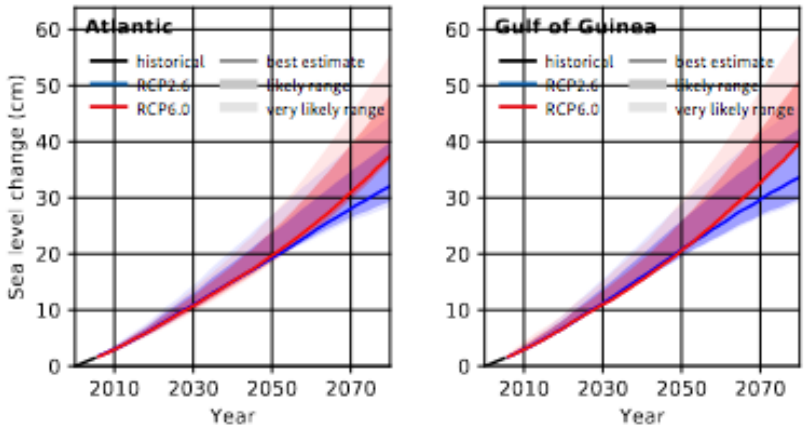

Figure 18: Historical and projected sea level rise under RCP2.6 and RCP6.0 on the Atlantic coast of the Sahel and the Gulf of Guinea (UNHCR, 2022)

5.4.4 Agriculture

Due to the geography and economies of the region, infrastructure to irrigate croplands is unrealistic, so agriculture is reliant on rainfall, which makes dry spells and droughts the number 1 cause of crop failures (UNHCR, 2022). Because of uncertainties in drought models, there is no definitive trend for crop yields, however, some models predict cropland drought exposure to double by the year 2080, which would naturally impact crop yields (Bezner, 2022). Maize, millet and sorghum are the primary staples in the region, making up 60-98% of total crop production, and show decreasing trends under all scenarios (Defrance, 2020)(UNHCR, 2022). One analysis predicted these crops would decrease in production by 5%, 10%, and 15% respectively by 2050 due to precipitation changes (Defrance, 2020). Cassava, groundnuts, cow peas and rice show stagnation under a RCP 2.6 model, but actually show increasing yields under RCP 6.0. While some crops are projected to fail, and others are projected to hold up well, large deviation from the baseline is projected for all major staples (UNHCR, 2022). One study found that under all scenarios in five different Sahelian countries, local agricultural production will drop below 50kg per capita by 2050 due to a change in monsoon seasonality (Defrance, 2020). Famine is predicted to worsen going into the future (Grolle, 2015).

This seasonal uncertainty can be devastating for subsistence-based populations (Hummel, 2015). Trends of long term migration are increasing in this region, and they are looking different than historical Sahelian migration patterns (BRILL, 2019). In general the trends tend to support the interviewee narratives and perceptions that a lack of water is causing agricultural famine, however the data is complex and potentially unreliable, and again data collection in this part of the world is lacking. Change in rainfall patterns and decreasing rainfall were the most mentioned impacts, and the interviewees said this was a reason for migration, mainly due to agricultural difficulties, famine, and unemployment.

5.5 Sub-Saharan Africa

This region of Africa is characterized by tropical, hot and wet conditions. Like many regions in Africa, station data is scarce, and study data is limited (Trisos, 2022)(WFP, C-ADAPT, ICPAC, 2018). This region is highly vulnerable to climate change, due to a population dependent on rain-fed agriculture, preexisting poverty and food insecurity (Bilali, 2020)(Flahaux, 2016). Land degradation coupled with unpredictable precipitation events and increased pressure over resources has led to higher instability in the DRC (Vlassenroot, 2005). Insecurity over the future of water management in these countries, as well as soil erosion, deforestation, crop production, and increasing temperatures, and the potential for more conflict and destabilization of traditional societies are primary concerns in this region (Kose, 2019)(Vinke, 2022).

Interviewee mentions of climate impacts in this region were first flooding, followed by changes in precipitation, agricultural difficulties, land change, changes in seasonal patterns, water scarcity, and pests/disease, as depicted below in the pie chart.

Observed trends and future projections from the IPCC regional synthesis compared to perceived risks and impacts from interviewee transcripts are depicted below. The top row goes by country, as an average of responses about the impact (yes affected, medium affected, or not affected or unsure), and the bottom row shows the observed trends and the future projections from IPCC data in the region.

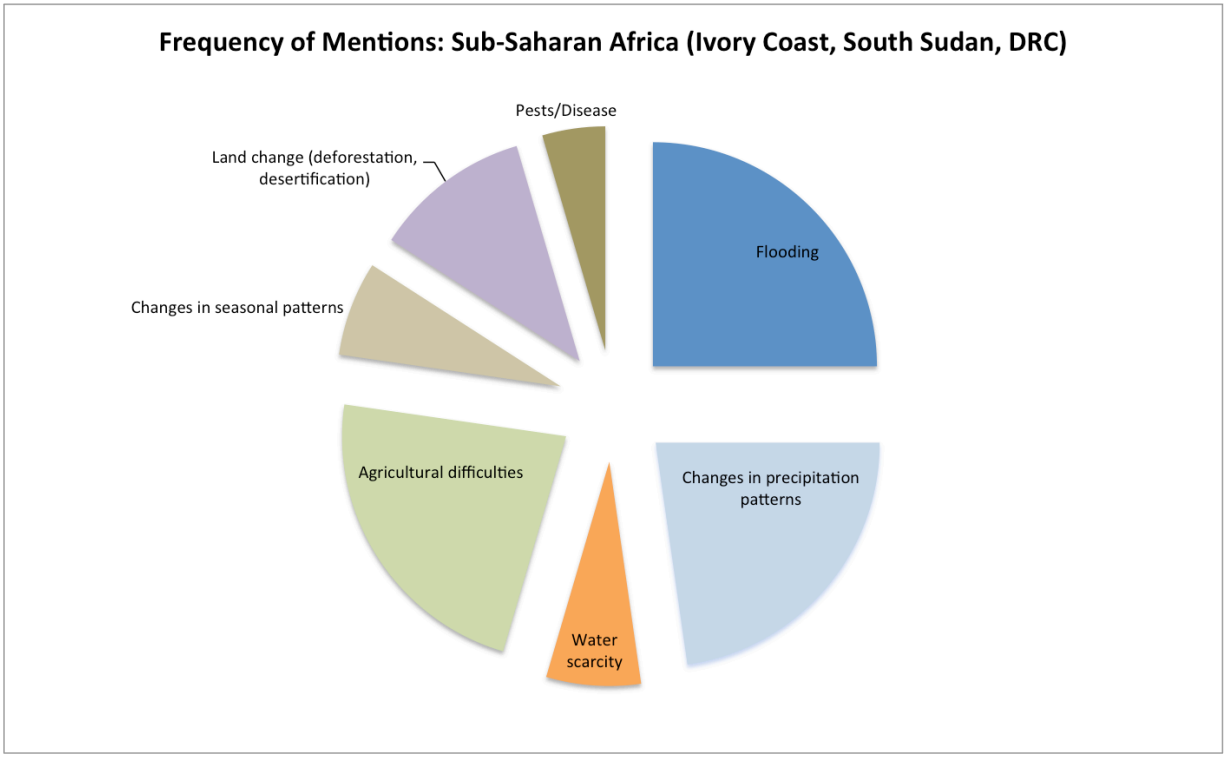

Figure 19: A pie chart displaying distribution of mentions of climate change impacts from the interviewees from Sub-Saharan Africa

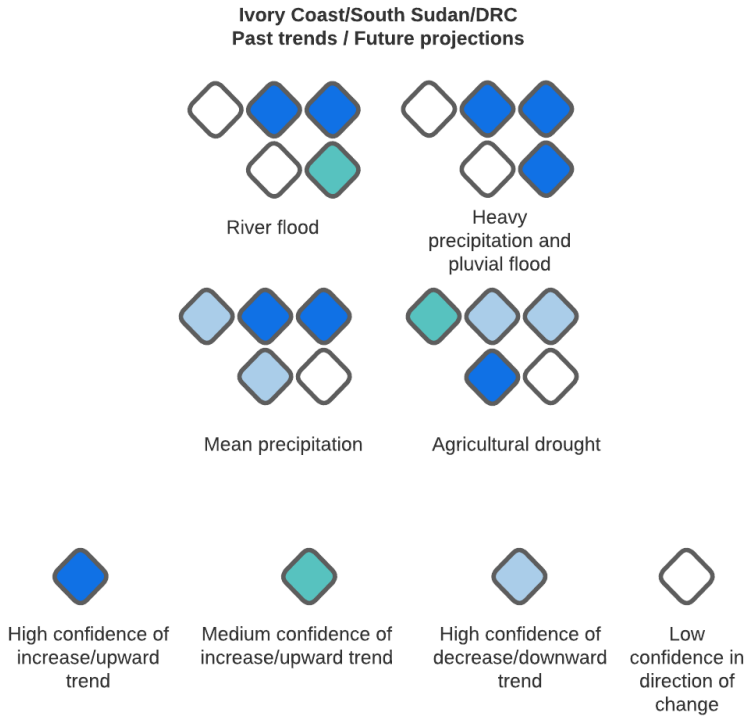

Figure 20: A comparison of interview responses from interviewees from Ivory Coast/South Sudan/DRC (country diamonds in order, top row) against IPCC Atlas data (bottom row) including past trends (bottom left diamond) and future projections (bottom right diamond) for the strength of confidence in various climate change impacts (IPCC Atlas Regional Synthesis, 2021)

5.5.1 Precipitation

This region faces rapid and uncertain changes in precipitation, as well as increased natural disasters due to climate change (Bilali, 2020). There is still uncertainty between models, and from the lack of confidence in past trends (Trisos, 2022). Uncertainty over the future of water resources, both quantity and quality, leads to concerns of future conflict and instability due to water in this region. In addition, traditional tribal hierarchies of environmental and land management are deteriorating due to water conflicts and individual land grabs, leading to a loss of tribal unity and tradition in sustainability and sharing resources. Low capacity of governments to adapt to climate change also increase instability, especially in newer countries such as South Sudan (Vinke, 2022)(Kose, 2019). This aligns well with interview responses, which said extreme events, namely flooding, and unstable political situations are leading to migration.

There is high confidence in a downward trend of mean precipitation in this region (Trisos, 2022), which contrasts with interview responses, as there was little talk of decreasing

rainfall like there was in the Sahel region. Only in the Ivory Coast was decreasing rainfall mentioned, but in the DRC and South Sudan, interviewees had high confidence in increasing precipitation. This perception was due mainly to intense flooding, which they also attributed to deforestation. Flooding was cited by the interviewees as a major reason for migration, but also in conjunction with other political factors. The following figure shows a trend of decreasing rainfall:

