Lund University
Department of Political Science

SIMZ31
Tutor: Robert Klemmensen

A polycrisis of climate change, food insecurity, socioeconomic inequality, and conflict intensity?

A statistical analysis of interrelated crises.

LUND UNIVERSITY

Alva Linnér

Spring 2023

Abstract

Along with escalating climate change impacts, aggravated hunger and malnutrition, and widening socioeconomic disparities, recent decades have also seen increased casualties during intrastate conflicts. The aim of this thesis is accordingly to investigate the interactions among climate vulnerability, food insecurity, and socioeconomic inequality and their effects on conflict intensity. The research problem was approached by conducting multiple linear regression analyses at the world and regional levels, including 84 countries and covering the 2002–2021 period. This thesis finds that both food insecurity and socioeconomic inequality have significantly affected the conflict intensity of intrastate conflicts at the world level. The statistical analysis demonstrates that these correlations are exacerbated when they interact with climate vulnerability. The regional analyses present more mixed results. The results are discussed in light of theories of greed versus grievance as well as environmental scarcity and conflict. I conclude that while grievances due to human insecurity and inequality have driven the intensification of civil wars, climate vulnerability stands to exacerbate these grievances. The thesis concludes that in a world facing mounting polycrises, understanding their interactions is vital in order to establish positive conditions and lasting peace.

Keywords: conflict intensity, climate vulnerability, food insecurity, socioeconomic inequality, greed versus grievances, environmental scarcity and conflict.
Words: 19 001

Table of Contents

1 Introduction

1.1 Interlinked crises

The world is facing compounding crises. This assessment is gaining traction in international security discussions, captured in concepts such as "cascade of crises" (Homer-Dixon and Rockström, 2022) and "polycrises" (World Economic Forum, 2023). *The Global Risk Report 2023* warns that "interrelated environmental, geopolitical and socioeconomic risks" and "eroding resilience are giving rise to the risk of polycrises – where disparate crises interact such that the overall impact far exceeds the sum of each part" (World Economic Forum, 2023, p. 9). The question arises: What is the empirical evidence for these compounding crises? In this thesis, I will look at the evidence for the extent to which climate change, poverty, food insecurity, and armed conflict are interrelated in shaping the predicament of human security.

While the world is inching closer to achieving the first Sustainable Development Goal 1 of ending poverty, progress to this end has been full of setbacks (UN DESA, 2022). Extreme poverty is increasingly concentrated in countries that are fragile, war torn, and conflict ridden. Many of these regions are vulnerable to climate change, which is expected to further impede human development. One target for SDG 16 concerning peace, justice, and strong institutions is to reduce all forms of violence and related fatalities. To achieve this goal, we need to understand the conditions under which armed conflict is likely to occur or become more violent (Palik *et al.*, 2020). While understanding the links between inequality, violent conflict, and climate change appears to be essential for realizing the Agenda 2030 sustainable development aspirations, we still lack studies that probe and further our understanding of how these factors are interrelated.

Intrastate and civil wars make up nearly all contemporary armed conflicts (Buhaug *et al.*, 2011), and the number of violent conflicts has been steadily on the rise since the emergence of "new wars" in the late 20th century (Palik *et al.*,

2020). As armed conflicts constitute substantial threats to human security and induce poverty, it is critical for development studies to probe their root causes and dimensions (Paffenholz, 2014). Whereas Karl von Clausewitz two centuries ago described war as a continuation of politics by other means, contemporary theories probe whether political actions are superseded by economic structures as an explanatory factor. Here another significant trend in world affairs comes in. While the global economic gap between countries has slowly narrowed in terms of GDP per capita in recent decades, the socioeconomic inequality within countries has developed in the opposite direction, becoming increasingly profound in many states (Alvaredo *et al.*, 2018). The question arises as to whether there is any correlation between the prevalence of civil war and socioeconomic disparities.

In parallel, climate change has been rising as an impending threat that will affect development prospects and ultimately have geopolitical ramifications. Climate change is affecting human security in vulnerable countries, driving the deterioration of biospheres and the seventh mass extinction, and researchers are identifying the violent consequences that climate change might have (Sommerville, Essex, and Le Billon, 2014; Welzer, 2017; Koubi, 2019; von Uexkull and Buhaug, 2021). Several armed conflicts and uprisings can be linked to climate-related causes, such as climate-related disasters (Fisher, 2022), rising food prices (Sommerville, Essex, and Le Billon, 2014), and resource scarcity (Buhaug, 2022).

An expected consequence of climate change is that it will increase food insecurity. One of the most central goals of both the former Millennium Development Goals and the present Sustainable Development Goals is eradicating world hunger. However, food insecurity is on the rise again after decades of decline (FAO *et al.*, 2022). Since 2019, the number of undernourished persons has risen sharply, from 8 per cent of the world population in 2019 to 9.8 per cent in 2021, totalling roughly 828 million people (FAO, 2022). Climate change is expected to further increase the risk of famine and malnutrition by 20 percent by 2050, according to the World Food Programme (FAO *et al.*, 2022). While the impact on the number exposed to hunger due to climate change varies significantly between scenarios depending on the assumptions as to the factors driving demand and supply

(Van Dijk *et al.*, 2021), climate change will increasingly have a negative effect on food security and access to sufficient nutrition and micronutrients in all Intergovernmental Panel on Climate Change (IPCC) scenarios (Intergovernmental Panel on Climate Change, 2022).

One expected effect of climate change is that global food production will be under increased pressure and thus the cost of food can be expected to rise, in turn exacerbating existing inequalities (IPCC, 2022).

The impacts of climate change will likely disproportionately affect impoverished communities due to their limited resilience in terms of social safety nets and financial resources. These vulnerable groups face greater challenges in coping with and recovering from disruptive weather events. Additionally, long-term climate change tends to have more severe consequences for economically disadvantaged regions, particularly those located in flood-prone or drought-exposed marginalized areas (Koubi, 2019; von Uexkull and Buhaug, 2021). Additionally, it is important to note that while climate adaptation measures can help mitigate the adverse impacts of climate change on human security, there have been instances in which these measures have inadvertently resulted in the exclusion of impoverished and vulnerable communities (Sovacool, Linnér, and Goodsite, 2015).

Previous research on socioeconomic inequality, food insecurity, climate change, and conflict has to a considerable extent studied these factors as possible root causes of the onset of conflict (Buhaug *et al.*, 2011; Hegre *et al.*, 2016; Rustad, 2016). However, there is a research gap concerning whether and how these factors affect the *intensity* of civil war, and what their combined effect entails. The study of conflict intensity is intriguing since it provides insights into the degree of violence and fatalities in armed conflict. By delving deeper into the factors that influence conflict intensity, we can better understand why some conflicts are more violent than others. Rather than exploring conflict outbreak, concerning the root causes of armed conflict, analysing conflict intensity can elucidate the extent to which governments resist rebellion, how far rebel organizations are willing to go to achieve their objectives, and how feedback loops can exacerbate and prolong conflict.

Between 2014 and 2019, fatalities due to organized violence were decreasing, but they sharply increased in 2021. There was a 46 percent increase in the number of conflict-related deaths from 2020 to 2021. While the number of state-based conflicts has declined, the remaining ones have become bloodier. The three biggest conflicts, in Yemen, Afghanistan, and Ethiopia, together saw 42,600 more deaths than in the previous year. The year 2021 was also the bloodiest in Africa since the Ethiopia–Eritrea war in 1999–2000 (Davies, Pettersson, and Öberg, 2022). Given this increase in conflict intensity in recent years, it is critical to study how it can relate to other trends in global security: climate change, food insecurity, and socioeconomic inequality.

1.2 Purpose and research questions

The aim of this thesis is to probe whether the relationships between socioeconomic inequality, food insecurity, and climate vulnerability affect the intensity of intrastate conflicts. In this thesis, I will use statistical analysis to examine whether and how the independent factors of inequality and climate change, by themselves and combined, affect the level of conflict intensity a country experiences during an intrastate armed conflict. This thesis strives to contribute to a more comprehensive understanding of the driving forces behind armed conflicts and why some conflicts are deadlier than others.

I will explore the relationships among how socioeconomic inequality, food insecurity, and climate change affect the intensity of intrastate conflicts using a multiple linear statistical analysis. The systematic analysis will test two hypotheses: 1) climate vulnerability, food insecurity, and socioeconomic inequality exacerbate conflict intensity in civil wars; and 2) when a country suffers from food insecurity or socioeconomic inequality and climate vulnerability, the combined effect is greater than when the independent variables are tested separately.

To measure climate change's potential impact on the intensity of intrastate armed conflict, the parameter will be climate vulnerability. Prevalence of undernourishment will serve as the parameter capturing food insecurity. To

measure the effect of socioeconomic inequality on conflict intensity in civil wars, vertical socioeconomic inequality will serve as the parameter.

To fulfil the research aim, three research questions will be addressed:

- *What effects do climate vulnerability, food insecurity, and socioeconomic inequality, respectively, have on conflict intensity in intrastate armed conflict?*
- *What is the combined effect of climate vulnerability and food insecurity on conflict intensity in intrastate armed conflict?*
- *What is the combined effect of climate vulnerability and socioeconomic inequality on conflict intensity in intrastate armed conflict?*

The thesis is structured as follows. After introducing and presenting the purpose of this study, I review previous research on the relationships among climate change, food insecurity, and armed conflict. I also explore previous research on poverty as linked to fragility, conflict, and violence, including socioeconomic inequality and armed conflict. Following this, I discuss earlier studies of the linkages between climate change and inequality and situate this thesis within the research field. This is followed by a discussion of the theoretical framework combining greed versus grievance as well as environmental scarcity and conflict, within which the hypotheses are formulated. After that, I describe the methods and data used to explore the research questions. I then continue by presenting the statistical results, followed by a discussion of them. Finally, I outline the conclusions that can be drawn from this study as to whether and how food insecurity, socioeconomic inequality, and climate vulnerability can affect the intensity of intrastate conflicts.

2 Previous research

This chapter outlines previous research on the impacts of climate change, food insecurity, and socioeconomic inequality on the prevalence on armed conflicts. The chapter is divided into three sections on previous research: climate change and armed conflict; poverty linked to fragility, conflict, and violence; and climate change and inequality.

2.1 Climate change and armed conflict

2.1.1 Increasing vulnerabilities

Along with the worsening effects of climate change, scholars have theorized about the possible correlation between environmental change and armed conflict. So far, there is no clear consensus as to exactly how climate change could pose, or already has posed, a threat to international or human security. Still, there are three predominant lines of research that can be distinguished in this growing literature: climate change as worsening prevailing vulnerabilities; climate change as a risk multiplier; and conflict as hampering the adaptive capacity to mitigate climate impacts.

The clearest link between climate change and conflict is that climate change exacerbates existing vulnerabilities (Buhaug, 2022). Climate change risks will become more complex as warming increases (IPCC, 2023). Climatic and non-climatic risk drivers will interact and exacerbate existing security risks across regions (IPCC, 2023). One such risk is the projected increasing food insecurity, in which the increase in extreme weather events, such as heat stress and flooding, has already exposed millions of people to acute food and water insecurity (IPCC, 2023). Climate change is therefore constraining efforts to meet other Sustainable Development Goals, such as SDG 2 (zero hunger) and SDG 6 (clean water and sanitation) (IPCC, 2023).

The IPCC presents scenarios for several different global warming levels. In all of them climate change is expected to disproportionally affect already

disadvantaged peoples and regions with other development challenges. Around 3.3–3.6 billion people live in areas with high vulnerability to climate change. In addition to rising temperatures, exposure to climatic hazards will depend on socioeconomic development trends in, for example, migration, inequality, and urbanization. Rural areas will be the most vulnerable to environmental changes and shocks. Globally, agricultural practices are critical for the livelihood of 60–80 per cent of the rural population. Thus, many rural livelihoods depend on practices that are expected to be affected by a changing climate through, for example, degraded ecosystem services, loss of water supply, degraded harvests, and soil erosion (IPCC, 2022).

According to Hanna Fjelde (2015), adverse climate conditions also increase the support for violence and prolong conflicts in regions where environmental scarcity makes for a lucrative market. Lower economic returns in the agricultural sector increase the risk of grievance-based armed conflict. They also facilitate recruitment by rebel groups, which often use economic incentives to recruit, targeting young men in poverty- and scarcity-prone areas. For example, Boko Haram has been able to attract new recruits in the face of widespread poverty and food insecurity, promising income, protection, and provision of basic needs to the targeted recruits (Omenma, Hendricks, and Ajaebili, 2020). Similarly, in Mali, terrorist groups recruit from pastoralist communities due to the increasing tensions between farmers and herders following long-term drought in the region (Mathieu Bere, 2017; Welzer, 2017). In other places, such as in Iraq and Syria, the Da'esh has taken control over water resources and used them to impose its will on regions suffering from water shortages (Welzer, 2017). Taking control over scarce resources can also provide sources of income for rebel groups, for example, when al-Shabaab sustained their violence through taking control over the lucrative charcoal production in Somalia (Welzer, 2017). This relationship can be illustrated as a vicious circle, in which violent conflict deters long-term growth and hinders the possibility of adapting to climate change, in turn threatening human security and increasing the risk of violent conflict (Buhaug, 2022). The regions most exposed to climate change already suffer from high levels of insecurity, poverty,

weak governance, and terrorism. For example, out of the fifteen countries evaluated to be most exposed to climate change impacts, eight are currently hosting United Nations peacekeeping or special political missions (Security Council, 2021).

Statistical studies also show that deviations from the normal climate, such as changes in precipitation or temperature patterns, increase the risk of violent conflict. Increased temperatures and lower average rainfall heighten the risk of armed conflict in both agricultural and non-agricultural areas (Wang *et al.*, 2022). Using geographically disaggregated data from 10,993 conflicts in Africa between 2000 and 2015, Wang *et al*. (2022) could establish a correlation between climate variability and increased risk of conflict. However, Helman and Zaitchik (2020) have not found that long-term warming has affected armed conflicts over the past three decades in general, but that the effects of increased temperatures are more adverse in already warm regions. This, they argued, could imply that global warming is more likely to lead to increased violence in these regions (Helman and Zaitchik, 2020).

Climate is often viewed as a *threat multiplier*, which, in the context of armed conflict, means that it indirectly affects conflict occurrence in numerous ways (Davies, Riddell, and Scheffran, 2020; Buhaug, 2022; Pacillo *et al.*, 2022). In this line of reasoning, climate change exacerbates other threats to human security, such as armed conflict, food and water insecurity, geopolitical insecurity, and financial threats (Werrell and Femia, 2016). This implies that while climate change might not be the root cause of several of these threats, it will likely heighten their implications.

The link between climate change and armed conflict is not a one-way street, however. Conflict can in turn exacerbate or even create vulnerabilities to climate disasters (Peters, 2021). Violent conflict can also weaken countries' capacity to adapt to or mitigate climate change impacts, and Regan and Kim (2020) have argued that while there is a strong link between climate change and armed conflict, regions with higher adaptation capacity are less likely to experience climate-related violence. Armed conflict severely affects household capacity to withstand food insecurity (Agwu, 2022) and cope with extreme weather events

(Muzamil *et al.*, 2021). It also erodes local and regional government capacity to adapt to and mitigate climate hazards. Armed conflict and climate impacts can therefore be described as forming a vicious circle, in which climate impacts increase the risk of armed conflict, and armed conflict increases the vulnerability to climate impacts (Buhaug, 2022). Regions can consequently become trapped in cycles of armed conflict, vulnerability, and climate change impacts (Buhaug and von Uexkull, 2021). Two examples of this are presented by Afghanistan and Yemen, countries heavily affected by war and humanitarian crises. The humanitarian crises in both countries can be partly attributed to climate change hazards, in which severe droughts have increased food and water insecurity drastically (Buhaug and von Uexkull, 2021).

2.1.2 Climate-driven food insecurity and violent conflict

One aspect that is continuously highlighted in the literature concerning climate change and armed conflict is the increased food insecurity that climate deviations bring about. After decades of decreasing the number of people living in food insecurity globally, it has been on the rise again since 2014 (FAO, IFAD, UNICEF, and WHO, 2022). When people cannot access or afford enough food, this can lead to economic instability and political unrest. In worse-case scenarios, this unrest can escalate into armed conflict. In regions where food insecurity is already prevalent, such as areas affected by desertification and drought, the situation can be exacerbated by conflict, leading to a vicious circle of poverty and violence (Hendrix and Brinkman, 2013). In addition, conflict itself can cause food insecurity by disrupting food systems and supply chains, destroying crops and livestock, and displacing populations from their homes and land (George, Adelaja, and Weatherspoon, 2020). This, in turn, can create further instability and conflict. Furthermore, food insecurity can also be used as a tool in war, with armed groups intentionally targeting food supplies or using hunger as a means of control and manipulation (Behnassi and El Haiba, 2022).