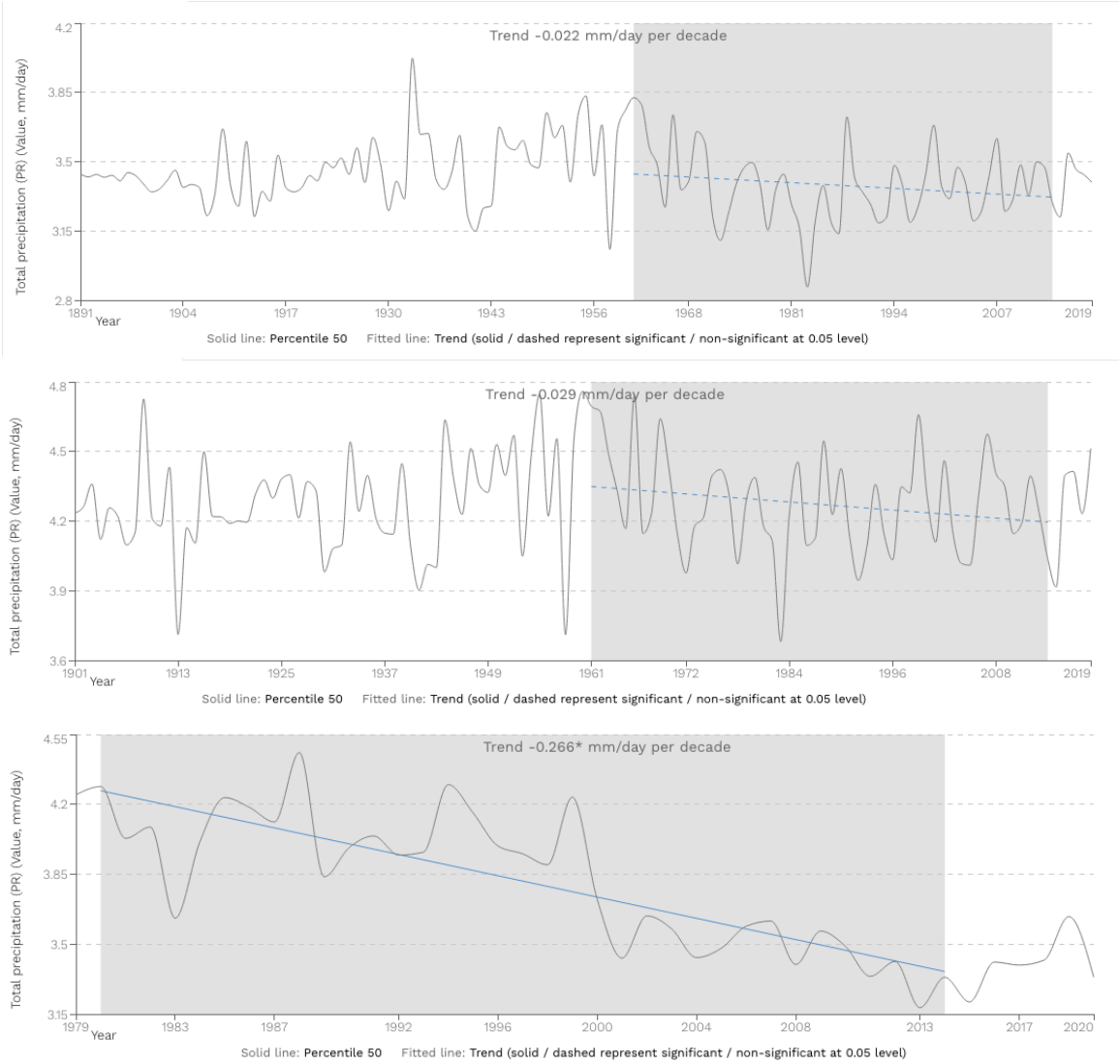

Figure 21: Observations from GPCC, CRU-TS, and ERA5 datasets (respectively shown from top to bottom) in the Central African Region showing trends in annual rainfall amount from 1961-2015 (IPCC, 2022)

5.5.2 Flooding

In the Sub-Saharan African region the interviewees did not focus so much on decreasing rainfall, and instead there was a lot of talk of flooding. Flooding was said to be a major driver of migration from South Sudan and the DRC, as well as political danger and instability, and foreign interests and conflict in the region. Flooding and loss of homes and livelihoods was mentioned as a direct reason for migration in South Sudan. One interviewee from South Sudan said,

"And also a good number of the states are affected by flooding…those states are full of water. (There is) a change to the rivers, and death of animals and people increases every time (it floods)."

Overall the data for flooding aligns very well with interview perceptions, which can be seen depicted in Figure 20. The IPCC sixth assessment states, "Averaged over the African continent for different levels of global warming, the present-day 100-year return period flood levels will have a return period of 40 years in 1.5°C and 2°C, and 21 years for 4°C warmer climate," and there is "high confidence that the intensity of extreme precipitation will increase in a future climate under both RCP4.5 and RCP8.5 scenarios and 1.5°C and 2°C GWLs, threatening widespread flood occurrences before, during and after the mature monsoon season." On average in Africa annual flood frequencies have fluctuated, but there is medium confidence in an upward trend in flood events occurrences from 1990-2014 (Trisos, 2022)(Caretta, 2022).

For most of the tropical African river basins, extreme river discharge as characterized by the 30-year return period of 5-day average peak flow is projected to increase by more than 10% by the end of the century for RCP8.5, and a consistent increase of flood magnitude is projected already by 2050 (Trisos, 2022)(Caretta, 2022). In South Sudan, there were three historic floods in 2019, 2020, and 2021, and flooding has become a major problem for the country (WFP, C-ADAPT, ICPAC, 2018)(Kose, 2019). With that said, in the sub-Saharan region river floods have low confidence in direction of change for past trends, and medium confidence in an increase going into the future (Trisos, 2022). Heavy precipitation and pluvial floods have low confidence in a direction of past trend, but high confidence in an increasing trend going into the future (IPCC Atlas, 2021). The following figures depict the data for extreme precipitation events in this region:

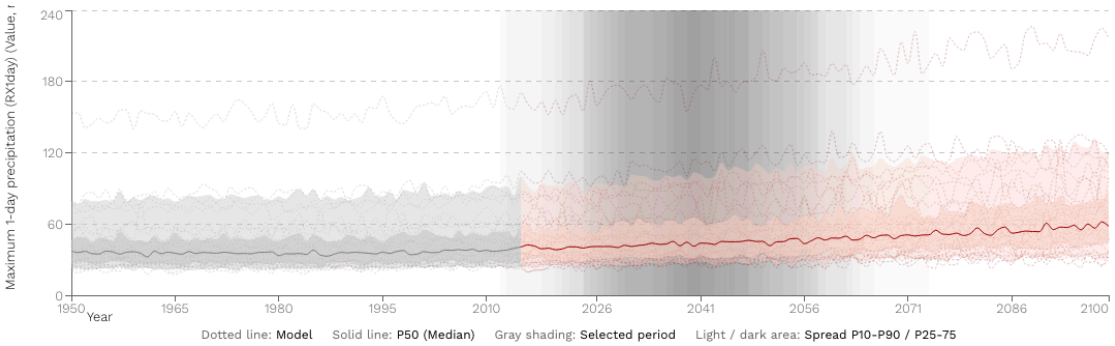

Figure 22: CMIP6 projections for maximum 1-day precipitation under a 2 degree warming scenario SSP5-8.5 in Central Africa Region (IPCC Atlas, 2021)

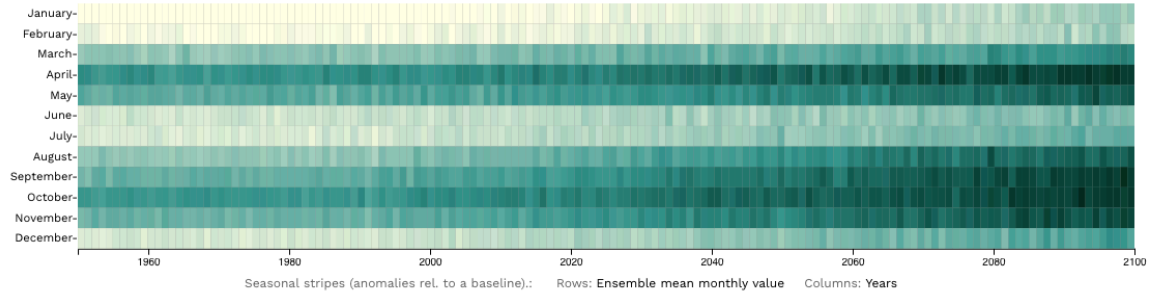

Figure 23: CMIP6 projections for maximum 1-day precipitation under a 2 degree warming scenario SSP5-8.5 seasonal stripes in Central Africa Region (IPCC Atlas, 2021)

It is clear that maximum one-day precipitation is increasing in the projections, indicating an increase in the intensity of rainfall events, as well as an increase in variability, which is shown in the time series graph. The seasonal graph shows a darkening and hence an intensifying rainfall pattern heading towards the year 2100.

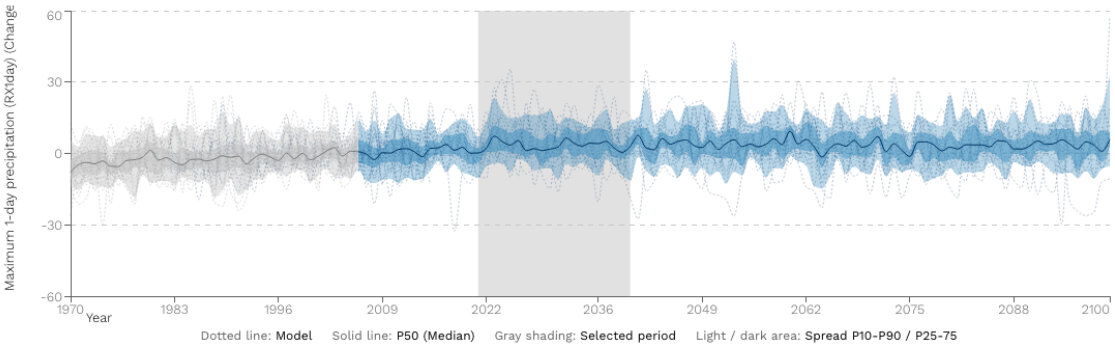

Figure 24: CORDEX Africa projections for percent change of max 1-day precipitation relative to baseline (1995-2014) under RCP 2.6 in Central Africa Region (IPCC Atlas, 2021)

5.5.3 Agriculture

Climate change is predicted to exacerbate existing poverty in this region, due to a decrease in crop yields, higher food costs and insecurity, and loss of income and livelihoods in the subsistence based agricultural sector. Staple crops such as rice, wheat, and maize will decrease in production and yield, and there will be increased stress in the livestock sectors

(Bilali, 2020). 55–62% of the Sub-Saharan workforce is employed in agriculture, but climate change of 3°C is projected to reduce labor capacity in agriculture by 30–50% in this part of the world relative to 1986–2005 (Bezner, 2022). There is high confidence in an increase of agricultural drought, and low confidence in direction of change going into the future (IPCC Atlas, 2021). This contrasts with 2/3 country responses, which were high confidence in decreasing agricultural drought (due to increasing flooding). Ivory Coast was the only country to report medium confidence in an increase in agricultural drought. There were responses from the DRC and South Sudan, which mentioned agricultural difficulties also, however this was due to flooding and the death of domestic animals from floods. In South Sudan in 2021, 10 million heads of livestock were affected by flooding, and 800,000 died due to flood damage. An increase in livestock disease after flooding was also seen, as well as pastoralists being forced to move and compete over high pasturing ground. Prices of staples crops also rose substantially in recent years due to flood pressure, as well as socio-political pressures (WFP, C-ADAPT, ICPAC, 2018)(Vinke, 2022).

Interview responses did not focus on agriculture so much as loss of agricultural land from flooding and conflict, which did motivate migration. In general, the data supports the interview perceptions that the agricultural sector is vulnerable to climate induced migration, and the perceptions of impacts in the region align with projections.

5.5.4 Land Change

Another common theme amongst interviews was deforestation land change causing worsening flooding. Decreased woody plant biomass was attributed to land clearing for agriculture in 11% of the region. The Miombo forest in Central Africa saw a loss of tree cover, and the Congo Basin saw a forest loss of 16.6 Mha between 2000 and 2014, mainly due to drought and forest clearing. This is reported with “high agreement” (Trisos, 2022). Responses from the DRC were very focused on deforestation, noting that it is forcing people to migrate as their lands are changing, but also due to conflict over resources from competing interests and parties. The DRC hosts a majority of the Congo Rainforest, a crucial asset in the fight for global climate stability, but also a region rich in resources. One interviewee spoke of how Chinese investors working with the government had killed his father and forced him to leave the country, since they wanted to harvest their family’s forest and would put him in jail if he refused. In South Sudan deforestation was also mentioned, but more indirectly, in reference to it increasing floods and forcing people to move due to loss of homes and farms (Kose, 2019). One scholar argued land has become a “resource of conflict” rather than a “source of conflict” in this region, especially in the context of the war in the DRC, and land is crucial in the new systems of power, control, and profit. In this way the interaction between climate change and conflict is highlighted, and this is confirmed as a major reason for migration by interviewees (Vlassenroot, 2005).

5.5.5 Pests/Disease

There have been significant locust outbreaks in recent years, as well as malaria and other tropical disease outbreaks associated with a warming climate. Interestingly, locust outbreaks in countries like South Sudan can be traced back to armed conflict not allowing

access to locust breeding grounds to prevent the outbreak, but also to floods which leave sitting water in otherwise desert areas, which provide breeding grounds for desert locusts (USAID, 2020). The interviewee from Ivory Coast was most concerned with an increase in disease, especially in disadvantaged areas, and said this is a reason for migration. The interviewee from South Sudan was more concerned about locusts, and in South Sudan this was mentioned as a reason for migration.

5.6 Horn of Africa

The Horn of Africa region is characterized by a hot, semi-arid climate, with much of the region consisting of desert. In recent years there has been unprecedented food insecurity accompanying extreme climate events, especially the droughts of 2011, 2015, and 2016 (Mirzabaev, 2022)(WFP, C-ADAPT, ICPAC, 2018). As with the rest of Africa, there is limited data, and due to the large variation in landscapes and elevations of this region, rainfall patterns have great spatial and temporal variation, and thus there is uncertainty in past and future trends (Trisos, 2022). There is a history of climatic factors driving migration in this region, notably drought, land degradation, and desertification. Migration is dynamic but can be concluded from other studies to be caused by climate drivers in this region, mostly irregular migration, and mainly to neighboring countries at the present time. There are large populations of Somali climate refugees in camps in Kenya and Ethiopia (Chaudhry, 2021)(Flahaux, 2016).

Interviewee mentions of climate impacts in this region were agricultural difficulties first, followed by water scarcity, changes in precipitation, land change, and seasonal patterns, as depicted below in the pie chart.

Observed trends and future projections from the IPCC regional synthesis compared to perceived risks and impacts from interviewee transcripts are depicted below. The top row goes by country, as an average of responses about the impact (yes affected, medium affected, or not affected or unsure), and the bottom row shows the observed trends and the future projections from IPCC data in the region.

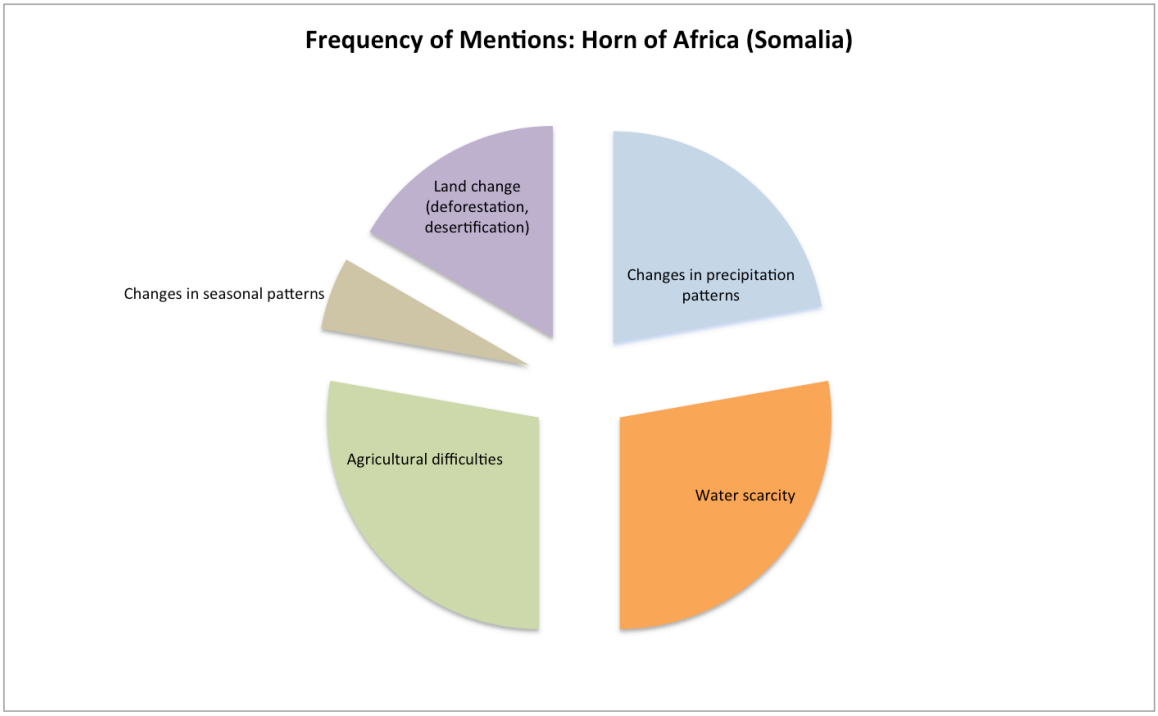

Figure 25: A pie chart displaying the distribution of mentions of climate change impacts from interviewees from the Horn of Africa

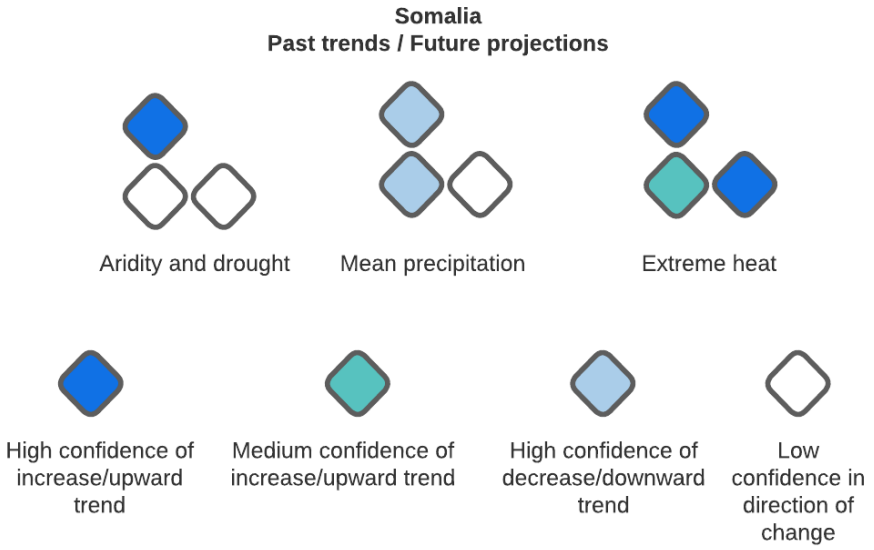

Figure 26: A comparison of interview responses from interviewees from Somalia (diamonds top row) against IPCC Atlas data (bottom row) including past trends (bottom left diamond) and future projections (bottom right diamond) for the strength of confidence in various climate change impacts (IPCC Atlas Regional Synthesis, 2021)

5.6.1 Precipitation

Since the middle of the twentieth century, strong drying trends have been seen in the Horn of Africa, however East Africa has also seen strong precipitation variability, with intense precipitation periods leading to pluvial flooding events (medium confidence). Overall, mean precipitation has high confidence of decreasing trends, and low confidence in future projections (Trisos, 2022)(Caretta, 2022). The strong drying trends are consistent with interview responses, which cited this as a primary reason for migration, but not the incidences of more extreme precipitation events. Some scenarios for 2030, 2050, and 2070 show rainfall anomalies that will increase livelihood impacts from climate change; one example of the effect of this is predicted lower than average rainfall extremes recurring into the future, limiting the regrowth of disturbed vegetation, continuing the cycle of desertification, and harming agricultural livelihoods (Ogallo, 2018). The following figure shows the decreasing precipitation trends from historical data, however future predictions have little certainty and some models predict an increase in precipitation events:

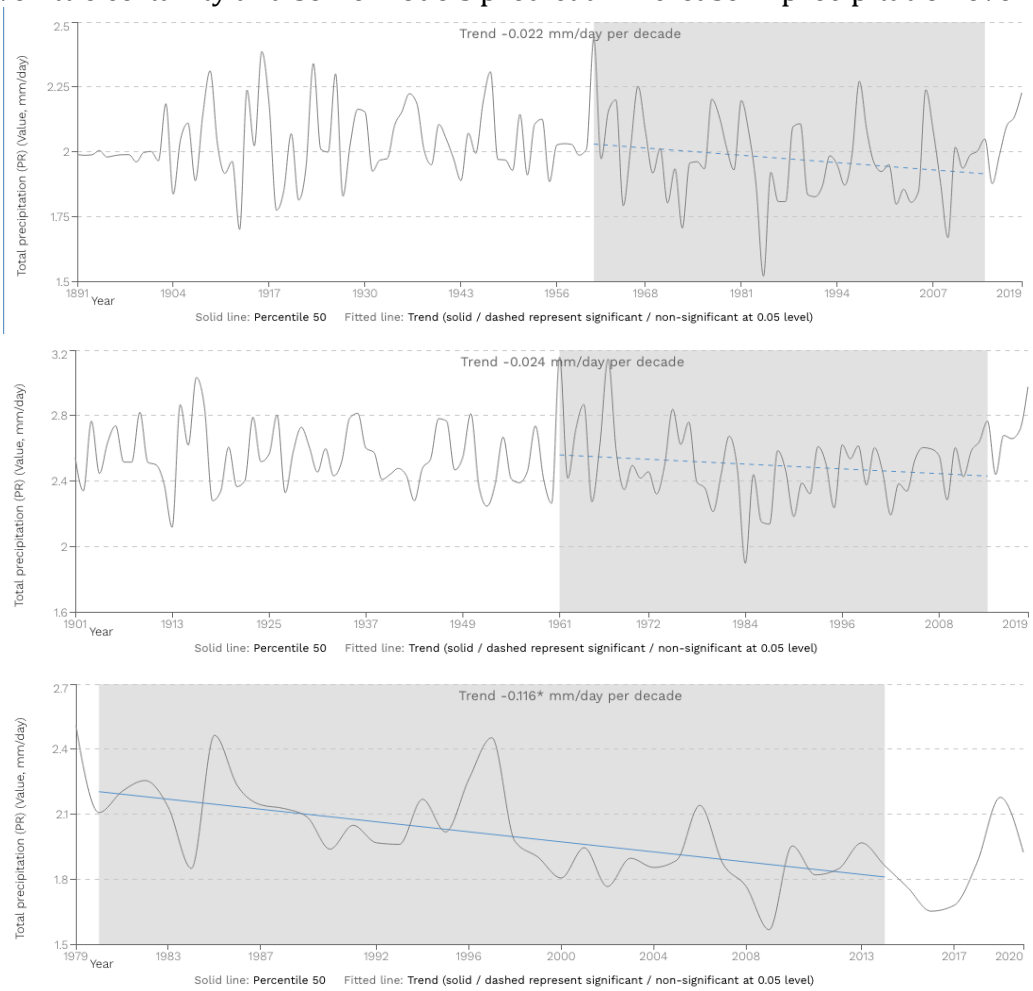

Figure 27: Observations from GPCC, CRU-TS, and ERA5 datasets (shown respectively from top to bottom) trends in annual rainfall amount from 1961-2015 in the North Eastern Africa Region (IPCC Atlas, 2021)

This aligns with interview responses, which cited drought and water scarcity as a major motivator and reason for forced migration. Interview perceptions had a strong certainty that aridity and drought were increasing, and that this was one of the main reasons for migration from this region, due to loss of livelihoods – even more so than conflict. There was no indication in the interviews that water scarcity was driving conflict, only that it was causing unemployment, famine, and death.

5.6.2 Heat and Aridity

Like most places in the world, mean temperature has been rising in this region. Extreme heat has also seen medium confidence in increasing trends, and high confidence in increasing trends going into the future (Trisos, 2022). Interview responses did not focus on heat waves, but desertification and aridity were mentioned often which can be worsened with higher temperatures. The first figure looks at increased temperature, the second at number of days over 40 degrees, and the third at aridity:

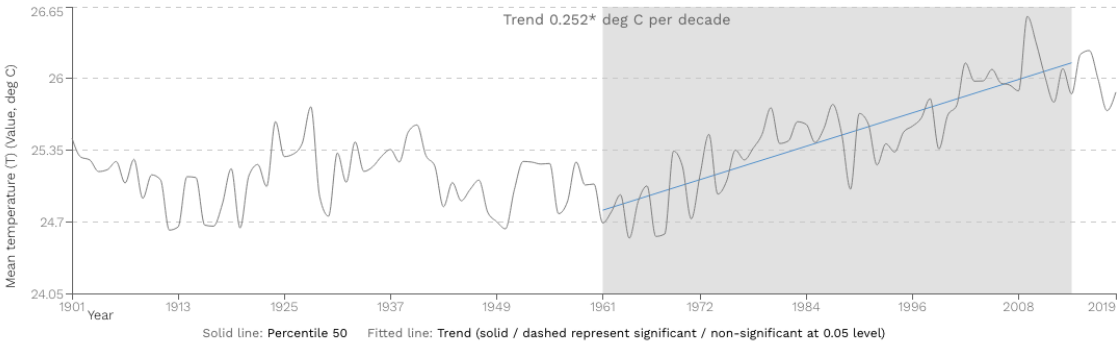

Figure 28: Mean temperature from 1961 to 2015 in the North Eastern African Region under CRU-TS dataset (IPCC Atlas, 2021)