Food insecurity is portrayed in the literature as posing a threat to both international- and community-level security for several reasons. There is a risk that

food insecurity, particularly involving key commodities such as wheat, maize, and rice, might increase geopolitical hostility and tension between countries (Adams *et al.*, 2021). Summers and Goodman (2020) noted an expected increase in protectionist trade policies in the face of climate change, especially in countries where climate change will increase arable land for producing key commodities, such as Russia (Summers and Goodman, 2020). This makes food insecurity a transboundary climate risk (Bednar-Friedl *et al.*, 2022).

However, food insecurity is both a driver and consequence of armed conflict. Armed conflict often exacerbates pre-existing threats to human security. Areas that experience prolonged periods of drought, for example, are more likely to experience armed conflict following them (Welzer, 2017). In Sudan, a country heavily affected by droughts and violent conflict, pastoralists have witnessed that, in the years when food is more available, there is no cattle raiding and consequent violence (Brinkman and Hendrix, 2011). This highlights the significant impact food security has on conflict intensity levels in a region. Food insecurity can also be used by rebel groups to recruit. Rebels can use it as a tool to convince communities to support them, by offering communities protection, rewarding them with arable land, or offering them higher prices for their produce (Welzer, 2017).

2.2 Poverty linked to fragility, conflict, and violence

Along with eradicating hunger, development research has also long been concerned with eradicating poverty and its consequences. Poverty is intricately linked to fragility, conflict, and violence, with some key areas being economic and social exclusion (Brinkman and Hendrix, 2011), competition over scarce resources (Ohlsson, 1999; Welzer, 2017), governance and institutional weakness (Nay, 2013), desperation and recruitment (Berdal and Malone, 2000), and humanitarian crisis (Sommerville, Essex, and Le Billon, 2014).

Here I will concentrate on the effects of socioeconomic inequality as it can be expected to rise with climate change, while it also can be expected to drive armed conflicts. Despite this central role, it remains an under-researched area.

Much previous research on the relationship between socioeconomic inequality and conflict has examined socioeconomic inequality as a possible underlying root cause of conflict (Buhaug *et al.*, 2011; Hegre *et al.*, 2016; Rustad, 2016). Although the correlation is still a topic of debate among scholars, proponents of a positive causal relationship frequently cite horizontal inequality, as opposed to vertical inequality, as the primary cause of violent conflict (Buhaug *et al.*, 2011; Fjelde and Østby, 2014; Bahgat *et al.*, 2017). Horizontal inequality refers to the socioeconomic inequality between different societal groups, such as ethnic or religious groups, or among geographical regions. In contrast, vertical inequality refers to socioeconomic inequality between individuals (Buhaug *et al.*, 2011).

Hanna Fjelde and Gudrun Østby (2014) argued that socioeconomic inequality produces intergroup grievances and suggested that the exclusionary politics of many states in Sub-Saharan Africa make the region particularly susceptible to this phenomenon. The authors claimed that high levels of inequality are likely to result in communal violence, and that regions with greater socioeconomic inequality within a country are more prone to such violence (Fjelde and Østby, 2014). Halvard Buhaug *et al*. (2011) also asserted that there is a correlation between inequality and the risk of conflict, but they also noted a lack of understanding in the field, as researchers have tended to overlook regional disparities within countries.

According to Fjelde and Østby (2014), socioeconomic inequality can lead to feelings of marginalization and relative deprivation, which can motivate mobilization and increase the risk of violent conflict. Baghat *et al*. (2017) suggested that widespread frustration over grievances can contribute to conflict escalation. The elites who are challenged by the grievances may fear the economic consequences of rebellion, which could lead them to take up arms to protect their status, creating a self-reinforcing spiral. Fjelde and Østby (2014) noted that while quantitative studies have not found significant relationships between vertical inequality and conflict, those that measure horizontal inequality have. The authors argued that horizontal grievances create intergroup comparison and fuel violence. They also suggested that unequal access to education can contribute to grievances

and violence, while Hegre *et al*. (2009) argued, in contrast, that education has a pacifying effect. As for why groups turn against each other rather than the state, Fjelde and Østby (2014) suggested that communal violence is often cheaper than rebellion against the state, and Buhaug et al. (2011) pointed out that looting can prolong conflicts.

According to Fjelde and Østby (2014), when there is high economic inequality, violence can be seen as a means to gain access to resources. However, they argued that it is not just grievances that drive less well-off groups to take up arms, but also incentives for economic gain from elites. As a result, the authors suggested that in regions where there is great vertical inequality, the risk of communal conflict increases. Meanwhile, Rustad (2016) argued that both vertical and horizontal inequality increase the risk of conflict. Her study of attitudes towards violence in the Niger Delta region shows that, among individuals, less well-off groups are more likely to support violence, while among groups, better-off groups tend to support violence more. This is in line with Boix's (2008) research, which argues that elites are less inclined to change through democratic means in states with high levels of inequality. Therefore, Boix (2007) contended that in states with static and uneven wealth distribution, the likelihood of violent conflict is greater.

2.3 Climate change and inequality

Climate change and inequality are by some scholars considered independent of one another, yet according to other research they are inextricably linked, forming a vicious circle. Initial inequality causes already disadvantaged groups to be disproportionally affected by climate change. Disadvantaged groups experience heightened vulnerability to the effects of climate change as they have less ability to mitigate or adapt to the threats and changes associated with global warming (Islam and Winkel, 2017). One of the groups that will suffer the most detrimental impacts of climate change are the populations of small island and developing states (SIDS). Within them, socially and economically disadvantaged groups are particularly at risk. Climate shocks can thus trap people in extreme poverty (Balboni *et al.*, 2021),

making it interesting to probe the statistical interactions among the polycrises of human security, inequality, and climate change with reference to civil war, as they are inextricably linked to other geopolitical issues. As climate change, food insecurity, and socioeconomic inequality are presented as mediating factors within the research field of intrastate conflict, this poses the question of whether they together amplify conflict intensity. This is the research gap that this thesis aims to address.

3 Theoretical framework

This chapter presents the theoretical framework of this thesis. First, the theory of greed versus grievance is presented, followed by a description of Homer-Dixon's theory of environmental scarcity and conflict. These two theories are then compared, and their similarities and differences are discussed. Lastly, the theory-based hypothesis on which this thesis is based is presented.

3.1 Greed versus grievance

The theory of greed versus grievance is a significant framework in the study of peace and conflict, and it concerns whether greed, defined as economic gain, or grievance, defined as the frustration caused by inequality, is the primary cause of civil war (Collier, 2004). This theory has been widely researched, particularly regarding contemporary conflicts that are frequently of an intrastate nature and have economic agendas as factors motivating the use of violence. The extent to which economic incentives drive contemporary conflicts varies, but Berdal and Malone (2000) argued that even conflicts driven by political or military goals can still have ties to economic opportunities to a certain extent.

A significant portion of research within the greed versus grievance framework focuses on why rebel organizations resort to violence. Some researchers believe that frustration and grievance are the main drivers of conflict, but others argue that rebel groups often have an economic agenda and seek to achieve their goals through violent means. These goals include access to scarce and valuable resources, access to black markets, and control over trade routes (Collier, 2004). According to Collier and Hoeffler (1998), when the perceived gains outweigh the possible losses of waging a civil war, rebels will resort to violence. In societies with high levels of inequality, young men, who are the primary target of recruitment by rebel organizations, face

minimal losses from joining the rebellion, thereby increasing the risk of conflict outbreak. In such societies, joining rebel groups may be the only option for employment or income (Collier, 2008).

Furthermore, economic and political power are often interconnected. According to David Keen (2000), modern conflicts frequently involve both economic and political motives. The possession of economic power enables one to exert greater control and influence (Collier, 2004). Consequently, certain political systems can generate violence, which can also be utilized to safeguard one's economic advantages (Collier, 2004).

The theory suggests a different interpretation of Karl von Clausewitz's (2008) famous claim that war is a continuation of politics by other means, contending instead that war is a continuation of economic activity by other means (Keen, 2000). According to this theory, war is not an end in itself but rather a means of securing economic objectives. This complicates warfare because if both parties perceive a war as beneficial to their economic goals, there is no incentive to end the conflict. As a result, economic motives may prolong civil wars (Collier, 2000).

The greed versus grievance theory encompasses violence from both top–down and bottom–up perspectives. Although previous research has mainly focused on violence instigated by rebel groups, violence instigated by political leaders can also be driven by greed (Keen, 2000). Grievances are often seen as a driver of bottom–up violence, as argued by Gurr (1993), who emphasized that the exploitation of grievances is crucial for group mobilization. Rebel organizations typically target young men from impoverished backgrounds for recruitment (Collier, 2008), doing so because their potential gains outweigh their potential losses. Armed groups can provide a source of livelihood or sustenance, particularly in regions with high unemployment or food insecurity, as noted by von Uexkull (2014).

While there is ongoing debate about whether greed or grievance is the main driver of conflict, some scholars have highlighted the limitations of the grievance perspective. Fearon and Laitin (2003) argued that grievances are

present in all societies, but not all societies experience armed conflict, suggesting that the prospect of economic gain is a more significant factor in the outbreak of civil war.

Moreover, Keen (2000) noted that not only rebels but also elites may exploit civil wars for their economic interests. Both rebels and elites can use armed conflict to pursue economic gains, at the expense of civilians, who are often the ones being exploited by both state and non-state actors. Therefore, Keen contended that it is mostly greed that drives civil conflict. Similarly, Collier (2000) argued that while grievances may be used to recruit civilians into rebel groups or the military, the leaders are primarily motivated by greed.

3.2 Environmental scarcity and conflict

In the early 1990s, Thomas Homer-Dixon, a Canadian political scientist, developed a theory of how environmental scarcity correlates to violent conflict. In this theory, Homer-Dixon theorized that scarcity of renewable resources, such as arable land, freshwater, and forests, can lead to social injustice, which in turn can incite insurgencies, riots, or even armed civil conflicts (Homer-Dixon, 1994). According to this theory, there are three main ways in which the environmental scarcity of renewable resources emerges and may lead to violence: *degradation and depletion* of renewable resources; *increased demand* for renewable resources through population growth; and the *unequal distribution* of these resources among social groups. Homer-Dixon (1999) maintained that there were several possible interactions among these factors, the two most important being *resource capture* and *ecological marginalization*.

Resource capture is defined as when the degradation and depletion of renewable resources interacts with a surge in population growth. This, Homer-Dixon (1999) argued, incites certain groups to monopolize or allocate these resources for themselves, exacerbating unequal access to them (Homer-Dixon, 1999). *Ecological marginalization* is defined as when unequal resource access is combined with population growth and causes the long-term migration of people

dependent on these resources for their livelihood. Often, they migrate to already ecologically fragile regions, where their settlement degrades the environment even further (Homer-Dixon 1999).

The key understanding in Homer-Dixon's theory is not that environmental scarcity *itself* causes violent conflict; rather, environmental scarcity causes societal and economic disruptions, such as migration or exacerbated inequality, which can incite the taking up of arms. Homer-Dixon argued that environmental scarcity strengthens group identities and causes social distrust of the government or other groups, as well as increasing intergroup competition. This, in turn, might escalate to violent conflict and coups d'état (Homer-Dixon, 1999).

When Homer-Dixon developed the theory in the early 1990s, he theorized that environmental scarcity, and therefore related conflicts, would increase in coming decades due to climate change and the increasing degradation of ecosystems. In the same decade, he could already support his theory by noting that environmental scarcities were contributing to violent conflicts in several regions, such as Mauritania, Senegal, Indonesia, the West Bank and Gaza, the Philippines, and the Sahel. Homer-Dixon (1994) argued that conflicts arising from environmental scarcity are more likely in less economically advanced countries, as they have fewer capabilities to buffer the environmental and social changes that a changing climate brings.

3.3 Comparing theories of greed versus grievance and environmental scarcity as drivers of conflict

Homer-Dixon's theory of environmental scarcity and conflict shares many features with the greed versus grievance theory. The theory of environmental scarcity can be connected to grievance in the sense that certain groups are disproportionally affected by increasing shortages of renewable resources due to unequal access to them. As mentioned above, this might fuel distrust and grievance towards the government, or even other social groups, due to perceived injustice. Environmental scarcities also produce economic deprivation, particularly in regions dependent on

arable land for secure livelihoods and among the groups disadvantaged by unequal access to the resources. This further increases the political and financial demands on governments, inciting civil strife.

In line with Collier and Hoeffler's (1998) theory of economic incentives in war, Homer-Dixon also touched on the opportunities that increasing environmental scarcities might present to certain groups. Homer-Dixon (1999) identified resource capture: when certain resources become more valuable due to population growth or increased scarcity, there are often groups seeking to allocate these resources for themselves, either to ensure supply or gain financial advantages, at the expense of other groups. As described by von Uexkull (2014), rebel groups might use existing grievances to recruit or to gain support for their violence. Grievances can act as "reasons" to incite violence or civil strife, with hidden economic agendas. Another similarity between the two theories is that both emphasize that certain natural resources can become valuable to obtain or monopolize during conflicts. Both grievance and greed might therefore incite violence following environmental scarcity.

The two theories deviate in what they emphasize as the key driver of violent conflict. While the greed versus grievance theory focuses more on the *economic incentives* for war, the environmental scarcity and conflict theory focuses on *environmental changes as inciting conflict*. As highlighted above, the focuses of these theories also include overlapping elements. For example, Homer-Dixon (1999) discussed the economic incentives for acting based on grievances, while Collier and Hoeffler (1998) addressed how resource scarcities can create lucrative markets. However, in both theories, these elements are merely two of many indicators included in the vicious circle of armed conflict. Nevertheless, combining *economic incentives for war* and *environmental changes as inciting conflict* can provide a more comprehensive explanation of how environmental change and economic incentives are inextricably linked, which is the main hypothesis of this thesis.

3.4 Hypothesis

This thesis will test two hypotheses based on previous research and the chosen theories. First, socioeconomic inequality, climate vulnerability, and food security, respectively, are hypothesized to affect conflict intensity in civil wars. Second, I hypothesize that the combined effect of exposure to the above factors will exacerbate the level of conflict intensity a country suffers in an intrastate conflict. This hypothesis is based on the similar lines of argument proposed by both the greed versus grievance theory and Homer-Dixon's theory of environmental scarcity. The theories both posit that civil war works in a vicious circle, in which environmental degradation affects human insecurity and economic grievances/opportunities in civil wars, and vice versa. The aim is to test whether there is a statistical correlation to support the hypotheses. To my knowledge, this is a relationship that has not previously been tested statistically.

4 Methodology

4.1 Research design

To study how polycrises are interrelated and how they affect conflict intensity, multiple linear regression was considered a favourable method. A regression analysis can tell us, by calculating the lines of best fit, the extent of the correlation between the independent and dependent variables (Halperin and Heath, 2020). Multiple linear models can be used when the aim is to analyse the relationship between multiple independent and dependent variables. Linear regression analysis is the most common technique for the statistical analysis in political research, according to Sandra Halperin and Oliver Heath (2020).

To answer the research questions, I opted to conduct a large-*N* statistical analysis, using data from 84 countries from different regions across the world: Sub-Saharan Africa, Northern Africa and Western Asia, Central and Southern Asia, Latin America and the Caribbean, and Europe and Northern America for the years 2002–2021.

To find out whether the statistical results of the regression analyses are significant, a null hypothesis will be applied. The null hypothesis means that we assume that there is no statistically significant relationship between the focal independent and dependent variables. In this study, the significance level is divided into three tiers, $p \leq 0.1$, 0.5, and 0.01. If the significance level is below 0.1, indicating a probability of less than 10 per cent that the null hypothesis is true, the hypothesis is rejected. This rejection signifies a significant relationship between the variables (Halperin and Heath, 2020).

When conducting a linear regression analysis, the slope of the regression line, i.e., the regression coefficient, demonstrates the extent to which the value on the *y*-axis increases for each unit increase on the *x*-axis. However, since the slope of a particular regression line may not be directly comparable to the slope of another one with different variables, its explanatory power is limited.

Nevertheless, including the regression coefficient is important as it illustrates the relative impacts of the different independent variables on the dependent variable within the model (Halperin and Heath, 2020).

The coefficient of determination (R^2) is another measure that can be derived from linear regression analysis. The R^2 value falls within the range of 0 to 1 and indicates the proportion of the variation in the dependent variable (y-axis) that can be accounted for by the variation in the independent variable (x-axis) (Halperin and Heath, 2020). To illustrate, an R^2 value of 0.6 would signify that 60 per cent of the variation in the dependent variable is attributable to the variation in the independent variable.