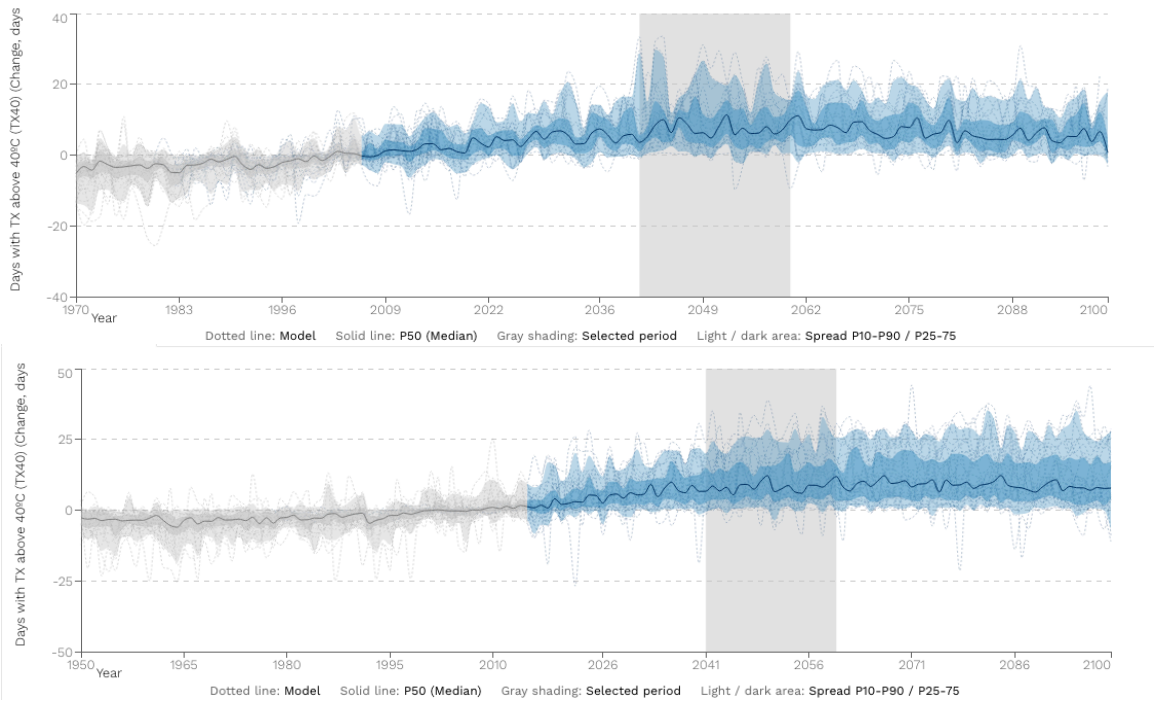

Figure 30: Change in the number of days above 40 degrees under RCP 2.6 in the North East Africa Region, relative to baseline (1995-2014). Top row: CORDEX Africa model, bottom row: CMIP6 model (IPCC Atlas, 2021)

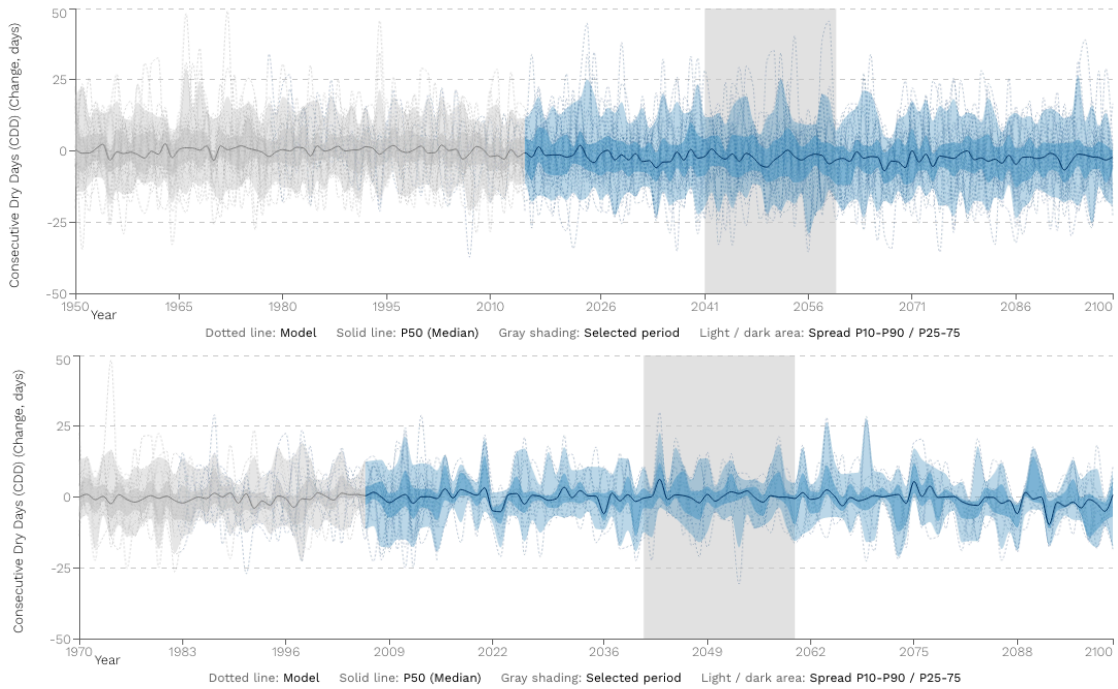

Figure 29: Change in the number of consecutive dry days in the North East Africa Region under a SSPI-2.6 scenario relative to baseline (1995-2014). Top row: CORDEX Africa model, bottom row: CMIP6 model (IPCC Atlas, 2021)

Aridity and drought show low confidence in both trends and projections, due to variability in data and models (Mirzabaev, 2022). However, there have been long, historic drought events in this region in recent years, which have resulted in migration (WFP, C-ADAPT, ICPAC, 2018). Notably droughts in 2007/2008, 2011/2012, 2015/16/17 have evidence of leading directly to displacement (Ogallo, 2018). While aridity trends and predictions have low confidence in direction of change, temperature and heat waves are clearly increasing. This combined with the decreasing precipitation trends would logically result in higher aridity. Combined with unsustainable land practices, this leads to desertification (O'Neill, 2022)(Mirzabaev, 2022).

The low confidence in change in aridity differs from interview responses, which had high confidence in increasing aridity leading to migration. However, temperature is increasing which aligns with interview responses, which can also be cited as a driver of migration. Overall, the data is consistent with interview perceptions, and increasing heat, aridity, and changing rainfall patterns have led to increased migration, although the future predictions have high uncertainty.

5.6.3 Agriculture and Land Change

Agricultural difficulties including unsustainable practices in a changing climate, land change (desertification), drought, death of animals, and famine were reported in the interview response in this region. Severe agricultural droughts have become "moderately common" events in recent years (Mirzabaev, 2022), and food security researchers have found that the scope of the seasonal drought-affected land is expanding (WFP, C-ADAPT, ICPAC, 2018).

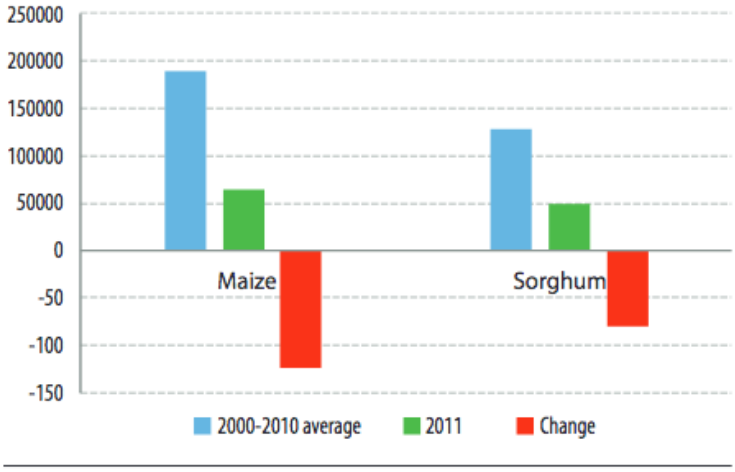

Figure 31: Chart showing the change in kg of crop yields of maize and sorghum after the 2011 drought in Somalia (WFP, C-ADAPT, ICPAC, 2018)

While large-scale climate events like recent unprecedented droughts obviously affect agricultural output, there is low confidence in trends of agricultural drought in this region due to high variability of the region and data (O'Neill, 2022)(Mirzabaev, 2022). Thus,

agricultural harm can be attributed to sudden onset events but not to slow onset events in this region. Averaged over the long term, trends across this region have low confidence; however, for example, after the drought in 2011, a decrease in crop yields of maize and sorghum compared to 2000-2010 showed a clear correlation (WFP, C-ADAPT, ICPAC, 2018) (Warsame, 2020).

The interview responses indicated strongly that agricultural difficulties due to drought and unsustainable practices were a large part of the reason people migrate from the Horn of Africa. Famine, death of animals, loss of biodiversity, and loss of livelihoods were the major drivers of migration – first to cities, then to other countries. In this case the perceptions were closely aligned to the climate data. Water scarcity, desertification, and famine were major drivers noted in the interviews, and these have also been cited in the literature as reasons for migration from this region (Oxfam, 2017)(Ogallo, 2018).

5.7 Migration

In the content analysis, the relationship between climate change and migration was then analyzed according to the interviewees. The following chart is one example from the interviews of how climate change is leading to migration. Some aspect of the following pattern/relationship was often mentioned in the interviews. Water scarcity in some regard was the most common mention, often in relation to changes in precipitation patterns and agricultural difficulties.

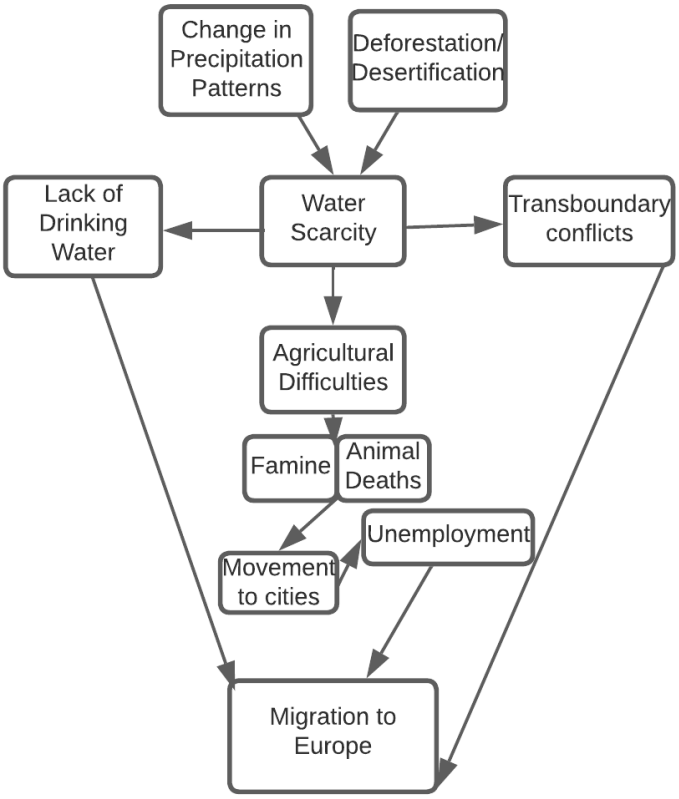

Figure 32: A flow chart of one example of how climate change influences migration, focusing on water

The relationship between climate change impacts and migration is complex, as shown above, and there is no one causational relationship that can be pointed at to demonstrate how climate change is forcing migration. It is relationships like the one above that form the backbone of climate migration. Water scarcity was cited in the interviews to lead to agricultural difficulties, famine, animal deaths, drinking water shortages, wildfires, transboundary conflicts, and sequential migration, often first to cities, and then across international borders. Water shortages leading to agricultural difficulties were especially noted in the Sahel, Middle Eastern, and Horn of Africa regions. In Burkina Faso, the Gambia, and Iran water scarcity was almost exclusively the driver of migration that was mentioned. One interviewee explained,

"In Burkina Faso, first, most people live on agriculture, often its very difficult for the gardeners, farmland to plant seeds, and crops to flourish... For some years, I think from 2007, it has been getting much worse; because the dry season is much longer and the rains are more rare, and that is very difficult for the population who lives on agriculture. You know even until now every day people are dying."