To test the hypothesis that when climate vulnerability interacts with food insecurity or socioeconomic inequality, conflict intensity heightens in relation to when only one of the independent variables is tested for, two interaction variables were computed. An interaction variable refers to a variable that is created by multiplying two or more variables together, and is used to represent the relationship between two or more variables that may depend on the value of another variable, known as a moderator (Aneshensel, 2013). In statistical models, the interaction variable is used to examine the effect of one variable on the effect of interest, while taking into account the influence of another variable, and how their combined effect differs depending at the level of the moderator variable. The presence or absence of an interaction effect can have important implications for the interpretation of statistical results and the development of predictive models (Aneshensel, 2013). In this thesis, the moderating variables were hypothesized to be food insecurity and socioeconomic inequality together with climate vulnerability. Two interaction variables were thus computed:

$$interaction1 = climate\ vulnerability\ \times\ prevalence\ of\ undernourishment$$
$$interaction2 = climate\ vulnerability\ \times exclusion\ by\ socioeconomic\ group$$

In multiple linear regression analysis, the computed interaction variables are used to examine the combined effect of the independent variables.

I constructed two models for conducting the regression analysis. The first model (hereafter, Model 1) included the three independent variables climate vulnerability, prevalence of undernourishment, and exclusion by socioeconomic group as well as an interaction variable computed on climate vulnerability times the prevalence of undernourishment. The second model (hereafter, Model 2) also included the three independent variables, but here the interaction variable was computed through multiplying climate vulnerability by exclusion by socioeconomic group. The models thus differ as to which interaction variable is included.

The full regression formula for Model 1 is:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ + (\beta_1 X_1 \times \ \beta_2 X_2) + \in$$

The full regression formula for Model 2 is :

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ + (\beta_1 X_1 \times \ \beta_3 X_3) + \in$$

In the models, *y* equals conflict intensity, β_0 the y-intercept, $\beta_1 X_1$ the regression coefficient of climate vulnerability, $\beta_2 X_2$ the regression coefficient for prevalence of undernourishment, $\beta_3 X_3$ the regression coefficient for exclusion by socioeconomic group, and $\in$ the model error.

The results of the multiple linear regression analysis are presented in tables including both models, to visualize their different results. The factors presented in the tables are the regression coefficients, significance levels, numbers or cases included, and R^2 value.

When conducting a multiple linear regression analysis, several assumptions are expected to be met: that the observations are independent; that the regression residuals are normally distributed through the population (i.e., normality); that the population variance of the residuals does not fluctuate in any systematic way (i.e., homoscedasticity); and that each predictor has a linear relationship with the dependent variable. While not an assumption, it is still relevant to inspect the Pearson's correlation (Pearson's *r*) among all variables, to check for

multicollinearity. Multicollinearity is when the independent variables are highly correlated, thus providing the same information about the dependent variable (Aneshensel, 2013). The results of these tests are presented in the statistical results. Histograms were also included in the statistical analysis for all the included dependent and independent variables as a visual representation of the distribution of data organized in different ranges.

To conduct the statistical analysis, I utilized the SPSS Statistics software platform.

This thesis is quantitative in character, meaning that the research questions and hypotheses are tested using a statistical method. Quantitative methods are often used in research concerned with testing or confirming theories or hypotheses, to establish whether a relationship between different variables can be established. In studies of a quantitative character, external validity is often considered to be high, meaning that the results of the analyses are generalizable to several different contexts. As this study encompasses 84 cases, this can be assumed to be true. For a multiple linear regression analysis to be robust, there needs to be at least 15 cases for each independent variable ($n = v * 15$). In this thesis, three independent variables will be included (i.e., socioeconomic inequality, vulnerability to climate change, and food insecurity), meaning that at least 45 cases should be included, which the case number of this thesis exceeds.

Internal validity, in contrast to external validity, signifies the confidence in establishing a causal relationship between the included variables (Aneshensel, 2013). When conducting a statistical analysis, this is often something that is opted out of in exchange for obtaining generalizable results for a larger portion of the population. Furthermore, when conducting quantitative analyses of issues as complex as armed conflicts, a causal relationship between variables should always be regarded with caution. Rather, what is of interest is to establish correlation.

4.2 Operationalization

A regression analysis includes both dependent and independent variables. The dependent variable is the factor we hypothesize will be affected by the level of another variable, the independent one (Halperin and Heath, 2020). The hypothesis in this study is that conflict intensity in civil wars relates to the level of susceptibility to climate disasters, food insecurity, and socioeconomic inequality, respectively, a correlation that will increase if the variables are combined. Reality, of course, is more complex than this, but to establish some correlation through statistical means, this is an assumption we must make. In this study we thus have one *dependent* variable, i.e., conflict intensity, three *independent* variables, i.e., climate vulnerability, food insecurity, and socioeconomic inequality, and two interaction variables.

Since the included variables can be conceptualized in several different ways, it is of value to be transparent about which definitions and measurements I will start from in this study. In the following paragraphs, I will explain how the different variables will be conceptualized and operationalized in this thesis.

Conflict intensity is defined by the Uppsala Conflict Data Program (UCDP) as the level of fighting a state-based conflict or dyad reaches, which is defined by the number of battle-related deaths in a conflict. Battle-related deaths, both (para)military and civilian, can give us an indication of how violent and intense a conflict is (UCDP, n.d.). In UCDP data, conflict-related deaths are defined as "fatalities caused by the warring parties that can be directly related to combat, including civilian losses" (UCDP, n.d.). In this thesis, conflict intensity will be operationalized by calculating the total number of conflict-related deaths in intrastate conflicts per 100,000 inhabitants in a country between the years 2002 and 2021. The decision to calculate the total number of deaths per 100,000 inhabitants was made because this thesis is not concerned with which years an armed conflict was low-intensity versus high-intensity, but rather with whether a country's pre-existing social indicators can affect how the armed conflict within the country plays out. The 2002–2021 period was chosen both to have a sufficiently long period to

be able to confirm a longer trend in conflict intensity during contemporary times, and due to limitations within certain datasets.

Socioeconomic inequality can be conceptualized in several different ways. Varieties of Democracy (V-Dem) defines exclusion as "when individuals are denied access to services or participation in governed spaces based on their identity or belonging to a particular group" (Coppedge *et al*., 2023, p. 211). Socioeconomic position, in turn, is defined as being "based on attributes of wealth, occupation or other economic circumstances such as owning property" (Coppedge et al., 2023, p. 211). Socioeconomic exclusion therefore occurs when people do not have the same access to voting, justice, education, or health care due to their economic position, and this is the definition that will be used in this thesis to define socioeconomic inequality, to highlight the *social* inequality that might come with economic disadvantages.

There are also other popular measures of socioeconomic inequality, such as the GINI Index of the World Bank. The GINI coefficient is a measure of the vertical income inequality within a nation or social group. It compares the cumulative proportions of the population with the cumulative proportions of income they receive, and the GINI coefficient is based on the extent to which that deviates from a perfectly equal distribution (DataBank, 2023). However, the GINI coefficient does not consider the difference in social opportunities that economic inequality creates. Therefore, I have opted to operationalize socioeconomic inequality using V-Dem's Exclusion by Socio-Economic Group index, as it highlights the inequality aspect more comprehensively than does the GINI coefficient of the World Bank.

The prevalence of food insecurity is linked to Sustainable Development Goal 2, i.e., zero hunger. The United Nations has defined eight targets and 13 indicators for SDG 2. Target 2.1 concerns the prevalence of food insecurity – universal access to safe and nutritious food – formulated as: "By 2030 end hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious food all year round" (FAO, 2023). Target 2.1 is in turn divided into two indicators, meaning measures of how well the

targets are met. Indicator 2.1.1 is the prevalence of undernourishment and indicator 2.1.2 the prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FAO, 2023).

In this thesis, food insecurity within a country will be defined as the prevalence of undernourishment, as reported by the United Nation's Food and Agriculture Organization (FAO). The FAO defines the prevalence of undernourishment in a country as "the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal and healthy life" (UN STATS, 2023, p. 1). The prevalence of undernourishment in a country is calculated based on the average food available for human consumption per person, level of inequality in food access, and the minimum calories required per day for the average human. The FAO defines hunger as being synonymous with chronic undernourishment, and the PoU index is used by the FAO as the main indicator of hunger pervasiveness. The prevalence of undernourishment index is the food insecurity indicator for which the FAO has the most robust and encompassing data. The data are presented by year and expressed as percentages representing the number of inhabitants in a country who experience food insecurity (FAO, 2023).

The FAO also has a newer index, the Food Insecurity Experience Scale (FIES), which measures the prevalence of moderate and severe food insecurity in a population, but for this thesis I opted to use the PoU index as data are available for it since 2001, and cover more countries. This limitation was considered. The FIES index is a subjective food insecurity indicator that can better represent the degree to which people consider that they are experiencing food insecurity. The FIES index is based on survey data and contains questions about people's access to adequate food at the individual and household level. It was introduced by the FAO as an index in 2014. Therefore, the current data availability is limited to less than a decade. However, it is a novel index that measures food insecurity through individual experience, and the FAO argues that it serves as a meaningful complement to other measures, such as the PoU index (FAO, 2023).

The FAO itself describes the limitations of using the PoU index as a definite measure of food insecurity. It highlights that food insecurity can still exist in poorer households even though food availability is high. Since food insecurity is an individual or household phenomenon, the average food available to each person might not be a sufficient measure of food insecurity for the total population. It is also important to consider that nutritional security is determined by several different factors in addition to food security, such as the household's health environment or the care of mothers and children (DataBank, 2023). However, even though the measurement is flawed, it is still one of the main indexes used as an indicator of the prevalence of food insecurity within a country. As the index is also one of the indicators for SDG 2 concerning zero hunger, it is considered robust and trustworthy at a higher level. Therefore, despite its limitations, I have opted to use data from the PoU index for this thesis.

Climate change vulnerability is also a concept that can be defined in various ways. In this thesis I have opted for the Notre Dame Global Initiative's (ND-GAIN) definition, that climate change vulnerability is "the propensity or predisposition of human societies to be negatively impacted by climate hazards" (Chen *et al.*, 2015, p. 3) The climate vulnerability variable measures how vulnerable a country is to climate change impacts, including the effect on its renewable resources such as food, water, health, ecosystem services, human habitat, and infrastructure. Consequently, the variable can be applied to Homer-Dixon's definition of environmental scarcity, as he relates it to renewable resources such as arable land, freshwater, and forests.

Climate change vulnerability will also be operationalized by using ND-GAIN's Country Index as a measure of how vulnerable a country is to climate-related hazards. The ND-GAIN Country Index is a ranking of 181 countries' vulnerability and readiness to successfully adapt to climate change security risks. In this thesis, I will focus on the vulnerability aspect. ND-GAIN calculates a country's vulnerability to climate change in terms of six indicators: food, water, health, ecosystem services, human habitat, and infrastructure. These indicators are in turn captured by six indicators that represent three components: the exposure to

climate-related or climate-exacerbated hazards; the sensitivity to the impacts of the hazards; and the adaptive capacity to cope with or adapt to the impacts. Exposure is defined as the extent to which human society and its supporting sectors are stressed by the changing climate conditions. Sensitivity is described as the degree to which people and the sectors they depend on are affected by climate-related perturbations. By adaptive capacity, ND-GAIN refers to the ability of society and its supporting sectors to adjust to reduce potential damage and respond to the negative consequences of climate events (Chen *et al.*, 2015).

4.3 Data and material

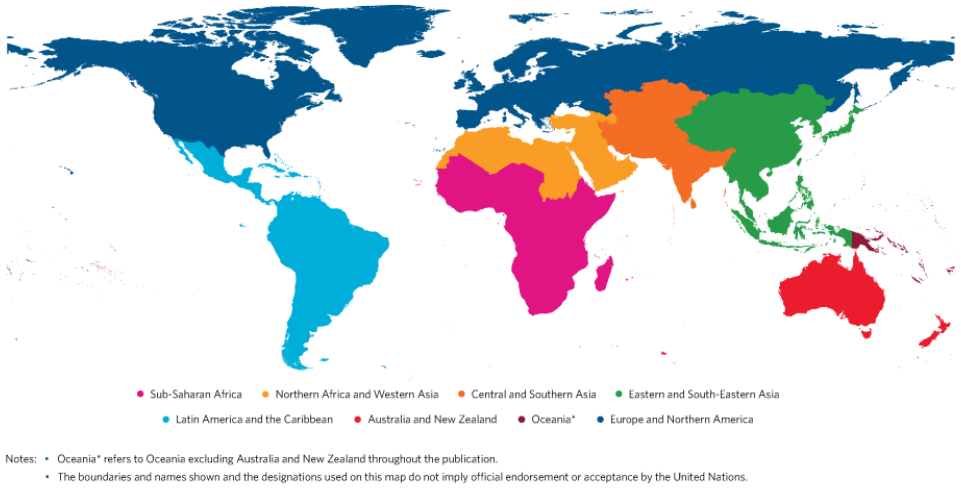
Data for both the dependent and independent variables were collected for a total of 84 countries that have experienced intrastate conflict since 2002, based on data from the Uppsala Conflict Data Program (UCDP). From the UCDP's dataset on conflict-related deaths, the number of casualties was retrieved for the included countries between the years 2002 and 2021 (Davies, Pettersson, and Öberg, 2022). The data on total population within a country were retrieved from the World Bank (2023).

The data for the variable representing socioeconomic inequality, i.e., exclusion by socioeconomic group, was retrieved from V-Dem's variable index for 2001 for the included countries (Coppedge *et al.*, 2023), except for South Sudan, which was only established as a state in 2011. The data on prevalence of undernourishment were retrieved from the FAO's food security indicator, i.e., prevalence of undernourishment (per cent), for 2001 (FAO, 2023). The data on climate vulnerability were retrieved from ND-GAIN's Country Index for 2001 (Chen *et al.*, 2015).

All the data used in this thesis are open access and free. The conflict intensity was calculated by me, with reservation for miscalculations, as follows: conflict intensity = (number of deaths/total population) * 100,000.

For the thesis, I ran the multiple linear regression analyses both all-encompassingly and regionally to establish whether there were any significant

differences between different regions of the world. The countries were divided into six regions based on the UN's regional groupings: Sub-Saharan Africa, Northern Africa and Western Asia, Central and Southern Asia, Latin America and the Caribbean, and Europe and Northern America (see Map 1). The UN's categorization of countries is determined by the geographic regions established in the Standard Country or Area Codes for Statistical Use (M49) (UN DESA, 2019).



Map 1: Regional groupings (source: UN DESA, 2019).

4.4 Limitations

From the UCDP's "countries in conflict view", 84 countries were presented as having experienced conflict since 2002. Due to missing data in both the FAO's PoU index and ND-GAIN's index of climate vulnerability, some cases were removed from the multiple linear regression analysis. The PoU index was missing data on food insecurity for eight countries: Zimbabwe, Eritrea, Niger, Guinea, South Sudan, Libya, Syria, and Tajikistan. The ND-GAIN index on climate vulnerability was missing data for three countries: Eswatini, South Sudan, and Somalia. Thus, ten countries were excluded from the model analysis, which accounts for 11.4 per cent of the original dataset. This is a limitation of this study, as the more cases included in an analysis, the more robust its findings can be assumed to be. Several of the countries removed have experienced very violent conflicts in the past two decades.

Therefore, the results of this thesis might not give a fully comprehensive view of how conflict intensity is affected by levels of socioeconomic inequality, climate vulnerability, and food insecurity.

The timeframe of the analysis is limited to the years 2002–2021. The timeframe was chosen due to data limitations for the years prior to 2002 and after 2021. The FAO's index on the prevalence of undernourishment presents data beginning from 2001, and the UCDP's data on conflict deaths are available up to 2021. To determine how climate vulnerability, food insecurity, and socioeconomic inequality affect conflict intensity, the retrieved data had to be from before the start of the timeframe. As discussed earlier, conflict affects climate vulnerability, food insecurity, and inequality levels as well. Had data been used from the same year or after 2002, they could skew the results, instead generating "reverse causality". Therefore, data on conflict intensity were retrieved starting from 2002.

The more cases included in a statistical analysis, the more robust its findings are assumed to be. In the regional analyses, the number of cases is sometimes limited to as few as five. Therefore, the findings from the regional analyses may be only indicative.

The analysis thus starts from 2002, to establish how the levels of the independent variables affect the upcoming conflict intensity. However, it is important to remember that the levels as of 2001, the year for which the data were retrieved, might have been affected by the conflicts existing in the countries in previous years. The levels might also have changed since then, affected by the conflicts. For example, as previous research has established, degradation of the environment and climate change can increase food insecurity and exacerbate existing inequalities. This vicious cycle can be identified in several armed conflicts. However, this thesis is not striving to identify the beginning of the vicious circle of violence and human insecurity, but rather to see whether there is any correlation between the levels of this insecurity and how a conflict plays out in the following years.

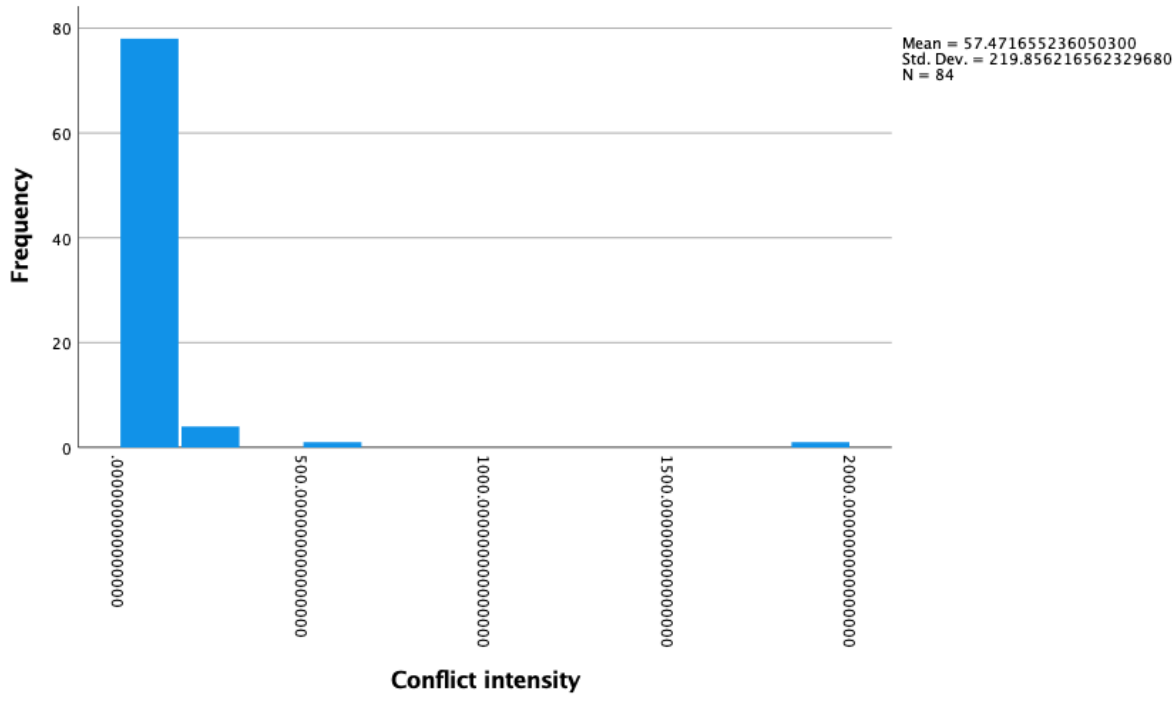
5 Statistical results

This chapter presents the results of the multiple linear regression. The dependent variable is conflict intensity and the independent variables are climate vulnerability, food insecurity, and socioeconomic inequality. The descriptive statistics are visualized through histograms. The results are presented in tables, displaying the results of both Models 1 and 2 applied at the world level and for each region. The tables include the constants for each independent variable as well as the interaction variables, significance levels, numbers of cases included, and R^2 values. This chapter first presents the descriptive statistics for each variable included and is then divided into sections based on the region analysed.

5.1 Descriptive statistics

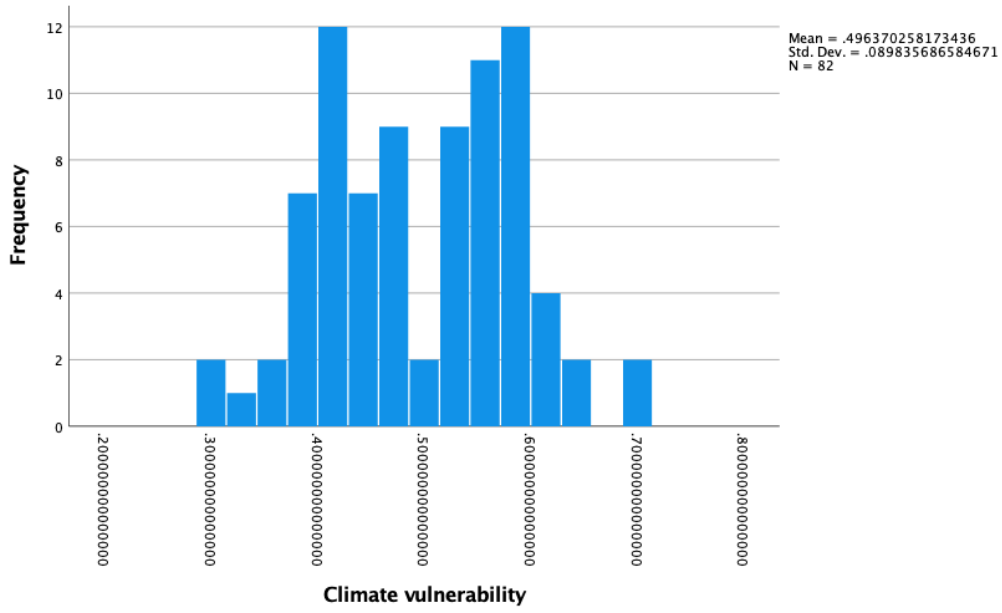
Histogram of the distribution of conflict intensity

Nine out of ten countries in the dataset have experienced a conflict intensity level of up to 100 battle-related deaths per 100,000 inhabitants – 74 of the cases included in this analysis. This is clearly illustrated by the histogram of the distribution of conflict intensity, the dependent variable in this analysis. The mean conflict intensity according to my calculations is around 57 battle-related deaths per 100,000 inhabitants. Two cases can be defined as outliers – extreme ones in this case: Afghanistan, with around 500 battle-related deaths per 100,000 inhabitants, and Syria, with slightly below 2000 battle related deaths per 100,000 inhabitants. Outliers can significantly skew the results of the regression analyses, but since these are prominent conflicts often studied within peace and conflict studies, they will be included in the analysis.



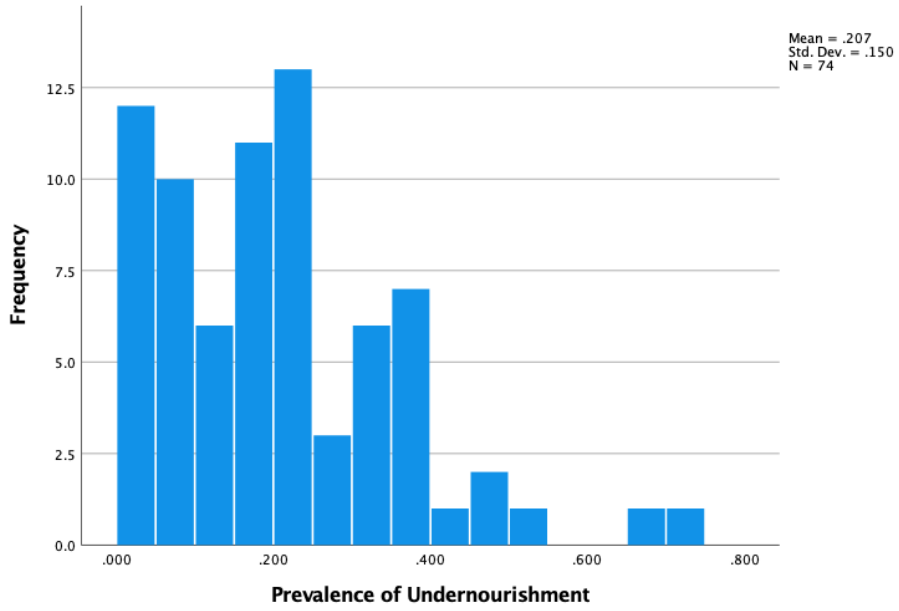
Histogram of the distribution of climate vulnerability

In the histogram of the distribution of climate vulnerability, one of the independent variables of the regression analysis, we can see that the cases are almost normally distributed, except at the 0.5 mark, giving the appearance of a bimodal distribution. The number of cases is 82, as two countries – Eswatini and South Sudan – were excluded because data were unavailable on their level of climate vulnerability. The mean climate vulnerability for the countries included in this analysis is 0.49, which can be interpreted as moderately to severely vulnerable to the effects of climate change impacts. Two outliers at the 0.7 mark – Somalia and Niger – were identified.



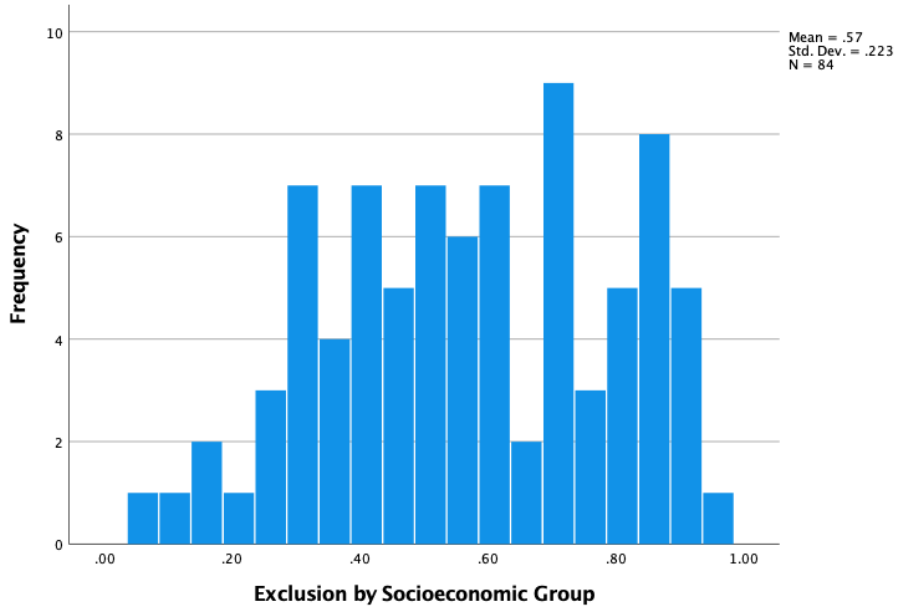
Histogram of the distribution of the prevalence of undernourishment

The histogram of the distribution of the prevalence of undernourishment, another of the independent variables included in the analysis, does not display a normal distrubution. The number of cases is 74, meaning that data are missing for ten countries in the dataset regarding how many people experience undernourishment. This could be because the mean value for the prevalence of undernourishment in the countries included in this analysis is 0.207, which means that around 20 per cent of the total population live with food insecurity within these countries. Two outliers can be identified, in this case Somalia, with a prevalence of undernourishment value of 70.6 per cent, and Angola, with a value of 67.5 per cent.



Histogram of the distribution of exclusion by socioeconomic group

Also for the independent variable exclusion by socioeconomic group, normal distribution was not found, as illustrated by the histogram. The number of cases includes the full dataset of 84 cases. The mean value for the level of exclusion by socioeconomic group is 0.57, indicating moderately high levels of exclusion. There are no extreme outliers in the distribution of this variable.



The Pearson's correlations among all the variables are below 0.8, which means that there is no multicollinearity between the variables (see Appendix A). Multicollinearity is when the independent variables are highly correlated with one another, possibly leading to biased or misleading estimates. In this aspect, therefore, the results are robust.

The assumption of independent observations holds for the multiple linear regression analyses, as each case included in the dataset represents a different country. The assumption of normality was inspected through creating a histogram of the regression residuals (see Appendices B and D). The residuals are somewhat normally distributed, with some positive skewness. The residuals are not fully normally distributed for several reasons, for example, because the independent variables themselves are not normally distributed or because of the extreme outliers (Aneshensel, 2013). To test for homoscedasticity and linearity, a scatter plot of the residuals was created (see Appendices C and E). Homoscedasticity implies that the variance of the residuals should be constant. As the cases in the scatter plot do not differ too much *vertically*, except for some extreme outliers, this assumption holds true. The assumption of linearity is violated, however, as the dots in the scatter plot decrease slightly along the *x*-axis. This could be because not all variables included in the analysis display a nonlinear pattern, or because there is no linearity at all (Aneshensel, 2013).

5.2 Multiple linear regression analysis

5.2.1 Conflict intensity at the world level

Through the multiple linear regression analysis with all the countries included in this thesis, we can establish statistically significant results for both Models 1 and 2 (see Table 1). Model 1 presents an overall significance level of $p = 0.002$. In Model 1, the independent variable prevalence of undernourishment displays a significance level of $p \leq 0.05$, whereas the interaction variable for climate vulnerability and

prevalence of undernourishment displays a significance level of $p \leq 0.01$. The independent variables climate vulnerability and exclusion by socioeconomic group do not present any significant results. The regression coefficient signifies the amount by which conflict intensity changes when the interaction variable is increased by one unit. The regression coefficient for the interaction variable in Model 1 is 1772.68, which is higher than for either climate vulnerability ($\beta = -271.88$) or prevalence of undernourishment ($\beta = -839.69$), separately. This means that the regression line for the interaction variable is steeper than when the independent variables are analysed on their own. This can be interpreted as indicating that when a country experiences higher levels of both climate vulnerability *and* food insecurity, the risk of higher conflict intensity is expected to rise sharply. Prevalence of undernourishment is still significant on its own, so there is a correlation between high levels of food insecurity and higher conflict intensity. However, as shown by the interaction variable, when this variable is combined with climate vulnerability, the conflicts tend to be even more violent in terms of number of deaths.

Table 1: Model fits for Models 1 and 2 at the world level.

Variable	Model 1	Model 2
Climate vulnerability	–271.88	–413.50
Prevalence of undernourishment	–839.62**	92.58
Exclusion by socioeconomic group	80.94	–393.58*
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	1772.68***	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		924.23**
Constant	99.29	173.04
N	73	73
R^2	0.212	0.187

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

For Model 2, the overall significance is $p = 0.006$. The analysis presents significant results for the independent variable exclusion by socioeconomic group at the $p \leq 0.1$ level, and the interaction variable for climate vulnerability and exclusion economic group combined has a significance level of $p \leq 0.05$. The interaction variable of climate vulnerability and exclusion by socioeconomic group has a regression coefficient of $\beta = 924.23$, which is higher than for either climate

vulnerability (β = –413.50) or exclusion by socioeconomic group (β = –393.58), separately. As in Model 1, this signifies that the regression line for the interaction variable in Model 2 is steeper than when the independent variables are analysed on their own. This can, again, be interpreted as indicating that when a country is susceptible to high climate vulnerability *and* high levels of socioeconomic inequality, conflict intensity is more likely to increase. The independent variable exclusion by socioeconomic group is significant on its own, which shows that there is a correlation between high levels of socioeconomic inequality within a country and increased conflict intensity, even without the influence of the other variables. However, as the interaction variable's lower *p*-value and higher regression coefficient show, this correlation increases when socioeconomic inequality is combined with climate vulnerability, leading to conflicts that tend to be even more violent in terms of number of deaths.

The number of cases included in the multiple linear regression analysis is 73, meaning that 11 cases were excluded due to missing data. Model 1 reports an R^2 value of 0.212, meaning that 21.2 per cent of the 73 cases included can be explained by the constructed model. Model 2 reports an R^2 value of 0.190, meaning that 19 per cent of the data can be accounted for by the constructed model. Model 1 presents a slightly higher R^2 value than does Model 2. Model 1 also has a lower significance level, p = 0.013, whereas Model 2, while still significant, has a significance level of p = 0.038. Comparing the significance levels of the different interaction variables, it can be established that the interaction variable in Model 1 has a more robust correlation to conflict intensity than does the one in Model 2, as well as a greater regression coefficient. This indicates that climate vulnerability combined with food insecurity has a greater intensifying effect on conflict than does climate vulnerability combined with socioeconomic inequality.

5.2.2 Conflict intensity in Sub-Saharan Africa

The multiple linear regression analysis did not find any statistically significant results for either Model 1 or Model 2 for the Sub-Saharan region. The models as a whole were not significant, and neither were any independent or interaction

variables. This regional analysis included 25 cases, meaning that we are missing variables for eight countries (see Table 2). For Model 1, the R^2 value was 0.302, meaning that 30 per cent of the cases included follow the regression line. Model 2 has an R^2 value of 0.26, meaning that around 26 per cent of the data follow the regression line. For the interaction variable for climate vulnerability and prevalence of undernourishment in Model 1, $\beta = 1278.60$, which is higher than for any of the independent variables. The same is true for Model 2's interaction variable for climate vulnerability and exclusion by socioeconomic group, for which $\beta = 1100.64$. However, since the results are not significant, no robust conclusion can be drawn from this.

Table 2: Model fits for Models 1 and 2 for the Sub-Saharan region.

	Model 1	Model 2
Climate vulnerability	–81.29	–410.16
Prevalence of undernourishment	–700.43	1.33
Exclusion by socioeconomic group	60.02	–543.57
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	1278.60	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		1100.64
Constant	30.06	211.73
N	25	25
R^2	0.302	0.259

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

The insignificant results of the model comparison for the regional analysis of Sub-Saharan Africa mean that the same conclusions cannot be drawn from it as from the model comparison for the world-level analysis. As the models do not display any significance, it can be assumed that for the Sub-Saharan region, the levels of the independent variables climate vulnerability, food insecurity, and socioeconomic inequality and of the interaction variables do not have any significant effect on the level of conflict intensity a country in the region experiences.