The way in which climate drivers can lead to conflict, socio-economic, political stress, and migration is often a feedback cycle. For example, in the Middle East it was found that drought did directly lead to migration, but it wasn't the drought that drove conflict, it was the migration that drove the conflict, which further fueled migration. In some cases, rather than water stress causing conflict over resources, herders and farmers in water stressed regions became more dependent on each other. Cultural and historical contexts, as well as adaptive capacities, between water stressed regions and countries were important in determining if drought led to conflict or cooperation (Feitelson, 2017). In the interview responses it was clear that reasons for migration are complex, and often water shortages were related to political problems, such as Taliban coercion, or government cutbacks, or transboundary leverage. Changes in rainfall patterns left the agricultural sector vulnerable to climate induced migration, but this is also in poor populations with no other options. The following figure depicts the range of complicated interactions that inform climate migration decisions:

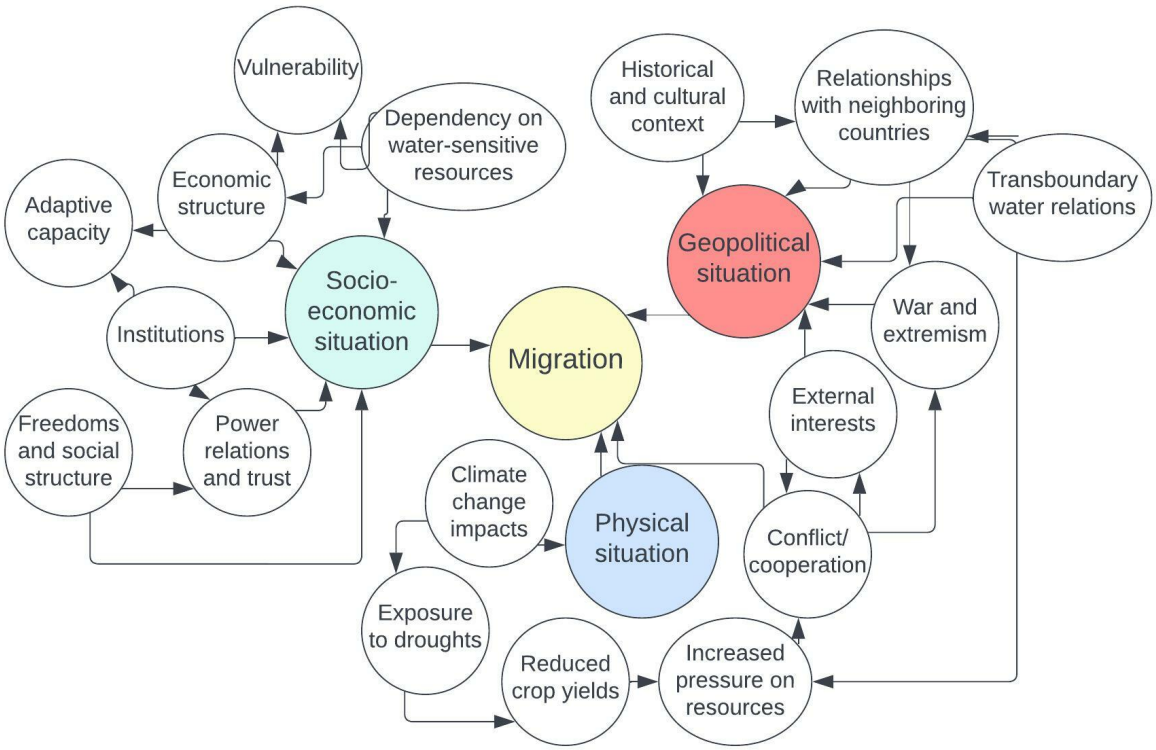

Figure 33: A more complex flow chart of how socio-economic, geopolitical, and physical factors play a role in migration, based again around the subject of water

Other relationships that were mentioned were locust infestations causing farmers to lose their crops and have to migrate, flood related home and agricultural losses both from sea level rise and fluvial floods forcing populations to migrate, and changing seasonal patterns including cold spells which make it difficult for crops to grow. The running theme amongst

the interviews was that agricultural difficulties were driving the need to migrate, regardless of the cause. One Syrian interviewee explained that farmers no longer want to grow wheat, cotton, or vegetables because of the intense cold now, and many of them sold their land and immigrated to Turkey and Sudan to grow crops there, and if not that then to Greece. Some interviewees explained,

"In Afghanistan the weather has very changed. A lot of people from the village come to the city. (They leave because they can't grow crops?) Yes."

"And also increase in the sea level, so it took a lot of homes. In a sense there is a lot flooded. So the sea will drop a lot of water, it will flood everywhere, and it will consume many homes. So that affects many people. So it has affected Nigerians very bad. And also it has affected our agriculture. Because there is no fertile…the land is no longer fertile for agriculture, to grow food, for the people, so it is very bad."

Agricultural difficulties are again a running theme in the relationships between climate change and migration. Other relationships mentioned were outside pressures, such as deforestation in the DRC from private companies and the government, leading to flooding and land degradation, and thus forcing farmers to migrate. The following table is the number of times climate change factors were mentioned in association with migration during the content analysis. The only two climate change factors that were consistently associated with migration mentions across all regions were water scarcity and agricultural difficulties.

Number of climate change mentions associated with migration mentions

	Middle East	Sahel	Sub-Saharan	Horn of Africa
Heat waves	x			
Cold spells	x			
Water scarcity	xxxxxxxx	xxxx	x	xxx
Change in Precipitation		xxx		x
Change in Seasons				
Pests/disease			x	
Pollution	x			
Floods		xx	xx	
Wildfires				
Land Change		xx	x	xxx
Agricultural Difficulties	xxxx	xxxxxxxx	x	xxxxx

Figure 34: Table indicating x when a mention of migration coincided with a mention of each climate change impact by region from the interview response transcripts

In the Middle East, water scarcity was the primary factor where migration was also mentioned, followed by agricultural difficulties. In the Sahel, agricultural difficulties were the primary factor, followed by water scarcity and change in precipitation. Sub-Saharan Africa had less mentions associated with migration, but floods were the primary factor. In the Horn of Africa agricultural difficulties were the primary factor, followed by water scarcity and land change.

5.8 Case Studies

5.8.1 Somalia:

Somalia is a mostly flat and arid to semi-arid country on the Horn of Africa, with over 80% of the country considered desert, 10% forest, and only 2% of arable land. The population is largely nomadic and pastoral (WFP, C-ADAPT, ICPAC, 2018). After decades of civil war and increased threats from extremism in the region, the central government is poorly defined, and it is considered one of the most dangerous countries in the world at the present time (UNEP, UNDP, 2022) (Ogallo, 2018). After years of drought and floods, civil wars, political instability, rapid population growth, low adaptive capacity, and a population dependent on agriculture for subsistence, Somalia is left highly vulnerable to climate change induced migration (Ogallo, 2018).

European countries house 14%, or 280,000, of the global Somali migrant population, a number which has continued to grow over the last decade, and there have been 140,000 new asylum applications from Somalis in Europe since 2008 (McAuliffe, 2022). The refugee camp on Lesvos in Greece houses Somalis as the third most populous demographic. While the Horn of Africa region, like many arid regions in the world, has faced more climate struggles than other regions, Somalia has especially bore the brunt of these events which lead to migration (Chaudhry, 2021).

“We are farmers, most of them (the people in Somalia) are farmers, some of them they are fishermen. There are two different people – people living in the countryside and people living in the cities. The countryside people living having problems since 1990 til now with climate change. They don’t know more about the climate changing…”

Figure 35: Satellite image of Somalia (Google Earth, accessed August, 2022)

5.8.2 Primary vulnerabilities and reasons for migration

According to the interviewee, unsustainable farming practices compounded by changing climate have decreased the resilience and increased the vulnerabilities of the Somali populations. An increase in exported agricultural commodities as opposed to the past where it was more of subsistence, pastoral based lifestyle has created sustainability problems. This is for two reasons, one being land change, and the other being less availability of resources for the domestic population when times of climatic stress hit the region.

This includes deforestation for the making of charcoal to export, which is also increasing desertification. Charcoal is the number one fuel source used to cook by households in Somalia, and is also referred to as "black gold" due to the profits that come from exporting it. Studies have found that there's been a 50% decrease in forest cover between 1993 and 2014. Charcoal production is the largest driver of environmental degradation in the south of the country, with foreign demand being responsible for the logging of 4.4 million logged trees each year sent for export (Ogallo, 2018). According to the interviewee, the forest which once could have been used as a resource for the locals is now desert, which is also harming those reliant on charcoal exportation, as it is not a sustainable business model. The interviewee explained,

"They don't know more about the environment, they cut the trees… They cut the trees, and make (charcoal) so they can cook the food, and they also send to other countries, export the cut trees. And the main reason is every ship who come to Somali ports, bringing food or

clothes, they will go back full of woods, they call it black wood (charcoal). More desert, yeah more desert now…. My father told me it was forest, and now you can see its desert."

Charcoal production has become a source of income for 70% of pastoralists in recent years, and continues to be exported despite international bans on charcoal from Somalia, as it was found to be funding extremist groups in the country. Charcoal became a major industry in Somalia due to poverty and struggling livelihoods, potentially due to climate change; however, an increase in charcoal production has also worsened climate change in the country and made the people less resilient to it (Ogallo, 2018). This is one example of the complex interactions found in the climate-migration nexus.

According to the interviewees, agricultural lands which were once used to grow crops to feed the local population, such as legumes, are being replaced by quick cash crops such as lemons and sesame seeds, which can be exported for a lot of money. This has also resulted in a decrease in traditional sustainable practices, such as the burying of part of the food harvest underground to have a backup supply all year round in case of climate extremes. Pastoralists still dependent on shrubs and vegetation for animal feed, and the rivers for water, will find it increasingly difficult to survive as desertification from deforestation increases (Ogallo, 2018). One study found evidence of land degradation and climate change negatively impacting the agricultural sector in Somalia (Mohamed, 2021). In the interview some of these problems were addressed:

"And there is also another problem in Somalia; they farm lemon, before they farmed something like beans, for the people and the animals, but now they start to farm lemon, or other things that they export. And also (sesame seeds). Every time the farmer (grows these seeds) he gets cash very easily. So before they were farming food they could eat, and they dig the hole to keep it safe, so all year they can eat, and also the animal. So all the people, before they were farming all the other food, but they start farming this (sesame seed) and lemon, and this (gets sold) outside of Somalia. So once there is no rain, they suffer a lot (because they don't have any food.) Before they had a culture of saving food, by digging in the ground, and storing food in a small tank, and they bury it, so everything will keep. But now they don't have anything saved, so they suffer."

Somalia is greatly affected by increasingly intense droughts and changing seasonal patterns, leading to agricultural damages, as well as biodiversity loss. These extremes are increasing with climate change, again compounding the increase in unsustainable practices. Transboundary water conflict is also causing water scarcity in the region, or water scarcity is causing transboundary conflict – the data is unclear. Conflict in Somalia is also high. There is a lack of coherent central government after decades of civil war and high risk from extremist groups (Ogallo, 2018) (Chaudhry, 2021) (Oxfam, 2017)(Warsame, 2020). Environmental problems highlighted in the interview were:

"They always wait raining time to farm, to get some water. It starts some few months its raining, and in summer there is no rain, and sometime rain comes late, and people dying for hunger for that. Because of climate change, because rain is getting late. They were waiting,

and then no rain coming, because of climate change. So also the animals are dying – goats, cows, camels, and then the people are dying also.

We have two rivers in Somalia, and we get it from Ethiopia these rivers. And when Ethiopia feels there is no water, they need a lot of water, they close. Like now, there are two rivers, the backbone of Somalia. They build dams so they close (the river) in Ethiopia. So now the river is like highway, there is no rain coming, they don't have the stuff to get the water from the ground; they suffer a lot, and the main reason is climate change. Even in the sea, I see all the fish come out, they die.

And also we lost the wildebeest, and there is no lion, no alligators, all of them they run away because they don't have food. They run to Kenya, Ethiopia, somewhere. Before it was a lot of animals living – lions, tigers, zebras…"

Unsustainable practices when paired with the climate risks the regions is facing, lead to increased vulnerabilities and lower resilience. Climate impacts can also drive a vulnerable population to unsustainable practices, likewise. High conflict in the region also leads to a decreased capacity to adapt and lowers resilience as well (Warsame, 2020). In turn, the result is migration, and according to the interview climate change is a major driver of forced migration from Somalia. The interviewee explains:

"(Is climate change one of the reasons people have to leave Somalia?) Yes yes yes. Most people when they lost their animals, and they find there is no rain, they try to escape. And they try to reach the cities so they can get food, and once they get there, they think they have no way to go back, because all the animals died – cows, goats, camels, so they stay there in the cities. And now there are many people in the capitals, and there are no more opportunities for jobs. You can find every street, many people sitting there, and the main reason is climate change. And now a lot of the people start to come to the cities, especially the capital. And when you walk you see other people packing, and I tried to do some research, and I asked them – Before you had a farm? Before you have some animals? What happened? – Tell me, I ask and give them some money. They said we are in famine –You can see many people are packing, there is a line in the city, father, children, grandfather, grandmother…they suffer and they pack, and they walk to camps…because of climate change."