5.2.3 Conflict intensity in Northern Africa and Western Asia

For the multiple linear regression analysis of conflict intensity and climate vulnerability, food insecurity, and socioeconomic inequality for Northern Africa, both Models 1 and 2 are found to be statistically significant as a whole at the $p \leq 0.01$ level. In Model 1, climate vulnerability is found to be significant at $p \leq 0.1$ (see Table 3). However, the interaction variable for climate vulnerability and prevalence of undernourishment was not significant. However, the independent variable for prevalence of undernourishment was significant ($p \leq 0.01$), as was climate vulnerability ($p \leq 0.05$). However, neither model presents significant results for the interaction variable, which in Model 1 is climate vulnerability and prevalence of undernourishment, and for Model 2 is climate vulnerability and exclusion by socioeconomic group.

Table 3: Model fits for Models 1 and 2 for the regions of Northern Africa and Western Asia.

	Model 1	Model 2
Climate vulnerability	–1044.02*	–1251.30**
Prevalence of undernourishment	–232.14	1034.98***

Exclusion by socioeconomic group	53.13	–403.18
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	2824.42	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		1032.73
Constant	364.73*	452.57*

N	13	13
R^2	0.824	0.841

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

The regression coefficient for the interaction variable in Model 1 is higher than for the independent variables, with $\beta = 2824.42$ as opposed to $\beta = –1044.02$ for climate vulnerability and $\beta = –232.14$ for prevalence of undernourishment. However, since the interaction variable does not have a significant *p*-value but climate vulnerability does, this model's results can be interpreted as only climate vulnerability having a visible correlation to the level of conflict intensity a country experiences.

In Model 2, the regression coefficient for the interaction variable is 1032.73, which is higher than for either climate vulnerability ($\beta = –1251.300$) or exclusion by socioeconomic group ($\beta = –403.184$), separately. However, the regression coefficient for prevalence of undernourishment is slightly higher at $\beta = 1034.97$. Along with this, it is climate vulnerability and prevalence of undernourishment that present significant *p*-values in Model 2. This can be

interpreted as indicating that the level of climate vulnerability and prevalence of undernourishment on their own are correlated to the level of conflict intensity a country experiences in the region, but that their combined effect cannot be established as consequential.

The regional analysis of Northern Africa and Western Asia included 13 cases. The R^2 value for Model 1 is 0.824, accounting for 82 per cent of the cases included. For Model 2, the R^2 value is 0.841, which means that 84 per cent of the cases included follow the regression line.

5.2.4 Conflict intensity in Central and Southern Asia

The multiple linear regression analysis for the Central and Southern Asia region presents a significance level of $p \leq 0.01$ for both Models 1 and 2. Model 1 presents a significant result for climate vulnerability with $p \leq 0.05$, and the same for the interaction variable for climate vulnerability and prevalence of undernourishment (see Table 4). For Model 2, climate vulnerability is significant at $p \leq 0.001$, and exclusion by socioeconomic group and the interaction variable for climate vulnerability and exclusion by socioeconomic group are significant at $p \leq 0.1$. The regression coefficient for the interaction variable for climate vulnerability and prevalence of undernourishment is $\beta = 8020.53$ in Model 1, which is higher than for the independent variables on their own ($\beta = -1647.84$ for climate vulnerability and $\beta = -3036.55$ for prevalence of undernourishment). The regression line is thus steeper for the interaction variable than for the independent variables on their own. This can be interpreted as indicating that when countries in this region experience higher levels of climate variability and food insecurity, the conflict intensity is likely to be higher. The results are similar for Model 2, in which the interaction variable is for climate vulnerability and exclusion by socioeconomic group, for which $\beta = 4587.40$, whereas for climate vulnerability it is –2759.12 and exclusion by socioeconomic group –2531.24. The interpretation of Model 2 is therefore similar to that of Model 1, namely, that when higher levels of climate vulnerability

and exclusion by socioeconomic group interact, the intrastate conflicts will likely be more intense.

Table 4: Model fits of Models 1 and 2 for the region of Central and Southern Asia.

	Model 1	Model 2
Climate vulnerability	–1647.84**	–2759.12*
Prevalence of undernourishment	–3036.55	1637.52***
Exclusion by socioeconomic group	109.32	–2531.24*
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	8020.53**	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		4587.40*
Constant	612.94*	1239.48*
N	10	10
R^2	0.933	0.921

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

Ten cases were included in this regional analysis, meaning that data were missing for one country. For Model 1, the R^2 value is 0.933, meaning that 93 per cent of the data follow the regression line, whereas Model 2 has an R^2 value of 0.921, meaning

that 92 per cent of the data follow the regression line. In the case of this region, only one country can be assumed to deviate from the regression line.

5.2.5 Conflict intensity in Eastern and South-eastern Asia

In the regional regression analysis for Eastern and South-eastern Asia, neither Model 1 nor Model 2 displays overall significance. The only significant variable is the prevalence of undernourishment in Model 2, at $p \leq 0.1$ (see Table 5). For Model 1, the regression coefficient of the interaction variable for climate vulnerability and prevalence of undernourishment is 147.90, which is higher than the regression coefficients for the other variables considered separately. However, since the model is not significant, it can be concluded that no correlation with conflict intensity can be established for Model 1. In Model 2, the regression coefficient of the interaction variable is –45.02, indicating that there actually is a negative relationship with the interaction of climate vulnerability and exclusion by socioeconomic group. However, since this interaction is not significant, no valid conclusions can be drawn from it. There is, however, a significant correlation between the prevalence of undernourishment and conflict intensity in Model 2. This can be interpreted as food insecurity being the only variable, in this study, that has an obvious effect on the level of conflict intensity in countries in Eastern and South-eastern Asia, deviating from other regions where climate vulnerability is often the independent variable that affects conflict intensity the most.

Table 5: Model fits for Models 1 and 2 for the region Eastern and South-eastern Asia.

	Model 1	Model 2
Climate vulnerability	–197.49	–150.99
Prevalence of undernourishment	53.16	128.76*

Exclusion by socioeconomic group	20.71	44.18
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	147.90	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		–45.02
Constant	62.72	39.60

N	9	9
R^2	0.667	0.652

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

Nine cases were included in this analysis, so there were no missing values in this regional analysis. Model 1 has an R^2 value of 0.667, meaning that around 67 per cent of the data follow the line of regression, and for Model 2, $R^2 = 0.652$, accounting for roughly 65 per cent of the data.

5.2.6 Conflict intensity in Latin America and the Caribbean

The multiple linear regression analysis for Models 1 and 2 for Latin America and the Caribbean do not indicate overall significance regarding the models. However, in Model 1, both the independent variable for prevalence of undernourishment and the interaction variable for climate vulnerability and prevalence of undernourishment are significant at $p \leq 0.1$ (see Table 6). Model 2 does not present any significant results. In Model 1, the regression coefficient for the interaction

variable is 1796.54, which is greater than the regression coefficient for climate vulnerability, i.e., β = –326.91, or prevalence of undernourishment, i.e., β = –1013.30. As the variable for prevalence of undernourishment is also significant in Model 1, the results can be interpreted as food insecurity correlating to the level of conflict intensity a country experiences. However, when combined with climate vulnerability, the conflict intensity is likely to increase.

Table 6: Model fits for Models 1 and 2 for the region of Latin America and the Caribbean.

	Model 1	Model 2
Climate vulnerability	–326.91	–577.81
Prevalence of undernourishment	–1013.30*	–211.55
Exclusion by socioeconomic group	36.71	–436.29
Interaction 1 (climate vulnerability *and* prevalence of undernourishment)	1796.54*	
Interaction 2 (climate vulnerability *and* exclusion by socioeconomic group)		1125.18
Constant	163.52	257.92
N	11	11
R^2	0.628	0.508

* Correlation is significant at the 0.1 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

*** Correlation is significant at the 0.01 level (2-tailed).

In Model 2 the regression coefficient for the interaction variable is 1125.175, which is greater than the coefficients for the other variables (for climate vulnerability β = –577.810 and for exclusion by socioeconomic group β = –436.292). However, since the results are not significant, no substantial conclusion can be drawn from this.

The multiple linear regression for Models 1 and 2 in this region include 11 cases, meaning that there were no missing values. The R^2 value for Model 1 is 0.628, meaning that around 63 per cent of the cases follow the regression lines, and for Model 2, R^2 = 0.508, meaning that around half of the cases included can be accounted for by the model.

5.2.7 Conflict intensity in Europe and Northern America

For the European and Northern American region, no statistical results could be obtained, as only five cases were included in this regional analysis. Therefore, SPSS reported that it could not run a multiple linear regression analysis as there were too few cases. This is, of course, a limitation of the regional analysis in this thesis, as not all relevant regions could be accounted for and compared.

5.3 Summarizing the statistical results

The results of Model 1 in the statistical analysis (based on the interaction of climate vulnerability and prevalence of undernourishment) show that there is a significant correlation between climate vulnerability and conflict intensity for North Africa and Western Asia, as well as for Central and Southern Asia. Prevalence of undernourishment displayed a significant correlation with conflict intensity at the world level, and for Latin America and the Caribbean in Model 1. Exclusion by socioeconomic group was not found to be statistically significant on its own for any region. The interaction variable for climate vulnerability and prevalence of undernourishment was found to be significant for conflict intensity at the world level, in Central and Southern Asia, as well as in Latin America and the Caribbean (see Tables 7 and 8).

The significance levels for the statistical analysis in Model 2 (based on the interaction between climate vulnerability and exclusion by socioeconomic group) show that climate vulnerability was significant for conflict intensity for North Africa and Western Asia as well as for Central and Southern Asia – that is, the same regions as in Model 1. Prevalence of undernourishment was also significant for these two UN regions. Exclusion by socioeconomic group showed significant results at the world level, for Central and Southern Asia, and for Eastern and South-eastern Asia. The interaction variable of climate vulnerability and exclusion by socioeconomic group was significant at the world level and for Central and Southern Asia (see Tables 7 and 8).

Table 7: Significant correlation between conflict intensity and the independent variables for Models 1 and 2 by region.

Independent variable	**Regions, Model 1**	**Regions, Model 2**
Climate vulnerability	North Africa and Western Asia, Central and Southern Asia	North Africa and Western Asia, Central and Southern Asia
Prevalence of undernourishment	World, Latin America and the Caribbean	North Africa and Western Asia, Central and Southern Asia
Exclusion by socioeconomic group	None	World, Central and Southern Asia, Eastern and South-eastern Asia
Climate vulnerability *and* prevalence of undernourishment	World, Central and Southern Asia,	n/a

	Latin America and the Caribbean	
Climate vulnerability *and* exclusion by socioeconomic group	n/a	World, Central and Southern Asia

Table 8: Regions with significant correlations between conflict intensity and independent variables for Models 1 and 2

Region	**Independent variables, Model 1**	**Independent variables, Model 2**
World	Prevalence of undernourishment, climate vulnerability, *and* prevalence of undernourishment	Exclusion by socioeconomic group, climate vulnerability, *and* exclusion by socioeconomic group
Northern Africa and Western Asia	Climate vulnerability	Climate vulnerability and prevalence of undernourishment
Central and Southern Asia	Climate vulnerability, climate vulnerability, *and* prevalence of undernourishment	Climate vulnerability, prevalence of undernourishment, exclusion by socioeconomic group, climate vulnerability, *and* exclusion by socioeconomic group
Eastern and South-eastern Asia	-	Exclusion by socioeconomic group

Latin America and the Caribbean	Prevalence of undernourishment, climate vulnerability, *and* prevalence of undernourishment	-

Both Models 1 and 2 yield significant results regarding the interaction variables at the world level. This means that *the conflict intensity is more likely to increase when climate vulnerability and food insecurity or socioeconomic inequality interact.* These findings support the hypothesis that when climate vulnerability, food insecurity, and socioeconomic inequality interact, conflict intensity may increase. However, the significance levels of the two models differ. Also, the models present different results for the regression analyses at the regional levels. This calls for further exploration and analysis of the results to understand why the results of the statistical analysis came out as they did.

6 Discussion

In this chapter, the results of the multiple linear regression analysis will be discussed through the lens of the theories of greed versus grievance and of environmental scarcity and conflict, respectively. The two theories are first considered separately before comparing their applicability to the statistical results. The chapter concludes by outlining some policy implications.

6.1 The explanatory value and limitations of the models and analysis

In this section I discuss the results and what the statistical analyses can and cannot reveal about the relationships between civil wars, climate change, food insecurity, and socioeconomic inequality.

6.1.1 On the causal chains of effects

The hypotheses of this thesis are that socioeconomic inequality, climate vulnerability, and food security affect conflict intensity in civil wars, respectively, and that their combined effect will further exacerbate the level of conflict intensity. As there are some empirical gaps in previous research, one ambition of this thesis has been not only to test these hypotheses but to bring further clarity to how these factors interact.

The results of the analysis instead showed that it was the other two variables that had an impact on conflicts, but that climate vulnerability can be a threat multiplier in terms of intensifying conflicts in societies where food insecurity and socioeconomic inequality are high.

6.1.2 Regional variations

The analysis gives robust results regarding the interaction of the independent variables for the world-wide analysis of the 84 countries. The results of the analysis at the UN regional level were not as clear cut; nevertheless, they have some interesting implications.

The hypothesis that the interacting variables provide more significant results and higher regression coefficients only holds for the Central and Southern Asian region. However, the results for Latin America and the Caribbean can be interpreted as validating the hypothesis that as climate vulnerability and food insecurity interact, conflict intensity will increase. The question arises as to why the hypothesis can be confirmed at the world level, but not in all regions. This could depend on at least two factors.

First, there are the limitations of the regional multiple linear regression analyses. The differences in results could be influenced by the number of cases. At the world level, the analysis includes 84 countries, whereas in the regional analyses, the numbers of cases are considerably lower. The results of the world-level analysis are thus more robust. The purpose of including the regional analyses was to investigate how climate vulnerability, socioeconomic inequality, and food insecurity might affect different regions, to initiate a preliminary exploration of a finer-tuned analysis of the possible relationships beyond the global averages.

Second, the regional analyses might have given different results if I had used disaggregated data, as they would have provided more cases by allowing consideration of sub-national regions. Yet, this would have required substantial data access work, which would have proved impracticable given the time constraints of this thesis research. Nevertheless, the UN regional data are still important to include in the statistical analysis, as we cannot assume that the factors are congruent for every region given that different regions of the world suffer from different levels of inequality, climate change impacts, and food insecurity. The observations show that it would be well worth exploring the regional differences in future research.

The regional analyses show that different aspects of human security affect conflict intensity differently across regions in the world. The extent to which a country is affected by certain factors may be influenced by its past experiences, level of development, or resilience in protecting human security.

The data are also aggregated at the national level, so regional differences within countries may influence the correlations. That is, food insecurity could potentially be more severe in one national region, while climate vulnerability is more severe in another. Nevertheless, this study supports the proposition that, across the world, the variables interact in a way that raises the likelihood of increased conflict intensity. Deeper insights into the regional differences would require further in-depth studies.

The regional analysis did not provide greater explanatory value to this analysis as to why or how the variables interact. This was not the purpose of the analysis. The analysis was designed to probe whether the hypothesis could be generalized to be valid also for regional groupings of countries. As the results differ between regional groupings, the analysis shows that the reasons underlying regional differences are worth further exploring. Perhaps grouping countries differently, for example, by type of government, homogeneous/heterogeneous populations, and rural/urban population proportions, could have provided greater explanatory value than the UN regions. Many of the regions had large differences between countries, for example, regarding level of conflict intensity or prevalence of undernourishment. The prevalence of outliers can also severely skew the results, which is important to take into consideration.

We can establish, based on the results, that food insecurity, socioeconomic inequality, and climate vulnerability are *global* threats to human security. Problems such as food insecurity and socioeconomic inequality are often based on systems of discrimination that have existed for hundreds of years. Another avenue to explore in future studies would be to look at countries that have been colonies as a category. Nevertheless, my results indicate that it is crucial to consider grievances and greed arising from societal differences when exploring why certain countries experience prolonged and highly intense conflicts.

After discussing the nature of the data, I will now turn to the explanatory value of the theories. In the following sections, the statistical results will be analysed and discussed in terms of the greed versus grievance theory and Homer-Dixon's theory of environmental scarcity and conflict, respectively, to gain a deeper understanding of why the statistical results came out the way they did.

6.2 The explanatory value of the theory of greed versus grievance

The theory of greed versus grievance proposes that economic incentives – greed – or frustration with inequality – grievance – can explain the outbreak and prevalence of armed conflicts (see chapter 3.1). In this thesis, the theory was tested by running a multiple linear regression analysis with climate variability, food insecurity, and socioeconomic inequality as independent variables, while including the interaction variable for climate vulnerability and food insecurity in Model 1 and for climate vulnerability and socioeconomic inequality in Model 2.

The results of the multiple linear regression analysis for Model 1 including all countries that have experienced intrastate conflicts since 2002 indicate that a country both vulnerable to climate change impacts and experiencing high food insecurity levels is likely to suffer higher conflict intensity. This conclusion is based on the regression analysis showing a significantly steeper slope for the correlation between conflict intensity and the interaction variable for climate vulnerability and food insecurity, versus when the independent variables are applied on their own. This means that if a country, in general, only suffers from climate vulnerability and not high food insecurity, its intrastate conflicts will appear less intense in terms of conflict-related deaths. The multiple linear regression analysis for Model 2 including all countries produced similar results. Here the model included climate vulnerability, food insecurity, and socioeconomic inequality as independent variables, while including the interaction variable for climate vulnerability and socioeconomic inequality.

Both food insecurity and socioeconomic inequality can be defined as breeding grounds for grievances. According to the theory of greed and grievance, a main explanation of why individuals resort to violence is if it can bring potential economic benefits, secure livelihoods, or remedy a perceived injustice. By resorting to violence, warring groups may obtain control over limited resources, trade routes, or gain influence over the political economy. In a country with high climate vulnerability and experiencing stresses on renewable resources such as land and water, resorting to violence can be lucrative. This strategy may be attractive to disadvantaged individuals in societies with high socioeconomic inequality who seek to gain power.

Collier and Hoeffler (2004) contended that when the perceived gains from violence exceed the potential losses, the likelihood of conflict escalates. Natural resources have also often been used as a bargaining chip by rebel groups. This can, for example, be illustrated by the Da'esh taking advantage of water shortages in Syria and Iraq by seizing water infrastructure and using it as leverage to impose its politics on the affected communities. Similarly, in Mali, terrorist groups have exploited the tensions between herders and farmers as a means of recruiting members from pastoralist communities (Welzer, 2017). Throughout history, food has been weaponized in the sense that it has been used to further political or military advantages (Zhou, 2022). In the words of the Swedish peace and conflict scholar Peter Wallensteen (1986), "the power over food production and distribution is of great importance, perhaps exceeded in significance only by access to military power" (p. 143). Food exports are used by powerful actors to wield influence, such as Russia's use of wheat exports for geopolitical leverage. Locally, this can similarly involve withholding or providing access to food. In addition, through appealing to grievances, the sheer withholding of food resources can be used to rally groups around a cause.

Ongoing environmental degradation can thus provide an opportunity for non-state armed groups to expand their power and exploit natural resources to advance their own strategic interests. It can be used as leverage towards

affected communities to impose the politics of the warring groups, for recruitment, or to finance the conflict through illegal trade of the increasingly scarce resources.

In a society where there is a high degree of socioeconomic inequality, a violent approach may appeal to those who are less well-off as a way of gaining power and economic means. As argued by Collier and Hoeffler (2004), when the anticipated advantages of engaging in violence outweigh the potential costs, the likelihood of conflict rises. As people lose their sources of food and their livelihoods, they become vulnerable to the allure of promises of protection, income, and justice that terrorist groups may exploit to advance their ulterior motives.

Therefore, in a warming world, a higher degree of unmitigated climate vulnerability ultimately risks increasing the deadliness of armed conflict. When climate change and climate vulnerability increase, so do the possibilities of exploiting scarce resources for monetary gains, according to the greed versus grievance theory. In many countries, rebel groups have taken advantage of the vulnerability that people face due to climate change. In countries with already high inequality, climate change substantially risks further exacerbating them.

The statistical results can be interpreted as indicating that climate change constitutes an additive stressor for people already living in human insecurity. As climate change is also expected to affect people differently depending on pre-existing inequalities, it could serve as an additional source of grievance towards those in power or those possessing inaccessible resources. People living in already precarious conditions could therefore view the possible gains from resorting to violence as outweighing the possible losses, as the grievance theory argues.

As described in section 4.2, exclusion by socioeconomic group denotes the differences in, for example, access to land, education, and political power that depend on the socioeconomic class a person belongs to. These inaccessible resources can be sources of grievances, adding to the frustration caused by perceived inequalities. As previous research concludes, climate change is expected to increase the levels of inequality around the world and affect disadvantaged peoples disproportionately (Islam and Winkel, 2017). Grievances

regarding inequality can thus be expected to increase, which is supported by the statistical results in this thesis. In a society where socioeconomic inequalities are high, people might resort to violence as a means of obtaining livelihoods, land, or power.

According to the greed versus grievance theory, the greater the level of frustration among people over their grievances, the more inclined they are to resort to violence. Similarly, this argument might suggest that governments will resort to violence more extensively to maintain their power. In numerous states characterized by socioeconomic inequality, the elites resist changes to land distribution, as in several Latin American countries. In Colombia, El Salvador, Nicaragua, and Guatemala, coalitions of landholders, politicians, and military forces have managed to hinder the efforts of state-led agrarian reform aimed at rectifying the unequal distribution of land (Escallón, 2021). Land ownership is crucial for voting, for example, in several countries and is one of the measures on which the V-Dem index of exclusion by socioeconomic group is based (Coppedge et al., 2023). As arable land becomes scarcer as a result of climate vulnerability, obtaining these areas will become more lucrative both for people seeking to satisfy their basic needs and for people seeking to gain or preserve economic advantages (Fjelde and von Uexkull, 2012).

The statistical results show that food insecurity and climate vulnerability have a higher significance level compared with socioeconomic inequality and climate vulnerability. Through the greed versus grievance theory, this result can be explained as increasing food insecurity prompting more severe grievances and implying higher possible economic gains than does increasing socioeconomic inequality. Whereas socioeconomic inequality can cause grievances in terms of perceived injustice, food security can determine people's actual survival. Access to food can therefore also give greater leverage for recruitment by rebel groups than can access to land, education, and political power. Food is not only a biological necessity, but also a physiological need, being on the lowest tier of Maslow's hierarchy of needs, whereas the aspects measured by the variable exclusion by socioeconomic group, such as property rights and health, can be

categorized as safety needs, one tier above physiological needs (Sandole, 1990). The validity of Maslow's human needs theory has been widely discussed in development research (e.g., Galtung, 2000), but can still serve as an explanation for why certain grievances can be perceived as more detrimental than others and can explain the desperate measures people might take to diminish them.

The intensity of conflicts involving large-scale exclusion by socioeconomic group can be attributed to the grievances arising from the exclusion, which can facilitate recruitment by rebel organizations. In Nigeria's Niger Delta region, for instance, the high unemployment rates made it attractive for young men to join the Niger Delta Volunteer Force (NDPVF). In 2004, the NDPVF declared war against the Nigerian government with the goal of gaining control over the region's vast oil resources (Rustad, 2016). The rebel leaders exploited grievances rather than greed to persuade young men to join their cause. Exclusion by socioeconomic group can generate grievances, as it goes beyond poverty to encompass a comprehensive understanding of the impact of economic inequality on the lives of the less affluent, such as limited access to healthcare and education. In this case, most rebels may not be motivated by greed or economic incentives to continue the conflict, but by the possibility of improving their people's lives. This can be exemplified by the second Liberian civil war, in which security and family protection were significant motivators for joining rebel groups (Hegre, Østby, and Raleigh, 2009; Podder, 2011).

Food insecurity has an even more direct impact on the quality of people's lives. The concept of food insecurity includes severe levels of individual undernourishment. Undernourishment causes people to be more susceptible to illnesses, fatigue, or even starvation. It stunts the growth of young children and lowers the level of nutrients in breast milk from mothers (FAO *et al.*, 2022.) In several countries, food insecurity has also been leveraged by rebel groups to recruit young men whose families, as well as themselves, are suffering. By addressing the food insecurity of people, recruitment often provides sustenance for both the men who join the rebel forces and their families, and sometimes even whole villages can benefit from the recruitment of their inhabitants (Welzer, 2017). As food insecurity

directly affects people's well-being, the perceived gains clearly outweigh the losses from inciting violence. It can cause people to take to desperate actions. As previous studies have shown, this is taken advantage of by rebel groups, who have other goals, often political or economic, when waging conflict. Along with this, climate change severely affects food security, and access to food is expected to diminish is several countries. People will thus become more food insecure and the prevalence of undernourishment is likely to increase. The IPCC's latest assessment concludes that not only will yields decrease in most regions, but so will the nutrition and micronutrient content of the food produced (IPCC, 2022). Thus, rebel organizations could increasingly use these problems to their advantage. They will have even more grievances to exploit to help them recruit new members, while they can benefit economically from the scarcity of food and other resources as they become more lucrative in a resource-constrained market.

The degree of exclusion by socioeconomic group also reflects the concentration of resources and power among the upper classes, which can be considered greed according to the theory As a result, it is possible that the government would be more willing to take risks in order to suppress rebellion sparked by grievances in order to maintain political power and resource control. This might explain why the intensity of conflicts increases with the level of exclusion by socioeconomic group: the wider the gap between those who have power, access, influence, and participation and those who do not, the more intense conflicts tend to be. According to Collier and Hoeffler (2004), rebel groups will engage in civil war if the perceived benefits outweigh the costs of rebellion. Conversely, we could make the argument that the same holds true for the government and military. Therefore, this might also explain why conflict intensifies as climate change worsens, as it might be more pertinent to protect the resources possessed. Violence can thus not be assumed to be exacerbated only by the repressed groups in a society.

6.4 The explanatory value of environmental scarcity and conflict

Homer-Dixon's theory of environmental scarcity and conflict relates to how environmental scarcity correlates to violent conflicts. This theory argues that violence might occur in response to the degradation and depletion of renewable resources. The demand for renewable resources increases through population growth or unequal access to these resources (see chapter 3.2).

The findings of Models 1 and 2 in the multiple linear regression analysis demonstrate that when a country is vulnerable to the impacts of climate change and experiences high levels of food insecurity or high socioeconomic inequality, the intensity of conflict is likely to be greater. This conclusion is based on the regression analysis, which indicates a significant increase in the slope of the correlation between conflict intensity and the interaction variables, versus when the independent variables are analysed separately.

The results for both Models 1 and 2 can be related to Homer-Dixon's argument that it is not environmental scarcity itself that causes or increases the intensity of conflicts. Rather, environmental scarcity causes societal and economic disruptions that can result in actors taking up arms. Climate vulnerability does not have a significant correlation to conflict intensity on its own, which can be interpreted as in line with the argument that environmental scarcity does not affect conflicts directly. However, when combined with economic and societal aspects, such as food insecurity and socioeconomic inequality, environmental scarcity has an immense effect. Yet, the results do not indicate that environmental scarcity causes these disruptions, as both the prevalence of undernourishment and exclusion by socioeconomic group are significant on their own, rather that it exacerbates their effects in terms of conflict intensity.

According to Homer-Dixon, environmental scarcity strengthens intergroup identities, causing social distrust towards the government and other groups as well as increasing intergroup competition. As this proposition finds support in my multiple linear regression analysis of Model 2, which highlights how

both climate vulnerability and exclusion by socioeconomic group exponentially increase the conflict intensity in a country, this argument seems to hold true.

Homer-Dixon theorized that the scarcity of renewable resources could ignite violence, riots, and armed conflict. The ND-GAIN index of climate vulnerability can serve as one indicator of environmental scarcity, as it measures the effect that climate change will have on, for example, renewable resources. Climate vulnerability also measures how exposed countries are to climate-related hazards, such as fluctuations in precipitation that can lead to increased desertification or flooding. This can be related to Homer-Dixon's argument about one of the three main ways that environmental scarcity emerges and leads to violence, namely, through the degradation and depletion of renewable resources. Through climate change, renewable resources are likely to become degraded and depleted, increasing a country's climate vulnerability. Accordingly, if a country is already battling inequality and undernourishment, conflict intensity is likely to rise. Therefore, Homer-Dixon's argument regarding the degradation of resources and likelihood of increased violence can hold true.

Homer-Dixon (1994) theorized that the coming decades would see an increased number of conflicts because of the effects of climate change on our ecosystems. The number of intrastate conflicts has indeed increased since Homer-Dixon developed his theory (Davies, Pettersson, and Öberg, 2022). Of particular interest for this thesis is that these conflicts have also become more intense. From the statistical analysis, it is evident that climate vulnerability does increase conflict intensity under certain conditions. As climate change increases the vulnerabilities experienced by countries, the results indicate that as the world is facing severe ecological and environmental consequences due to global warming, yet another threat is impending: deadlier conflicts.

The multiple linear regression analysis shows that, at the world level, climate vulnerability does not have a significant correlation to the conflict intensity of intrastate conflict. This is in line with Homer-Dixon's argument that it is not environmental change as such that *directly* affects conflict; rather, it contributes to societal and economic stress, which may lead to armed conflict. As we can see from

Table 1 on conflict intensity at the world level, the prevalence of undernourishment and exclusion by socioeconomic group are significant as independent variables in Models 1 and 2, respectively. This means that they directly affect the level of conflict intensity a country experiences, which climate vulnerability does not. The significant relationship between food insecurity and socioeconomic inequality could be interpreted as the economic/political factor that intensifies conflict, in line with Homer-Dixon's argument. However, if climate vulnerability were the root cause of these issues, presenting a causal relationship, it would have displayed significance in the multiple linear regression analyses. However, the results become even more significant when food insecurity and socioeconomic inequality interact with climate vulnerability. That means that an even more robust correlation between the independent and dependent variables can be established.

The regression analysis shows that the results are more significant when climate vulnerability is combined with food insecurity than with socioeconomic inequality. The higher explanatory value of food insecurity could be attributed to food insecurity being dependent both on renewable resources and on the distribution of these resources. Socioeconomic inequality, on the other hand, only denotes the unequal distribution of these resources, for example, land. Therefore, the greater significance of food insecurity and climate vulnerability could be explained by the fact that food is *directly* affected by both the degradation of renewable resources and their unequal distribution, two reasons for inciting violence according to Homer-Dixon.

According to Homer-Dixon, there are three main ways that the environmental scarcity of renewable resources leads to armed conflict: the degradation and depletion of renewable resources; increased demand for renewable resources; and the unequal distribution of these resources among social groups. As described in section 3.2, Homer-Dixon meant that environmental scarcity often leads to events of resource capture. This is defined as the depletion of renewable resources along with population growth, which results in unequal access to these resources due to certain groups keeping them for themselves. This exacerbates pre-existing inequalities and can threaten food security for groups whose resource

access has diminished. This could explain why conflict intensity is exacerbated in societies with high levels of food insecurity and inequality as climate vulnerability increases.

One critique of Homer-Dixon's theory is that it posits a deterministic path from environmental scarcity to armed conflict (Gleditsch and Urdal, 2002). The theory has received critique for overlooking political and economic factors in conflict that, for example, the greed and grievance theory captures (Bayramov, 2018). Does environmental scarcity cause these tensions or exacerbate them? According to the statistical analysis in this thesis, the latter could be the case. Therefore, it could be argued that environmental scarcity is not the root cause of the intensification of armed conflict, as it does not have any significance in the statistical analysis.

6.5 Comparing the explanatory value of the two theories

The statistical results indicate that climate vulnerability does not have a significant impact on the level of conflict intensity a country suffers at the world level. Why is this the case? Homer-Dixon theorized that environmental scarcity causes societal and political tensions, which in turn can lead to armed conflict. In this line of argument, environmental scarcity is the root cause of conflict outbreak. In contrast, according to Collier and Hoeffler's greed versus grievance theory, it is instead economic aspects that constitute the root causes of the outbreak of violence. Through the present statistical analysis, we can see how environmental scarcities and vulnerability can exacerbate the greed and grievances in societies in which inequality and human insecurity are already high. While drawing on two theories that deal with the root causes of conflict, this thesis' analytical design did not set out to identify the root causes of armed conflict. Rather, these theories were used to explore whether the correlation of the independent variables can help us understand why some conflicts are more intense than others. Here the two theories are helpful. Homer-Dixon argued that environmental scarcity worsens existing

problems. In this case, food insecurity constitutes a type of environmental scarcity. However, it is well established that lack of purchasing power is a primary factor behind food insecurity, which is more in line with Collier and Hoeffler. However, a changing climate puts further stress on food production and the quality of nutrients and micronutrients (FAO, 2021; IPCC 2022; see section 6.2). So rather than choosing between whether it is environmental scarcity or inequality that drives conflict, we need to analyse them in combination.

When comparing the explanatory value of the two theories regarding the statistical results, we can conclude that the greed versus grievance theory can explain why socioeconomic inequality and food insecurity correlate to conflict intensity, whereas environmental scarcity can explain why this correlation becomes even more intense when climate vulnerability is also high. Greed versus grievance can thus explain why violence intensifies when human insecurity and inequality are high, whereas Homer-Dixon's theory of environmental scarcity can explain the impact of environmental vulnerability.

Based on the preceding discussion, it is evident that the two theories can shed light on different aspects of the results. Although the theory of environmental scarcity and conflict has a greater explanatory value in illuminating why climate vulnerability together with socioeconomic inequality and food insecurity has an impact on conflict intensity, the greed versus grievance argument helps us comprehend why groups resort to violence when human security is threatened in several ways. By integrating the theories, we can view socioeconomic inequality and food insecurity as sources of grievances in these instances, which are further exacerbated through climate vulnerabilities. The greed versus grievance theory also serves to complement Homer-Dixon's theorizing, as he concludes that environmental scarcities in themselves do not lead to conflict, but rather worsen societal and economic problems that may do so. Consequently, we need to look for explanatory factors in how environmental scarcities affect societies in such a way that conflicts may intensify.