5.8.3 Adaptation options

The government is still being defined after decades of civil war in Somalia, which obviously leads to difficulties in implementing national adaptation plans. Heavy conflict in the region also makes carrying out any frameworks or adaptation plans logistically challenging. No formal plans have been released nationally (Warsame, 2020). However, NGOs in the region have projects focused on increased monitoring of water and land resources, training farmers and pastoralists in soil and water conservation practices, ecosystem-based adaptation, increasing institutional framework and adaptive capacities and knowledge of vulnerable communities, as well as development of drought resistant maize and sorghum

seeds, and planting of drought resistant grasslands (UNEP, UNDP, 2022). Increasing capital available for farmers and pastoralists can prevent them turning to charcoal production and increase resilience to climate change (Mohamed, 2021)(Ogallo, 2018). At the moment the first adaptation strategy people turn to is migration, once livelihoods fail in Somalia. If first line of defense adaptation strategies, preventative methods, can be used first, the flow of refugees from Somalia may decrease in the future (UNEP, UNDP, 2022)(Chaudhry, 2021).

5.8.4 The Gambia:

The Gambia is a small country in the West African/Sahel region, located entirely within Senegal, and encapsulating the Gambia River to the coast. It has a tropical climate, just on the southern belt of the sub-tropical and semi-arid Sahel region. There are two seasons generally, a wet monsoon season between April and July blown in from the Atlantic, and a dry season between September and March when the dry Harmattan winds blow in from the Sahara. There is a large subsistence agriculture dependent population, high poverty numbers, high government corruption, low GDP, and low resource wealth in the country (UNEP, UNHCR, 2022)(Ceesay, 2020). One interviewee explained,

"Even if it's not me personally, so many people are affected. They must go out, to look for greener pasture."

Figure 36: Satellite image of The Gambia (Google Earth, accessed August, 2022)

5.8.5 Primary vulnerabilities and reasons for migration

The Gambia's vulnerabilities include a low GDP and a resource scarce environment, so much of the population is unemployed and reliant on subsistence agriculture. They are also facing increased climate pressures like much of the Sahel region (UNEP, UNHCR, 2022). The Gambia is in a unique position amongst the other countries, in that there is not much

active conflict in the country that is fueling migration. “Economic migrants” are common from the Gambia, as well as those leaving for religious and other reasons, however there has not been a mass exodus due to war such as in Syria or Afghanistan, and there is not active conflict such as in Somalia or the DRC. For this reason it is a good country to examine climate refugees in, because in a sense we are able to isolate the causes of migration more than countries with more complex situations (Ceesay, 2020). It was interesting in this regard in that all of the interviewees from the Gambia stated the same climate factors and relationships forcing people to leave their country. There was no deviation between interviews. They all cited changes in precipitation, water scarcity, and agricultural difficulties, and they all seemed to have personally witnessed these issues in their country. However, it was not a reason for any of their own personal migrations. One refugee explained,

“Climate change really has affected my country… The rain really dropped…like its not raining anymore as it was before, and then also so many countries on my journey coming to Greece here which are also facing the same kind of dry, especially the countries close to the Sahara, like the desert, Mali, Niger, they are very dry, and climate change is affecting so many of those countries as well. Like Mali, and other places relying on agriculture. Cause if the climate is not suitable for them, the agriculture system goes down. When they grow their crops they don’t have enough rain to grow the crops… If you’re farming, if your livelihood is on the farm, in the end you see your family suffering all the time, like famine. What is expected is not coming out of the farm, when poverty is affecting your family. They would rather go out and look for greener pasture. It affects so many people.”

Low capacity to adapt due to corrupt central government, low GDP, high unemployment numbers, and low upward mobility for young people is compounded by increasing climate problems, leading to lowered resilience. While the Gambia is a rather resource scarce country, interviewees did mention pressure from encroaching Chinese investments in the country, especially in the fisheries industry, which are depleting the resources they do have and causing pollution (Koumou, 2016). For a region facing increased impacts from climate change, unsustainable development can exacerbate problems going into the future (Ministry of Environment, 2018) (Ceesay, 2020).

The interviewee also made a point of saying there is high value placed on religion in The Gambia, which can discourage formal education. There is strong belief in traditional magic and rituals and this is where locals turn in the face of adversity instead of to science, according to the interviews. While this does not necessarily lower resiliency of communities, and could even strengthen communities with traditional knowledge, it can make people less willing to learn, trust and adapt to the science of climate change (Parsons, 2021). Despite this, again, all of the interviewees did believe climate was changing and it was forcing people to migrate, which shows how powerful a lens local perceptions and knowledge can be as well.

5.8.6 Adaptation options

The Gambian national government has released a thorough climate adaptation plan, and there is a good amount of humanitarian funding funneling into the Gambia for adaptation projects (Ministry of Environment, 2018). There is also investment interest from players like China (Koumou, 2016). The finance and interest is there, and the Gambia presents a unique opportunity to develop in a sustainable way if it is done well. UN recommendations for adaptation strategies involve restoring degraded farmlands and forests, establishing ecologically sustainable businesses which will bring income to low income communities as well as provide ecosystem services, and diversifying food and income sources with home gardens with diverse crops to ensure a harvest availability in all seasons (UNEP, 2022). Early warning systems and better monitoring systems would also help to potentially prevent migration events in the future (Grolle, 2015).

5.8.7 Iran:

Iran is an arid and semi-arid country, with humid mountainous conditions in the north, colder conditions in the northwest, and hot and dry conditions in the rest of the country. It's faced heavy economic sanctions, as well as other economic adversities, and at present is in a somewhat dire socioeconomic and political situation, including hosting high levels of inequality for women, leaving it vulnerable to climate risks, worsening the situation and lowering resilience of communities (UNDP, 2022) (Daneshvar, 2019). It is suggested that Iran faces more severe climate effects than even it's neighboring countries in the rest of the Middle East, and it is also one of the biggest emitters and quickly urbanizing (Daneshvar, 2019).

"(Is climate change a reason people migrate to Europe?) With climate change in Iran, yes. It's one of the reasons. The water is not enough for farming. And for the life, the water is not enough."

Figure 37: Satellite image of Iran (Google Earth, accessed August, 2022)

5.8.8 Primary vulnerabilities and reasons for migration

The primary reasons for migration from Iran mentioned in the interviews were water scarcity and pollution. These were coupled with inadequate handling of these problems by the government, low social freedoms, discrimination and conflicts. Iran is vulnerable to drought due to it being an already arid landscape, but unsustainable consumption of groundwater compounded by low river flows and rainfall runoff to replenish it, and high irrigation requirements for agricultural lands, have made it worse (UNDP, 2022) (Daneshvar, 2019). Sinkholes were reported by multiple interviewees, due to a lack of groundwater, and the need to search farther and deeper for places to builds wells was mentioned often:

“In Iran, I was there 35 years, climate change I was feeling. 7 or 8 cities in Iran, with climate change over there, with no water…no water for (farmlands)… The water from the well, there was nothing, because they get dry, the wells over there, and for these reasons they migrated to another city or some place good for farming.

Before when we dig the well, 60 meters, you can reach the water. Right now, you just can’t reach the water, drinkable water… We use a lot of water for farming. Now the ground falls down (sinks). In Iran. Right now it doesn’t make sense to even do that (dig wells) because there is no water, even rain. There is a (drought). 40 years ago it was good water, everywhere there were wells. Now they are completely dry. Middle of Iran, especially in the desert.”

“I was in Tehran, 50 meters down from my house was a well. In my house, I saw the ground, there was a big hole, maybe 2 meters, where the ground falls down (due to a lack of groundwater).”

Further water scarcity problems faced are increasing agricultural difficulties, and also migration due to a loss of drinking water. Multiple interviewees mentioned cities which had been abandoned due to a lack of water, as well as lakes and rivers which had dried up. The lack of water also causes increased fire weather. Recent droughts, they said, have dried up Lake Urmia in Tabriz and the Karun River in Isfahan and several swamps in Iran, and many farmers have lost their farmland. In southern Iran, they said, many palm orchards have been destroyed by drought, and even many (populations of) animals such as buffalos and camels have died. Even humid mountainous regions in Iran, they said, are starting to face shortages of water. The agriculture uses too much, and there is not enough for the people and animals to drink, they said. The responses from multiple interviews included:

"(Has climate change caused problems in Iran?) Yes, a lot…we have some cities that have no water, no rain and everywhere is dry. So yes it impacts my country, but it's not a reason I left. Yeah maybe (it is a reason some people leave), like when it is dry, like really out of water, or they don't have any water to drink or wash, then they migrate, they have to. It is worse now (than 10 years ago). Many people cannot grow their vegetables…and drought, it has a bad impact in some cities in Iran, they are really suffering because of this reason. And you can see they are drinking waste water, or they have to deal with it somehow. For example, in one city, there is popular river. I think 50 years ago, maybe 40 years ago, it was full of water, full of fishes, now it is completely dry. I remember when I was 6 I visited, and I could see the dead fish everywhere because there is no water. And you see lots of forests are dry, fire in lots of places because of the hot weather."

"There is a lake in Iran. 10 years (ago), 5,200 square meters…its dry right now completely. There is no water. There is a river…in the middle of Iran; 3 or 4 cities were farming with that water. Right now its completely dry. I went to one bridge, it's so famous (in the center of Iran), and right now there's no water, there's nothing, but when I went over, I think it was maybe 15 years ago, there was water and one place you can go for restaurant to see the water and sitting there. It was such a good place for holiday. But right now there is nothing. There is a lake in the north of Iran, and there there is water. It's so famous, because its close to the biggest lake in the world, and also after the lake there is a big mountain. And when the clouds come they get stuck there, the weather is humid over there, and it's such a good place for farming. Now they have water, but it's going down. The biggest problem is, the drinkable water, they are using it for farming, they use a lot… and especially it is hard for the animals if they can't find water, it is hard for them to live."

"I was in 17 cities in Iran, and the first thing I saw as a kid…when I grow up something else happened. Everything has changed in this time since I was a child. 25 years ago I went to (a city in the middle of Iran), in the desert, and after 20 years I went over (again) to the same place, the same village, and it was completely destroyed, there was nothing there, everybody left, because there was no water over there. Right now, they migrate to big cities in Iran…those who have some money or can travel, prefer to go to Europe or some other countries."

Many of the refugees interviewed were originally from Afghanistan, or their parents had been from Afghanistan, but they had migrated to and spent most of their lives in Iran. This is the case for most Afghan refugees – they spend many years in Iran until eventually moving on to Europe if they need to and are able to (Hugo, 2012). This is important to evaluate because climate change may be a factor fueling this migration from Iran to Europe, in complex ways. For example, the Afghan damming of the Helmand River flowing between Afghanistan and Iran has caused a rift between the countries, as the water is no longer flowing into Iran from the mountains in Afghanistan. Political turmoil in both countries prevented the ratification of any treaties over transboundary water rights, and most of the knowledgeable scholars and engineers who would be able to negotiate more equitable sharing of the river resource have fled Afghanistan (Goes, 2016). Three of the interviewees mentioned the Helmand Dam as a source of contention and reason for migration to Europe. Afghan refugees in Iran already face ethnic discrimination and are often unable to ever fully integrate, go to school, or work legally in Iran (Hugo, 2012). Now they are being used as a bargaining tool against the Taliban to coerce the group into opening the Helmand River again. One interviewee explained:

"(Is scarcity of water is a big problem in Iran?) Yeah. Especially with Afghanistan, in Afghanistan right now there is a dam, because of this no water comes to Iran. And for that the Iranian people, and the government are angry, and so they deport the Afghan people. Maybe 1 week or 2 weeks ago they put a big truck, full of Afghan people, and they send them back to Afghanistan. Because they escape from the Taliban, but because they have no water (in Iran), they send them back to Afghanistan. (You think they send them back because of the water?) Yes, every time it's like this."