Homer-Dixon argued that environmental changes might incite conflict, as they increase economic and political pressures in a society. This can be

connected to the greed versus grievance theory, which argues that these economic and political disruptions exacerbate grievances, or provide increased financial advantages, serving as reasons for intensifying violence. Therefore, we can assume that higher levels of climate vulnerability might be the reason why, in a society already plagued by inequalities, that these inequalities might be exacerbated.

According to the greed versus grievance theory, there are economic incentives for acting on the grievances that are exacerbated through climate vulnerability. This can both be to ensure survival and justice, and to ensure financial gain in times of resource scarcity.

One aspect highlighted by Homer-Dixon and by Collier and Hoeffler is the opportunities that increasing environmental scarcities might offer to certain groups. As discussed in earlier sections, resource scarcities both provide leverage for recruitment and open lucrative markets for rebel groups.

If environmental scarcities and climate vulnerability continue to exist, they will provide increasing leverage and economic opportunities. If food insecurity and inequality are conditions that breed grievances, we might assume that warring groups would be keen to perpetuate these conditions, or even exacerbate them. If grievances due to human insecurities exist, warring groups will stand to make economic gains from them.

What the statistical analysis indicates is that when environmental scarcities due to the degradation and depletion of resources interact with the unequal distribution of resources (as in food security) or political power (as in exclusion by socioeconomic group), there are significant effects on the deadliness of intrastate conflicts. Climate change impacts are thus crucial to consider as a possible threat multiplier in conflicts. As food security and socioeconomic inequality are often deeply rooted and complex issues, stubbornly resisting attempts to diminish them, climate mitigation and adaptation can stand as first steps to decrease the deadliness of contemporary conflicts. In lessening the impact of the vicious circle of inequality, poverty, and conflict, this is an important consideration.

7 Conclusions

The aim of this study was to probe what effects climate change impacts, food insecurity, and socioeconomic inequality have on conflict intensity. This aim was approached by conducting a multiple linear regression analysis and model comparison. Deaths per 100,000 inhabitants was used as the dependent variable for conflict intensity. Climate vulnerability was used as an independent variable for climate change impacts, along with prevalence of undernourishment for food insecurity and exclusion by socioeconomic group for socioeconomic inequality. Two interaction variables were computed to measure the combined effects of climate vulnerability and food insecurity, as well as of climate vulnerability and socioeconomic inequality. The scope of the study was limited to 84 countries that had experienced intrastate conflict during the 2002–2021 period.

The regression analyses show that food insecurity and socioeconomic inequality are significantly correlated with the number of deaths in intrastate conflicts. In general, this means that the higher the food insecurity or socioeconomic inequality is in a country, the more intense the intrastate conflicts are. While there are many factors behind the intensity of a conflict, the multiple linear regression analyses indicate that the variation in the number of deaths can be related to the prevalence of undernourishment or exclusion by socioeconomic group in one of five cases across the world.

The regression analyses identified an even stronger significant relationship when food insecurity and socioeconomic inequality interact with climate vulnerability. Thus, countries that experience high levels of both food insecurity and socioeconomic inequality and are susceptible to climate change impacts are more likely to see intense conflicts in terms of the number of deaths.

The regression analyses and model comparisons established that the independent variables *influence* conflict intensity. To understand *what* the effects entail, the results can be analysed in terms of the theories of greed versus grievance and of environmental scarcity and conflict. The results of this thesis indicate that the theory of greed versus grievance can explain why violence intensifies when

human insecurity and inequality are high, whereas Homer-Dixon's theory of environmental scarcity can explain why this correlation intensifies with higher levels of climate vulnerability.

This study contributed to existing research by establishing the interaction effect that climate vulnerability has on conflict intensity in societies where food insecurity or socioeconomic inequality is high. While relationships between climate change, food insecurity, and socioeconomic inequality and intrastate conflicts have been identified in previous research, this thesis contributes by conducting a novel multiple linear regression analysis including all these parameters. This study provides robust findings regarding the positive effects that socioeconomic inequality and food insecurity have on conflict intensity, and regarding the threat-multiplying effect that climate vulnerability has on intrastate conflicts.

In a warming world, a higher degree of unmitigated climate vulnerability could therefore increase the deadliness of armed conflicts in countries plagued by food insecurity and inequality. There are three ways to reduce these risks, all on the table in the implementation of the Paris Agreement. First, for every tenth of a degree of increased warming, the IPCC's Sixth Assessment Report concludes that the negative impacts on livelihoods will be more severe (IPCC, 2023). The results of this analysis provide yet another argument for the urgent importance of stronger mitigation policies.

Second, given the long-term effects of emissions released today, mitigation will not be enough (IPCC, 2023). The world needs a much stronger effort to support local and regional adaptations to climate change that are mindful of how well-intentioned measures can also lead to maladaptive outcomes that can exacerbate local grievances (Sovacool, Linnér, and Goodsite, 2015).

Third, the results also make a case for funding the Loss and Damage Mechanism, the operationalization of which COP27 agreed upon after 30 years of negotiations. The fund shall provide financial assistance to countries and communities that suffer the consequences of global warming through, for example, land erosion or degradation, flooding, or diminishing resources (Naylor and Ford,

2023). These are all exposures that my analysis indicates can increase the deadliness of armed conflict.

As stated earlier, one should be careful when establishing causal relationships for phenomena as complex and dynamic as civil wars. Yet, despite the limitations of this thesis, the results give an inclination of correlations that merit further exploration. This study highlights the importance of considering aspects of socioeconomic inequality and food insecurity when addressing conflict resolution, but also of mitigating climate change impacts. We need better insights into how multiple crises of human development can have augmenting synergetic effects on one another. To establish positive peace in world facing polycrises, it is crucial to consider how these crises are interrelated, in order to begin to dismantle the vicious cycles of climate change, inequality, and armed conflict.

8 Bibliography

Adams, K., Benzie, M., Croft, S. and Sadowski, S. (2021) *Climate Change, Trade, and Global Food Security: A Global Assessment of Transboundary Climate Risks in Agricultural Commodity Flows*. Stockholm Environment Institute. Available at: https://doi.org/10.51414/sei2021.009.

Agwu, G.A. (2022) 'The Boko Haram Conflict and Food Insecurity: Does Resilience Capacity Matter?', *Journal of African Economies*, p. ejac015. Available at: https://doi.org/10.1093/jae/ejac015.

Alvaredo, F., Chancel, L., Piketty, T., Saez, E. and Zucman, G. (eds) (2018) *World inequality report 2018*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.

Aneshensel, C. (2013) *Theory-Based Data Analysis for the Social Sciences*. 2455 Teller Road, Thousand Oaks California 91320 United States: SAGE Publications, Inc. Available at: https://doi.org/10.4135/9781506335094.

Bahgat, K., Dupuy, K., Gates, S., Mokleiv Nygård, H., Rustad, S.A., Strand, H., Urdal, H., Østby, G., Barrett, G. and Hillesund, S. (2017) *Inequality and Armed Conflict: Evidence and Data*. PRIO, p. 209. Available at: https://www.prio.org/publications/10538 (Accessed: 27 March 2023).

Balboni, C., Bandiera, O., Burgess, R., Ghatak, M. and Heil, A. (2021) *Why do people stay poor?* w29340. Cambridge, MA: National Bureau of Economic Research, p. w29340. Available at: https://doi.org/10.3386/w29340.

Bayramov, A. (2018) 'Review: Dubious nexus between natural resources and conflict', *Journal of Eurasian Studies*, 9(1), pp. 72–81. Available at: https://doi.org/10.1016/j.euras.2017.12.006.

Bednar-Friedl, B., Knittel, N., Raich, J. and Adams, K.M. (2022) 'Adaptation to transboundary climate risks in trade: Investigating actors and strategies for an emerging challenge', *WIREs Climate Change*, 13(2). Available at: https://doi.org/10.1002/wcc.758.

Behnassi, M. and El Haiba, M. (2022) 'Implications of the Russia–Ukraine war for global food security', *Nature Human Behaviour*, 6(6), pp. 754–755. Available at: https://doi.org/10.1038/s41562-022-01391-x.

Berdal, M.R. and Malone, D. (2000) 'Introduction', in M.R. Berdal and D. Malone (eds) *Greed and Grievance: Economic Agendas in Civil Wars*. Boulder, Colo: Lynne Rienner Publishers, pp. 1–15.

Boix, C. (2008) 'Economic Roots of Civil Wars and Revolutions in the Contemporary World', *World Politics*, 60(3), pp. 390–437.

Buhaug, H. (2022) ‘Armed Conflict and Climate Change: How These Two Threats Play Out in Africa’, *PRIO: Climate and Conflict*, 10 November. Available at: https://blogs.prio.org/ClimateAndConflict/ (Accessed: 27 March 2023).

Buhaug, H., Gleditsch, K.S., Holtermann, H., Østby, G. and Tollefsen, A.F. (2011) ‘It’s the Local Economy, Stupid! Geographic Wealth Dispersion and Conflict Outbreak Location’, *Journal of Conflict Resolution*, 55(5), pp. 814–840. Available at: https://doi.org/10.1177/0022002711408011.

Buhaug, H. and von Uexkull, N. (2021) ‘Vicious Circles: Violence, Vulnerability, and Climate Change’, *Annual Review of Environment and Resources*, 46(1), pp. 545–568. Available at: https://doi.org/10.1146/annurev-environ-012220-014708.

Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M. and Chawla, N. (2015) ‘University of Notre Dame Global Adaptation Index Country Index Technical Report’.

Collier, P. (2000) ‘Doing Well out of War: An Economic Perspective’, in M.R. Berdal and D. Malone (eds) *Greed and Grievance: Economic Agendas in Civil Wars*. Boulder, Colo: Lynne Rienner Publishers, pp. 91–112.

Collier, P. (2004) ‘Greed and grievance in civil war’, *Oxford Economic Papers*, 56(4), pp. 563–595. Available at: https://doi.org/10.1093/oep/gpf064.

Collier, P. (2008) *The bottom billion: why the poorest countries are failing and what can be done about it*. First issued as an Oxford University Press paperback. Oxford: Oxford University Press.

Collier, P. and Hoeffler, A. (1998) ‘On Economic Causes of Civil War’, *Oxford Economic Papers*, 50(4), pp. 563–573.

Coppedge, M., Gerring, J., Knutsen, C.H, Lindberg, S.I., Teorell, J., Altman, D., Bernhard, M., Cornell, A., Fish, M.S, Gastaldi, L., Gjerløw, H., Glynn, A., Good God, A., Grahn, S., Hicken, A., Kinzelbach, K., Krusell, J., Marquardt, K.L, McMann, K., Mechkova, V. Medzihorsky, J., Natsika, N., Neundorf, A., Paxton, P., Pemstein, D., Pernes, J., Rydén, O., von Römer, J., Seim, B., Sigman, R., Skaaning, S-E., Staton, J., Sundström, A., Tzelgov, E., Wang, Y-T., Wig, T., Wilson, S. and Ziblatt, D. (2023) ’V-Dem [Country-Year/Country-Date] Dataset v13’ *Varieties of Democracy (V-Dem) Project*. Available at: https://doi.org/10.23696/vdemds23.

Coppedge, M., Gerring, J., Knutsen, C.H, Lindberg, S.I., Teorell, J., Altman, D., Bernhard, M., Cornell, A., Fish, M.S, Gastaldi, L., Gjerløw, H., Glynn, A., Good God, A., Grahn, S., Hicken, A.,

Kinzelbach, K., Krusell, J., Marquardt, K.L, McMann, K., Mechkova, V. Medzihorsky, J., Natsika, N., Neundorf, A., Paxton, P., Pemstein, D., Pernes, J., Rydén, O., von Römer, J., Seim, B., Sigman, R., Skaaning, S-E., Staton, J., Sundström, A., Tzelgov, E., Wang, Y-T., Wig, T., Wilson, S. and Ziblatt, D. (2023) 'V-Dem Codebook v13' *Varieties of Democracy (V-Dem) Project.*

DataBank (2023) 'Metadata Glossary' *The World Bank* Available at: https://databank.worldbank.org/metadataglossary/world-development-indicators/series/SI.POV.GINI (Accessed 15 April 2023)

DataBank (2023) 'Metadata Glossary' *The World Bank* Available at: https://databank.worldbank.org/metadataglossary/world-development-indicators/series/SN.ITK.DEFC.ZS (Accessed 15 April 2023)

Davies, K., Riddell, T. and Scheffran, J. (2020) 'Preventing a Warming War: Protection of the Environment and Reducing Climate Conflict Risk as a Challenge of International Law. Goettingen Journal of International Law (Special Issue: Environmental Protection and Armed Conflicts)', 10, pp. 307–343. Available at: https://doi.org/10.3249/1868-1581-davies-riddell-scheffran.

Davies, S., Pettersson, T. and Öberg, M. (2022) 'Organized violence 1989–2021 and drone warfare', *Journal of Peace Research,* 59(4), pp. 593–610. Available at: https://doi.org/10.1177/00223433221108428.

Escallón, J.M.V. (2021) 'The historical relationship between agrarian reforms and internal armed conflicts: Relevant factors for the Colombian post-conflict scenario', *Land Use Policy*, 101, p. 105138. Available at: https://doi.org/10.1016/j.landusepol.2020.105138.

FAO (2023) 'Sustainable Development Goals: Indicator 2.1.1 - Prevalence of undernourishment' *Food and Agriculture Organization of the United Nations* Available at: https://www.fao.org/sustainable-development-goals/indicators/211/en/ (Accessed 15 April 2023)

FAO (2023) 'Voices of the Hungry: Bringing experience-based food insecurity measurement to the global level' *Food and Agriculture Organization of the United Nations* Available at: https://www.fao.org/in-action/voices-of-the-hungry/background/en/ (Accessed 15 April 2023)

FAO, IFAD, UNICEF, WFP and WHO (2022) *The State of Food Security and Nutrition in the World 2022*: *Repurposing food and*

agricultural policies to make healthy diets more affordable. Rome: FAO. Available at: https://doi.org/10.4060/cc0639en.

Fearon, J.D. and Laitin, D.D. (2003) 'Ethnicity, Insurgency, and Civil War', *The American Political Science Review*, 97(1), pp. 75–90.

Fisher, J.D. (2022) *Managing environmental conflict: an Earth Institute sustainability primer*. New York: Columbia University Press (Columbia University Earth Institute sustainability primers).

Fjelde, H. (2015) 'Farming or Fighting? Agricultural Price Shocks and Civil War in Africa', *World Development*, 67, pp. 525–534. Available at: https://doi.org/10.1016/j.worlddev.2014.10.032.

Fjelde, H. and Østby, G. (2014) 'Socioeconomic Inequality and Communal Conflict: A Disaggregated Analysis of Sub-Saharan Africa, 1990–2008', *International Interactions*, 40(5), pp. 737–762. Available at: https://doi.org/10.1080/03050629.2014.917373.

Fjelde, H. and von Uexkull, N. (2012) 'Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa', *Political Geography*, 31(7), pp. 444–453. Available at: https://doi.org/10.1016/j.polgeo.2012.08.004.

Galtung, Johan (2000). 'International Development in Human Perspective' in M.R. Berdal and D. Malone (eds) *Greed and Grievance: Economic Agendas in Civil Wars*. Boulder, Colo: Lynne Rienner Publishers, pp. 301–335.

George, J., Adelaja, A. and Weatherspoon, D. (2020) 'Armed Conflicts and Food Insecurity: Evidence from Boko Haram's Attacks', *American Journal of Agricultural Economics*, 102(1), pp. 114–131. Available at: https://doi.org/10.1093/ajae/aaz039.

Gleditsch, N.P. and Urdal, H. (2002) 'Ecoviolence? Links Between Population Growth, Environmental Scarcity and Violent Conflict in Thomas Homer-Dixon's Work', *Journal of International Affairs*, 56(1), pp. 283–302.

Gurr, T.R. (1993) 'Why Minorities Rebel: A Global Analysis of Communal Mobilization and Conflict since 1945', *International Political Science Review*, 14(2), pp. 161–201. Available at: https://doi.org/10.1177/019251219301400203.

Halperin, S. and Heath, O. (2020) *Political research: methods and practical skills*. Third edition. New York: Oxford University Press.

Hegre, H., Buhaug, H., Calvin, K.V., Nordkvelle, J., Waldhoff, S.T. and Gilmore, E. (2016) 'Forecasting civil conflict along the shared socioeconomic pathways', *Environmental Research Letters*, 11(5), p. 054002. Available at: https://doi.org/10.1088/1748-9326/11/5/054002.

Hegre, H., Østby, G. and Raleigh, C. (2009) 'Poverty and Civil War Events: A Disaggregated Study of Liberia', *The Journal of Conflict Resolution*, 53(4), pp. 598–623.