This shows that water scarcity, aside from causing agricultural difficulties and drinking water shortages, can also influence migration in more complex ways. Another interviewee mentioned that the Helmand River controversy and the government's general lack of competency in dealing with the country's water scarcity has led to numerous protests in Iran.

Another vulnerability Iran faces is bad air pollution, which makes living conditions difficult and, according to interviews, can influence people to migrate. Iran is a high emitter and quickly urbanizing (Daneshvar, 2019). This was mentioned by all interviewees from Iran, one example being:

"Iran had really good weather, and now this is getting really worse because of all the cars. Everybody is using their personal cars or motorcycles, they don't usually use the subways or bus. I remember…sometimes in Iran, in the capital, there were days that were black, dark…was like gloomy weather…you were never able to see the mountains…because they are using lots of cars and factories."

5.8.9 Adaptation options

While there are some government frameworks on lowering emissions, as well as on adapting to climate change, according to those interviewed the government has not been handling it at all, leaving the people vulnerable. Some adaptation measures recommended by the UN are educational and outreach programs to educate communities on better management of resources, enhancing irrigation efficiency, agricultural research and transfer of technology, developing drought resistant crops, developing monitoring systems and early warning systems, stabilizing watershed management, reduce water loss/increase water recycling, and introducing laws and regulations to manage the country's resources and emissions (UNDP, 2022). According to interviewees another way to prevent migration from Iran would be to better integrate Afghan refugees into the country, so they are not faced with discrimination and unemployment. At the present time, migration is often an adaptation strategy for those struggling with climate related impacts in Iran, if they have the means to do so.

6.0 Discussion

6.1 Research questions answered

- How does climate change influence migration from a refugee perspective?

This covers the scope of the whole study. This was answered in the results section and has a multitude of answers. Many refugees, the majority, did believe it was forcing migration in their country, but did not think it was a part of their personal story. It was more often said that climate change is impacting the countries of origin in some way, then it being a reason for migration, but it was also cited as a reason for migration in some cases. In some cases there was a lot of certainty in it being a driver of migration, but in most cases there was a lot of uncertainty whether climate change was the main driver of migration, although it was admitted that it was playing a role in some way. This is consistent with the literature which also shows uncertainty in whether climate change is influencing migration, and the complex ways in which is does so. While it is interesting that the responses indicated high levels of knowledge that climate is changing and some certainty that it is causing migration, the discrepancies between responses in this study confirm much of the literature, that it is difficult to fully comprehend the climate-migration nexus. With that said, this study provides valuable insight into refugee perceptions of climate migration, and it is valuable to note the majority of interviewees do think climate is causing migration, despite it not being a part of their personal experiences (Simpson, 2021)(Parish, 2020)(Vinke, 2021).

On the whole, it was agreed that climate change does increase migration from the refugee perspective; however it is a complicated relationship. War, conflict, political instability, and unemployment were also drivers of migration. If climate change worsens these factors in a country, then it can influence migration, but there was low confidence in the relationship. Sometimes these factors interacted in the interview responses, such as fuel shortages due to war and extremism leading to the perception of increasingly harsher climate extremes, and the use of unsustainable and polluting fuel sources, which worsened environmental

problems. This kind of relationship is most clearly seen in unemployment due to agricultural difficulties, which was a major mention in the interview responses; when rainfall patterns change, water availability is lowered, migration is induced, conflict is induced, and unemployment, famine, and further migration are the result. This was seen in many of the interview responses from the Sahel. Another relationship seen in the interviews was exacerbated resource scarcity in conflict torn countries. Pressure from outside forces also contributed, in cases such as resource rich DRC being ravaged and the local population being forced to flee (Koumou, 2016)(Vlassenroot, 2005). In this case interviewees said deforestation from external interests was fueling land degradation and furthering flooding, which was due to more extreme climate events; all of this together was leading to migration. Most refugees who spoke of how climate change was affecting their country, also said that most people who migrate are doing so due to conflict or unemployment, not because of the climate. In the case of unemployment there was high certainty that it was influenced by climate change, but in the case of conflict there was low certainty that it was linked to climate change. The interview responses build upon the existing research well, which notes complex feedback mechanisms in the climate migration relationship. For example migration from climate induced stress can be a direct link, but the migration can cause conflict, which leads to further environmental stress and vulnerability, and further migration (Hummel, 2015)(Grolle, 2015)(Flahaux, 2016).

- How does climate change affect the regions people are fleeing from?

  Most of those interviewed believed climate change was happening, knew what it was, and had witnessed the effects. Only two of the interviewees did not think the climate was changing. These perceptions would be more thoroughly explained by examining socio-economic factors such as level of education and literacy, as well as their situations at home before fleeing (De Longueville, 2020)(Koubi, 2016)(Brussow, 2019). The primary topics were migration due to drought, change in rainfall, and agricultural famine. This was the most common theme, and seen in the Middle East, Sahel, and Horn of Africa regions. Other seasonal shifts bringing cold spells and heavy snowfall were cited, as a cause for agricultural difficulties and also hardship for people, leading to migration in the Middle East region. In the Sub-Saharan Africa region the main topics mentioned were flood from fluvial sources that have caused people to lose their homes, lives, and agricultural land due to floods and definitely were believed to force migration. Pests such as locusts, disease in disadvantaged communities in cities, as well as air pollution and water pollution were cited as impacts, and sometimes reasons to migrate in this region as well. Heat waves and wildfires were not often cited, but were in the Middle East, and can be inferred to be more prevalent in relation to drought and aridity, which was a cause for migration. Land change including deforestation and desertification were a major impacts in the interviews, and sometimes were cited as reasons to migrate, especially in the Horn of Africa. Deforestation was sometimes linked to desertification, in the case of Somalia. In places like the DRC and South Sudan in Sub-Saharan Africa, deforestation was linked to increase flooding in the interviews. And in Iran desertification was linked to increased drought, and vice versa. These are a few examples of the complex interactions of climate hazards seen in the literature (Mirzabaev, 2022). It is notable that perceptions of refugees discerned these

interactions, and this is a valuable contribution to the literature on climate change perceptions (Parsons, 2021)(Praag, 2021). Other impacts of climate change, including increasing storms and intensity of storms (IPCC, 2022) were not really covered in the interviews, only by a couple of people in relation to intense rain and flooding. Slow onset events were the primary focus of the refugee perceptions. However, sudden onset events can also cause major displacement of people (McAuliffe, 2022), perhaps more so in other countries and regions, or mainly leading to temporary internal migration, which is why it was not examined so much in this study.

There was a lot of variety in the physical science data compared to the interview responses. Sometimes it matched very well, and other times it did not, and sometimes there was too much uncertainty or a lack of data to really draw comparisons. In the Sahel, for example, much of the literature pointed to shifting rainfall patterns as the reason for agricultural difficulties and failures, thus forcing subsistence based populations to migrate, for income and livelihoods (Hummel, 2015). This aligns well with interview responses, which mostly likewise pointed to shifting rainfall patterns as a reason for agricultural famine, and subsequent migration. However, there was a lack of consistent data and projections for the Sahel region to definitively point to a correlation between interview responses and climate data. The exception was sea level rise trends and projections, which were aligned well with the interview response from Nigeria, and this was cited as a reason for migration in the interview, both because of loss of life and home, and also due to decreased value of agricultural lands. In the responses from Burkina Faso, some of the interviewees did not believe the climate was changing or that it was a reason for migration, however these were also the interviews with the most difficulties in language barriers so this could be a reason. Socioeconomic factors in this case would be interesting to investigate further, as this could also cause the discrepancies in responses (Parsons, 2021). The rest of the interviewees had consistent responses about shifting precipitation patterns and agricultural difficulties, although again this cannot be compared well against the climate data due to low confidence in the data and models (IPCC, 2022).

- Do refugees believe climate change is a reason people need to migrate to Europe?

  The answer here was definitively yes, the majority of interviewees believed climate change was a reason people migrate from their country; however, it was not necessarily their own personal reason. The answers varied and it was not often cited as the primary reason, although sometimes it was. Often it was a reason in conjunction with other reasons such as political instability, conflict, or discrimination. Sometimes it was thought that it was not possible for “bad weather” to be a reason to migrate to Europe, although even in these interviews a lot of the time climate change was still acknowledged to be impacting their countries. This perception that climate cannot be a reason to seek asylum in Europe influenced a lot of the answers, as many of those interviewed were certain that it was not possible, even if it may be a reason for leaving the origin country.

Migration is often considered an adaptation strategy to adapt to climate change, and can be a last resort or a first line option. One study in Burkina Faso found that men and women both perceived migration has harmful to socio-economic standing and health. Despite this, migration was still used as a way to overcome difficulties due to climate change, and increase household survival. Migration is often not considered a choice, but as being forced, especially in rain-fed subsistence agriculture populations. One debate amongst researchers is whether migration indicates adaptation, or a failure to adapt (Vinke, 2022). It is no longer reliable to look to the past for indications of how climate migration will look in the future. The Sahel is historically a region where people have migrated in response to environmental stressors, but predictions of how famine will influence migration are no longer clear as stressors become more pronounced, and the Savanna disappears as a haven for migrants. Settlements that were set up after previous migration events were also found to be more vulnerable to future climate shocks, and had a 75% migration rate due to dry seasons, as opposed to 10% in older settlements. Early warning systems in these regions could be a potential solution to mitigate famine and subsequent migration, but to adequately set these up, an understanding of risk perceptions is important (Grolle, 2015). There is evidence from a study in Burkina Faso that migration patterns are becoming more permanent; this part of the Sahel also has a history of short term migration to cities for work, but more and more people are migrating places with the intention of staying long term, and this can be attributed to increasing climate variability (BRILL, 2019).

Additionally, it is interesting to assess whether climate change is influencing conflict, and subsequently migration – or whether climate induced migration is causing conflict. In the Sahel, there is a large evidence base of land based conflicts between different agrarian groups such as herders and farmers; these conflicts have been due to a forced change in lifestyle due to climate variability, and subsequent conflicts over land resources. “Rent seeking” or corruption amongst state officials who are governing grazing lands has also exacerbated land conflicts in the Sahel, as there is low trust in government officials causing people to “solve problems on their own” (Benjaminsen, 2012). These beliefs are important to understand as they are crucial for informing migration decisions, so this study adds to the literature nicely, contributing knowledge of refugee beliefs in Europe (Koubi, 2016)(Parish, 2020).

- How do perceptions compare with the physical science basis and predictions?

Generally the data and projections did not match up with the interview answers perfectly; however, there were certainly correlations. This can be explained in the vast regional diversity, even within study regions, and also in the nature of climate data; for example there may be correlating trends between perceptions and data, but the data trend does not have statistical significance, while the perceived trend does not need to meet this criteria. Also averaging data across countries within one region, which may have diverse climate zones, is not an ideal way to analyze data, especially when compared to human perceptions that also come from very different sources and places and situations. That said, there were interesting deviations between the two sources, and in places where there is little confidence in a direction of a trend from the data, the perceptions become very valuable. In

places where the observed data was not sufficient to show a trend, but refugee perceptions strongly felt there was a trend in one direction, this is valuable. Alternatively, in places where the data matched perceptions, this only strengthens the confidence in the knowledge of how climate is affecting these regions. In places where the data was opposed to the perception, this also provides valuable information; for example if mean precipitation is increasing but perceptions say it is decreasing, this can indicate that there are longer dry spells between more intense storms – data which would otherwise be difficult to gather without meteorological stations (IPCC, 2022)(Koubi, 2016)(Parish, 2020) (Longueville, 2020).

In this study it was found that refugee perceptions of climate impacts often matched with the climate data, either the past trends, or future predictions. Sometimes the perceptions were stronger than the confidence in the data, and this was seen in regards to rainfall events and trends, as well as other seasonal and long term shifts in climate. Sometimes there was a perceived decrease in precipitation, whereas the data indicated an increase, but this could be accounted for when looking at seasonal precipitation trends, which tended to align with the perceptions. Agricultural trends were often aligned with interview responses, and there was a decrease in agricultural production across all regions and interviews in some form. This was also a common driver of migration in the interviews. Extreme and sudden onset events were not perceived so much, but there were certainly mentions of it, in relation to flooding and wildfires, although more in regard to long-term increase. This is interesting, as the climate-migration literature often fails to discern slow onset trends; therefore these interviews provide a valuable glimpse into the subjective and lived experience of people forced to migrate from regions in Africa and the Middle East, regions which are said to feel the most intense climate change effects (IPCC, 2022)(UNHCR, 2022).