Helman, D. and Zaitchik, B.F. (2020) 'Temperature anomalies affect violent conflicts in African and Middle Eastern warm regions', *Global Environmental Change*, 63, p. 102118. Available at: https://doi.org/10.1016/j.gloenvcha.2020.102118.

Hendrix, C. and Brinkman, H.-J., (2013) 'Food Insecurity and Conflict Dynamics: Causal Linkages and Complex Feedbacks' *Stability: International Journal of Security and Development*, 2(2), p.Art. 26 DOI: https://doi.org/10.5334/sta.bm

Homer-Dixon, T.F. (1994) 'Environmental Scarcities and Violent Conflict: Evidence from Cases', *International Security*, 19(1), p. 5. Available at: https://doi.org/10.2307/2539147.

Homer-Dixon, T.F. (1999) *Environment, Scarcity, and Violence*. Princeton University Press. Available at: http://www.jstor.org/stable/j.ctt7pgg0 (Accessed: 27 March 2023).

Homer-Dixon, T, and Rockström, J. (2023) 'What Happens When a Cascade of Crises Collide?' *New York Times.* Nov. 13, 2022. Available at: https://www.nytimes.com/2022/11/13/opinion/coronavirus-ukraine-climate-inflation.html. (Accessed 23 March 2023).

Intergovernmental Panel on Climate Change (2022) *Climate Change and Land: IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. 1st edn. Cambridge University Press. Available at: https://doi.org/10.1017/9781009157988.

IPCC (2023) *Synthesis Report of the IPCC Sixth Assessment Report (AR6): Longer version***.** Available at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf (Accessed 5 May 2023)

Islam, S.N. and Winkel, J. (2017) 'Climate change and social inequality', no. 152. Available at: http://digitallibrary.un.org/record/3859027/files/wp152_2017.pdf.

Keen, D. (2000) 'Incentives and Disincentives for Violence', in M.R. Berdal and D. Malone (eds) *Greed and Grievance: Economic Agendas in Civil Wars*. Boulder, Colo: Lynne Rienner Publishers, pp. 19–42.

Koubi, V. (2019) 'Climate Change and Conflict', *Annual Review of Political Science*, 22(1), pp. 343–360. Available at: https://doi.org/10.1146/annurev-polisci-050317-070830.

Mathieu Bere (2017) ‘Armed Rebellion, Violent Extremism, and the Challenges of International Intervention in Mali’, *African Conflict and Peacebuilding Review*, 7(2), p. 60. Available at: https://doi.org/10.2979/africonfpeacrevi.7.2.03.

Michael Coppedge et al. (2023) ‘V-Dem Dataset v13’. Varieties of Democracy (V-Dem) Project. Available at: https://doi.org/10.23696/VDEMDS23.

Muzamil, M.R., Tschakert, P., Boruff, B. and Shahbaz, B. (2021) ‘An extreme climatic event and systemic vulnerabilities in the face of conflict: insights from the Taliban insurgency in Swat, Pakistan’, *Regional Environmental Change*, 21(1), p. 3. Available at: https://doi.org/10.1007/s10113-020-01738-y.

Nay, O. (2013) ‘Fragile and failed states: Critical perspectives on conceptual hybrids’, *International Political Science Review*, 34(3), pp. 326–341. Available at: https://doi.org/10.1177/0192512113480054.

Naylor, A.W. and Ford, J. (2023) ‘Vulnerability and loss and damage following the COP27 of the UN Framework Convention on Climate Change’, *Regional Environmental Change*, 23(1), p. 38. Available at: https://doi.org/10.1007/s10113-023-02033-2.

Ohlsson, L. (1999) *Environment, Scarcity, and Conflict: A Study of Malthusian Concerns*. Department of Peace and Development Research, Göteborg University. Available at: https://books.google.se/books?id=3hOEAAAACAAJ.

Omenma, J., Hendricks, C. and Ajaebili, N. (2020) ‘al-Shabaab and Boko Haram: Recruitment Strategies’, *Peace and Conflict Studies* [Preprint]. Available at: https://doi.org/10.46743/1082-7307/2020.1460.

Pacillo, G., Kangogo, D., Madurga-Lopez, I., Villa, V., Belli, A. and Läderach, P. (2022) ‘Is climate exacerbating the root causes of conflict in Mali? A climate security analysis through a structural equation modeling approach’, *Frontiers in Climate*, 4, p. 849757. Available at: https://doi.org/10.3389/fclim.2022.849757.

Paffenholz, T. (2014) ‘Civil Society and Peace Negotiations: Beyond the Inclusion-Exclusion Dichotomy: Participation of Civil Society in Peace Negotiations’, *Negotiation Journal*, 30(1), pp. 69–91. Available at: https://doi.org/10.1111/nejo.12046.

Palik, J., Rustad S.A., and Methi, F. (2020) ’Conflict Trends in Africa, 1989–2019’, *PRIO Paper*. Oslo: PRIO.

Peters, L.E.R. (2021) ‘Beyond disaster vulnerabilities: An empirical investigation of the causal pathways linking conflict to disaster

risks', *International Journal of Disaster Risk Reduction*, 55, p. 102092. Available at: https://doi.org/10.1016/j.ijdrr.2021.102092.

Podder, S. (2011) 'Child Soldier Recruitment in the Liberian Civil Wars: Individual Motivations and Rebel Group Tactics', in A. Özerdem and S. Podder (eds) *Child Soldiers: From Recruitment to Reintegration*. London: Palgrave Macmillan UK, pp. 50–75. Available at: https://doi.org/10.1057/9780230342927_3.

Regan, P.M. and Kim, H. (2020) 'Water scarcity, climate adaptation, and armed conflict: insights from Africa', *Regional Environmental Change*, 20(4), p. 129. Available at: https://doi.org/10.1007/s10113-020-01713-7.

Rustad, S.A. (2016) 'Socioeconomic Inequalities and Attitudes toward Violence: A Test with New Survey Data in the Niger Delta', *International Interactions*, 42(1), pp. 106–139. Available at: https://doi.org/10.1080/03050629.2015.1048856.

Sandole, D.J.D. (1990) 'The Biological Basis of Needs in World Society: The Ultimate Micro-Macro Nexus' in J. Burton (ed) *Conflict: Human Needs Theory*. Basingstoke: MacMillan, pp. 60–88.

Security Council (2021) 'People, Countries Impacted by Climate Change Also Vulnerable to Terrorist Recruitment, Violence, Speakers Tell Security Council in Open Debate' *Meeting Coverage*, SC/14728. Available at: https://press.un.org/en/2021/sc14728.doc.htm (Accessed 15 February 2023)

Sommerville, M., Essex, J. and Le Billon, P. (2014) 'The "Global Food Crisis" and the Geopolitics of Food Security', *Geopolitics*, 19(2), pp. 239–265. Available at: https://doi.org/10.1080/14650045.2013.811641.

Sovacool, B.K., Linnér, B.-O. and Goodsite, M.E. (2015) 'The political economy of climate adaptation', *Nature Climate Change*, 5(7), pp. 616–618. Available at: https://doi.org/10.1038/nclimate2665.

Summers, C. and Goodman, S. (2020) 'Weaponizing Wheat: Russia's Next Weapon in Pandemic and Climate Eras', *Georgetown Journal of International Affairs*, 21(1), pp. 62–70. Available at: https://doi.org/10.1353/gia.2020.0014.

von Uexkull, N. (2014) 'Sustained drought, vulnerability and civil conflict in Sub-Saharan Africa', *Political Geography*, 43, pp. 16–26. Available at: https://doi.org/10.1016/j.polgeo.2014.10.003.

The World Bank (2023) 'Population, total' *The World Bank Data*. Available at: https://data.worldbank.org/indicator/SP.POP.TOTL (Accessed: 24 March 2023)

UCDP (n.d) ’UCDP Definitions’ *Uppsala Universitet* Available at: https://www.pcr.uu.se/research/ucdp/definitions/ (Accessed April 14 2023)

von Uexkull, N. and Buhaug, H. (2021) ‘Security implications of climate change: A decade of scientific progress’, *Journal of Peace Research*, 58(1), pp. 3–17. Available at: https://doi.org/10.1177/0022343320984210.

UN DESA (2019) *The Sustainable Development Goals report 2019*. New York: United Nations.

UN DESA (2022) *The Sustainable Development Goals Report 2022*. July 2022. New York, USA: UN DESA. Available at: https://unstats.un.org/sdgs/report/2022/

(Accessed 24 April 2023)

UN STATS (2023) *SDG indicator metadata*. Available at: https://unstats.un.org/sdgs/metadata/files/Metadata-02-01-01.pdf

Van Dijk, M., Morley, T., Rau, M.L. and Saghai, Y. (2021) ‘Van Dijk et al. (2021), A meta-analysis of projected global food demand and population at risk of hunger for the period 2010–2050, data and scripts’. Zenodo. Available at: https://doi.org/10.5281/ZENODO.4911251.

Wallensteen, P. (1986) 'Food crops as a factor in strategic policy and action,' in A.H. Westing (ed) *Global Resources and International Conflict*. Oxford: Oxford University Press, pp. 143-158.

Wang, Q., Hao, M., Helman, D., Ding, F., Jiang, D., Xie, X., Chen, S. and Ma, T. (2022) ‘Quantifying the influence of climate variability on armed conflict in Africa, 2000–2015’, *Environment, Development and Sustainability* [Preprint]. Available at: https://doi.org/10.1007/s10668-022-02436-x.

Welzer, H. (2017) *Climate wars: why people will be killed in the twenty-first century*. Paperback edition. Translated by P. Camiller and P. Camilleri. Cambridge Malden, Mass: Polity.

Werrell, C.E. and Femia, F. (2016) ‘Climate Change, the Erosion of State Sovereignty, and World Order’, *The Brown Journal of World Affairs*, 22(2), pp. 221–235.

World Economic Forum (2023) *The Global Risk Report*. Geneva: World Economic Forum.

Zhou, J. (2022) *Producing Food, Security, and the Geopolitical Subject*. Linköping: Linköping University Electronic Press (Linköping Studies in Arts and Sciences). Available at: https://doi.org/10.3384/9789179292836.

9 Appendix

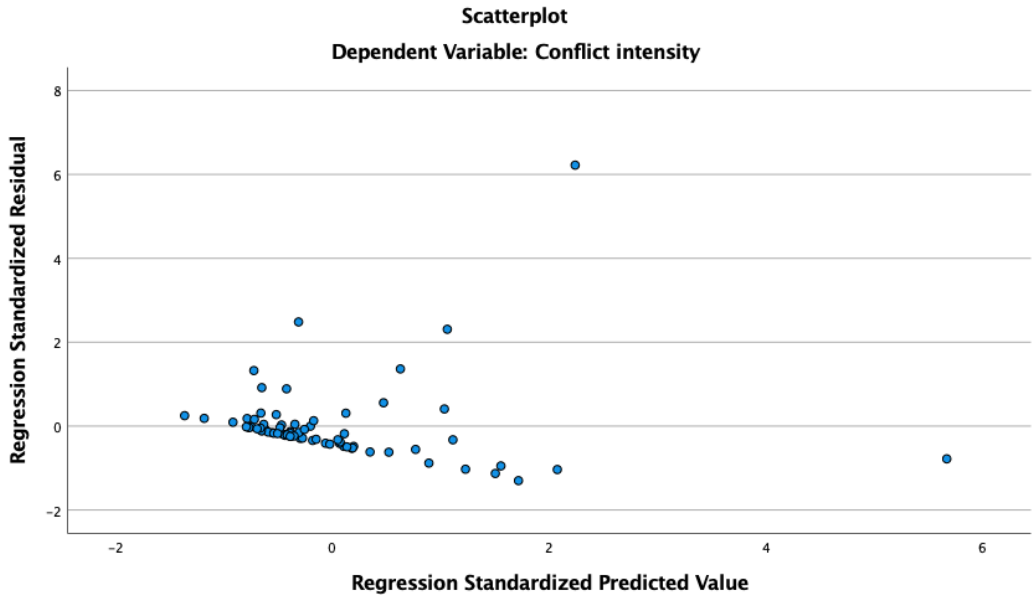
Appendix A: Pearson's correlations

Correlations

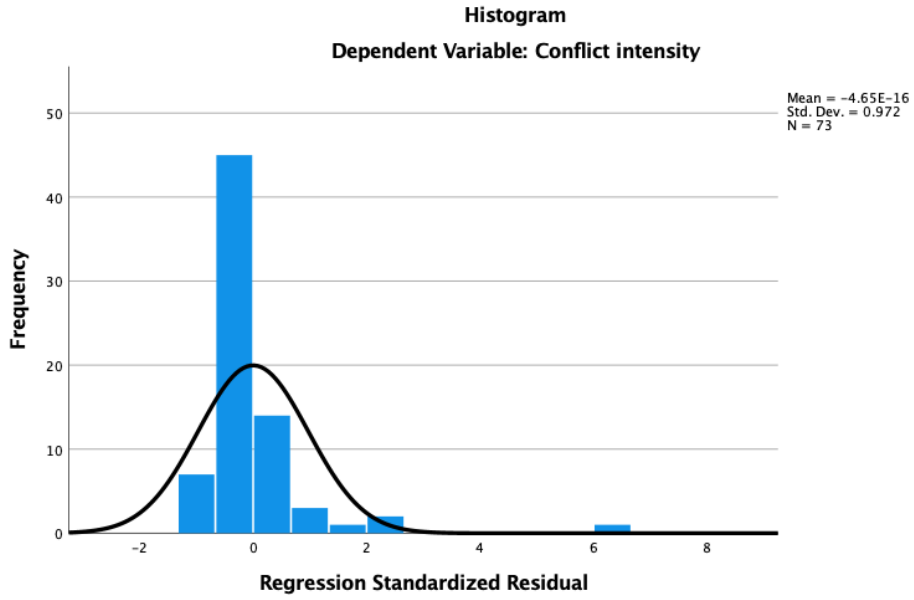
		Conflict intensity	Exclusion of Socioeconomic Group 2001	Prevalence of Undernourishment 2001	Climate vulnerability
Conflict intensity	Pearson Correlation	1	.005	.349**	.013
	Sig. (2-tailed)		.964	.002	.910
	N	84	84	74	82
Exclusion of Socioeconomic Group 2001	Pearson Correlation	.005	1	.582**	.515**
	Sig. (2-tailed)	.964		<.001	<.001
	N	84	84	74	82
Prevalence of Undernourishment 2001	Pearson Correlation	.349**	.582**	1	.722**
	Sig. (2-tailed)	.002	<.001		<.001
	N	74	74	74	73
Climate vulnerability	Pearson Correlation	.013	.515**	.722**	1
	Sig. (2-tailed)	.910	<.001	<.001	
	N	82	82	73	82

**. Correlation is significant at the 0.01 level (2-tailed).

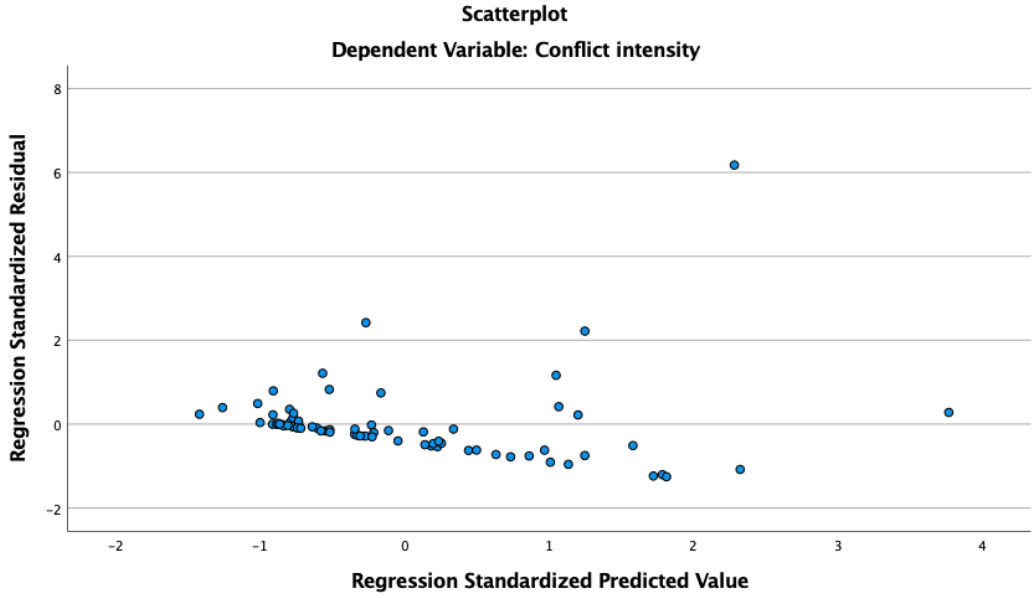
Appendix B: Residual scatterplot for Model 1



Appendix C: Residual histogram for Model 1



Appendix D: Residual scatterplot for Model 2



Appendix E: Residual histogram for Model 2