6.2 How climate change impacts those en route to Europe

While climate can be a factor fueling initial migration from refugee home countries, it can also play a factor in forcing migrants to continue moving from country to country. For example, when conditions in the refugee camps in Turkey and Greece are unacceptable, they feel forced to continue on to countries further in the EU, such as Germany. One Iranian interviewee noted the extreme heat in the camp in Greece had caused the death of a Somali baby,

“In the camp, in the summer, the weather is always extremely hot, you cannot really breath or deal with it. It is hot, its boiling. I was working with the clinics…a lady came like panicking, she went to the pediatricians room, and after 10 minutes, maybe 15, I was translating in the other room and saw the woman was crying. I asked and they said the baby died because it was super hot. I think the weather was like 40 degrees.”

On the other hand, in the winter in Greece there can also be excessive rain and cold. One interviewee mentioned knowing a man who had died of cold overnight in one of the tents,

and said there were many more. Often it is those who are older and cannot stand it, or young men who use heaters inside the tents and die of asphyxiation.

One Syrian interviewee said of living in the camp in Greece,

"I used to wake up to find all my clothes wet because of the rain. In the summer, the heat was so intense that the ice water melts within 5 minutes. And in the fall there was so much (wind) and storms that the tent was tore off."

While there are political and socio-economic factors that influence asylum seekers to move from Turkey and Greece further into the EU, and a simple solution may be to not house them in refugee camps anymore, but in hotels and buildings equipped to handle the elements, at the present time it seems climate change may also play a role in continuing migration routes into Europe mainland (Fotaki, 2022). Below are the projections and past trends from the Mediterranean region, which shows that although cold spells and frost show a decrease, the other risk factors are projected to increase and have been observed increasing in the past as well.

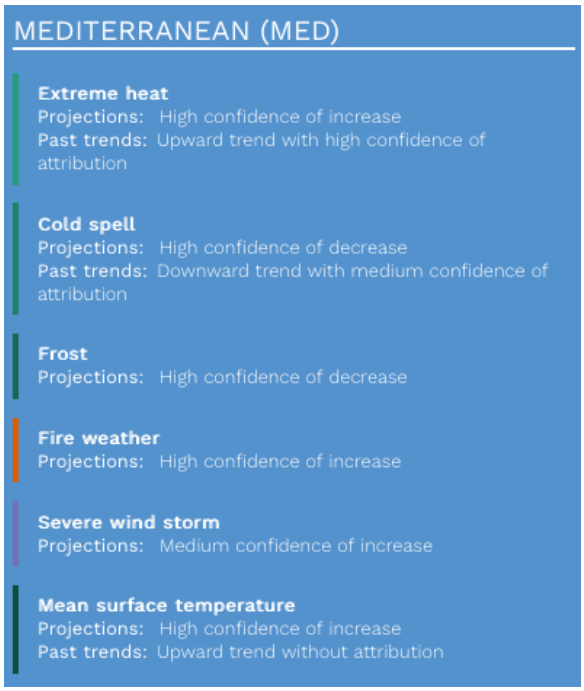

Figure 38: Climate change past trends and future projections for the Mediterranean region (IPCC Atlas Regional Synthesis, 2021)

6.3 Issues

One of the major problems faced in this analysis was a lack of consistent data from the regions and about the regions. The nature of climate research and projections is uncertain, but these regions also have a lack of data collection to begin with, so models are even more

unreliable. There is also large variability between and within regions, since this study covered such a large scope. While the best available data was used, a smaller scale study of one area with good monitoring stations and data would likely produce more meaningful results (IPCC, 2022). This would also allow for a higher sample size from one region. This of course requires fieldwork in these regions, and in this case the focus may not be so much on migration. In this regard, the study was well done because the interviews focused on those who had already migrated to Europe and could reflect with hindsight on their motivations for the journey as well as reasons other people migrate from their countries. The sample size was large enough when considering the demographic as refugees in Europe, but this is a very large and varied demographic (Flowerdew, 2015)(Zapata-Barrero, 2018).

While regional definitions can be fluid, and South Sudan, for example, could have been placed in the Horn of Africa region, and Nigeria, for example, could have been placed in Sub-Saharan Africa instead of the Sahel, for this study the groupings were based on climatic zones and the tendencies of interview responses. The Horn of Africa region is highly diverse climate wise, so including Somalia in a category with South Sudan for the purposes of this study would not produce clear results, as they have very different climate signals and interview responses. Nigeria was not such a clear decision, but since the northern part of the country is in the Sahel belt, which is a very distinct climate zone, it was included in this region. The large range of countries geographically made it important to categorize them by similar climates and problems mentioned in the interviews. However, if they had been grouped differently, the results may have been presented differently, and shown different trends (UNHCR, 2022)(Hummel, 2015).

Difficulties faced included language barriers, varying levels of knowledge and understanding about the subject matter, varying lengths and detail of responses. Some interviewees gave very succinct answers and it was difficult to go more in depth with them. Others spoke for a long time and with more questions went deeper into the topic. This led to discrepancies in the quality of data from the different countries, as there was not as much material to work with in the content analysis and comparisons for some countries, so the results may not have been a good representation of the real situation. In this case, larger sample sizes from each country would be beneficial (Flowerdew, 2015)(Zapata-Barrero, 2018).

6.4 Contribution to field

This study was a valuable contribution to climate-migration research because it provided a unique viewpoint – that of refugees in Europe – on how climate change is impacting countries in the global south, and how it is influencing migration to Europe. While there have been studies done on the local level to gauge climate change perceptions on immigrant populations in Morocco (Praag, 2021), farming communities in Burkina Faso (Henry, 2003), Tanzania (Brussow, 2019), and Cambodia (Parsons, 2021), to name a few, there are no or few studies on climate change perceptions among the refugee population in Europe. This is an important population, as it is heavily focused on in the media and

amongst Western scholars, lawmakers, and policy makers. As well, there is high contention on the Greek islands and other receptions points within Europe, which receive these migrant populations, often coming via irregular routes from Africa and the Middle East. A better understanding of how climate change is fueling these migrations is crucial to forming better policies and models going into the future (Fotaki, 2022)(McAuliffe, 2022). Additionally, compared to the rest of the world, there have been comparably few studies done on climate perceptions on the African continent, which leaves a large gap in knowledge since Africa is both more vulnerable and affected more by climate change than other parts of the world (Flahaux, 2016)(Steynor, 2019).

Understanding the perception of climate change impacts and how it influences migration is important in understanding resilience, vulnerability and exposure to hazards. It is valuable in that it provides a more complex analysis of climate change impacts in regions where local data may be lacking or uncertain, and it also incorporates socioeconomic factors into the perception, as each individual is made up of a unique background and influences (Longueville, 2020)(O'Neill, 2022)(Parish, 2020). This is relevant to understanding decisions to migrate, which are decided from a number of factors including community knowledge and support, literacy, livelihood, but also perception of how severe the impacts are from climate change (Koubi, 2016)(Parish, 2020). There are many layers to risk perception understanding, but an important one is personal experience of climate events, as these have proven to promote higher risk perception of climate change; however, this information can really only be gleaned from subjective accounts. By adding to the literature on climate change perceptions in Africa, valuable research gaps are being filled, which can help promote better policies for migration and also adaptation locally (Flahaux, 2016)(Steynor, 2019).

This has implications for future adaptation to climate change, as evidenced by a study in Somalia which found that local knowledge of climate change and perception of the risk mitigated destructive forestry techniques, such as charcoal production, and increased willingness to adapt sustainable methods (Jama, 2022). Additionally, a study in the Middle East found that lowered adaptive capacity led to increased risk of conflict due to drought; without the lowered adaptive capacity, there was not evidence that drought was a major driver of conflict (Feitelson, 2017). This means that perceptions of climate change impacts are very relevant to understanding responses to climate change in the future, effects of climate change on socio-political factors, and the thresholds of whether there will be adaptation on a local level or people will be forced to migrate north (Steynor, 2019). Additionally, terminology can be an important determinant of whether populations will take steps to adapt – for example, saying the Middle East is “drying up” can be a more accurate depiction of the permanent shift in climatology, rather than “drought” which can indicate a temporary anomaly. In the Middle East, adapting to drought is arguably a part of the culture and history, however this can also inhibit accurate risk perceptions of modern climate threats. Understanding how people perceive climate risks is a part of knowing how to respond to them (Karami, 2019).

While comparisons to physical climate data were complicated, and interview responses were also complicated, and distinct conclusions were difficult to make, the study still contributed cross-disciplinary perspectives and information, which creates a more complete picture of the climate-migration nexus. Discrepancies between perceptions and data can be used to try to improve methodologies of assessing climate impacts in certain regions or for certain climate factors. Vulnerabilities and adaptation strategies of those migrating to Europe can be better understood now than from the existing research before. Asylum seeker perceptions of their rights to migrate due to climate change can be valuable in the debate over whether "climate refugees" should become a legal definition. Understanding to what extent refugees believe climate change is affecting their country and whether it is causing migration is important to truly know the extent of damage climate change is causing already, more thoroughly than the climate data alone. While the research could be improved or better replicated in the future, this study provides the framework for cross-disciplinary research such as this. This can build on existing attempts to quantify climate perception and migration in thresholds and scales, but furthering our understanding of how subjective decisions are correlated with climate data (Valkengoed, 2021). A better understanding of the climate-migration nexus is valuable in political and legal frameworks as well, to make more informed policies and laws (Arenilla, 2020).

Photo taken by author: Mavromouni Refugee Camp, Lesvos, Greece

Photo taken by author: Turkey across Aegean Sea, Lesvos, Greece

7.0 Conclusion

This was a mixed-methods, interdisciplinary study on the refugee perception of climate change, in their home countries and also how it influences migration. There are gaps in climate-migration research regarding local and individual perceptions, as well as difficulties in finding proper methodologies to assess climate migration. A better understanding of this interaction is important for implications in policy decisions going into the future (Arenilla, 2020). What this study found is that there is a correlation for the most part between perceptions of climate change in countries of origin and climate data, but it does not exactly match; there are distinct places and impacts for which the perceptions had more confidence in a direction of change than the low confidence of the climate data and projections, and in some places the perceptions opposed the climate data, while in others it supported it. This is valuable in that many of these regions lack local monitoring and meteorological data, so by looking at where the large scale climate data matches and does not match, gaps in understanding of climate impacts can be narrowed. In addition the study found that the majority of refugees did not believe climate had played a role in their migration, but the majority also believed that it did play a role in others' migrations. The majority believed the climate was changing and it was impacting their countries and migration in general. Lastly, the complex interactions between mobility drivers were analyzed based on interview responses, and vulnerabilities, resilience, and adaptation strategies were understood better from the narrative accounts.

Further research that would be useful to follow up this study with would be a further analysis of the socioeconomic classes of the interviewees, i.e. if they attended secondary school or university, if they came from farming or subsistence backgrounds, if their family financially supported their migration, literacy and English levels. Most asylum seekers in Europe come from middle class backgrounds, as it is financially very burdensome to reach Europe through illegal channels. This can affect their perception of climate change, as it will likely be felt most by the most vulnerable populations, and those reliant on agricultural for survival. On the flip side of this, those with higher education and literacy will likely have a better grasp on climate change and more knowledge outside of their own personal story. To elaborate on this, further understanding of the perception of vulnerability, including socio-economic factors would also be valuable, i.e. family networks, NGO involvement, culture, gender, financial losses/gains. As well, a larger sample of women interviewees would be valuable in understanding climate impacts in the countries. While most asylum seekers in Europe are male, there is certainly a large female population as well, with a different perception of risks and vulnerabilities. In some cases females may be more affected by climate change than the male population, and they often have more vulnerability in that there is lower social mobility and education access in many countries. While some studies found there were no differences between climate change perceptions of men verses women, other studies have found that women will often stay behind, while men migrate (Flahaux, 2016)(Vinke, 2022)(Parish, 2020). So these variables would be interesting to include in an interview based study in the future. In climate perception research it has been increasingly understood that socioeconomic factors play a big role in perceptions and migration decisions (Flahaux, 2016)(Parsons, 2021), so this would be an

interesting way to further this research. Overall this study made an interesting contribution to the climate-migration literature by providing a glimpse into the perceptions of refugees in Europe as to how climate change has affected their countries, and how it has influenced migration.

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A special thank you to the supervisors of this thesis,

and the UZH Geography Alumni Department

for the support,

as well as to the interviewees who donated their time and stories for this project.

Personal Declaration

I hereby declare that the submitted thesis is the result of my own, independent work. All external sources are explicitly acknowledged in the thesis.

September 29, 2022
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