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CLIMATE CHANGE, ENVIRONMENTAL DEGRADATION, AND CONFLICTS.

Causal pathways and mechanism

Figure 1. Word-cloud based on most common words in bibliography selected abstracts

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CLIMATE CHANGE, ENVIRONMENTAL DEGRADATION, AND CONFLICTS.

This work aims to understand the different mechanisms that link climate change, environmental degradation, and conflicts.

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Content

Abstract

Many press articles and T.V. news warn us about the unforeseen effects of climatic changes on the onset and development of conflicts. Every time a new study emerges, media news resonates and alerts society regarding water wars or migration due to natural disasters. NGO's, governments, and international agencies have raised awareness, asking for more funding to tackle the arguable multiplier risk of climate change. Seemingly, academics have not reached common ground about the effects of climate change and environmental degradation on conflicts. Different statistical procedures, case studies, and mixing studies have brought contradictory results. This study maps out an extensive net of drivers based on a systematic literature review of more than 300 articles on the topic, complemented by experts' and practitioners' interviews.

I am interested in understanding plausible pathways from climate change to conflict and addressing different perspectives on the topic among scholars, more than if climate change and environmental degradation cause conflict. Despite a lack of academic agreement, there are precise mechanisms that help us understand how climate change interacts with socio-economic variables to increase the likelihood of conflicts. Finally, I show some agreements and disagreements between practitioners and academics.

Background

Overpopulation, resource scarcity, environmental depletion, and climate change threaten our modern society. However, our understanding of the effect of these threats has been framing from different approaches. On the one hand, the Neo-Malthusian perspective highlights that environmental changes pose a significant threat to vulnerable people due to the scarcity of natural resources and population growth. On the other hand, the optimistic (cornucopian) perspective relies on humankind's ability to cope with these environmental risks based on market and technology. (Bernauer, Böhmelt, & Koubi, 2012) The famous Simon–Ehrlich wager in the '80s showed part of this debate between Neo-Malthusians and optimistic academics. Paul Ehrlich, a biologist, stated that population growth would rapidly deplete natural resources. Simon, an economist, was skeptical and was at odds with it[1]. After ten years, Simon won the bet by proposing that five important metal prices would go down over the '90s despite the growing population. Nonetheless, climate change undeniably pushes this bet again due to its unpredictable effects.

At the beginning of the '90s, some research centers, such as Environmental Change and Acute Conflict Project (Toronto Group) and CSS Environment and Conflicts Project (Zurich group), conducted several qualitative investigations. These groups argued that environmental stress seems to increase conflicts through scarcity or political instability (Homer-Dixon, 1994) (Bernauer, Böhmelt, & Koubi, 2012). Nevertheless, the lack of systematization and generalization of those qualitative studies led to no robust results (Gleditsch, 1998). On the contrary, research using large data sets displayed mixed results. Some supported this relationship by finding a significant direct and indirect association between deforestation, land degradation, and scarce freshwater supply on civil wars and armed conflicts (Hauge & Ellingsen, 1998). Some rejected this relationship and highlighted the effect of political and economic

[1] https://www.npr.org/sections/money/2013/12/31/258687278/a-bet-five-metals-and-the-future-of-the-planet?t=1607624822957

factors (Raleigh & Urdal, 2007). For instance, a replication of (Hauge & Ellingsen, 1998) done by (Theisen, 2008) lends little support to the relationship between water scarcity, population density, soil degradation, deforestation, and civil war.

In recent years, the concerns about the relationship between environmental degradation and conflict have increased because of climate change disruptions. Ex-President Obama, in his acceptance speech for Nobel Prize (2009), said: "there is little scientific dispute that if we do nothing, we will face more drought, more famine, more mass displacement – all of which will fuel more conflict for decades" (Gleditsch, 2012, p. 3). In 2017, UN General Secretary Antonio Guterres pointed out, "climate change was exacerbating internal conflicts."[2] Furthermore, the Fifth Assessment Report's experts from the Intergovernmental Panel on Climate Change (IPCC) stated that climate change would threaten human security. (Gleditsch & Nordås, 2014). Under those circumstances, the literature about climate change and conflict has risen sharply. (Mach et al., 2019)(Breckner & Sunde, 2019)(Solomon et al., 2018) (M. Burke et al., 2015a) (Koubi, 2018a).

This work aims to understand the different mechanisms that link climate change, environmental degradation, and different kinds of conflicts. The report is dividing into seven chapters. In the first chapter, I introduce the research problem and a brief state of the literature's art divided into the scientific and social basis of doing a master thesis on climate change, environmental degradation, and conflicts. In the second chapter, I propose the general research question and sub-research questions, which mainly deal with identifying the main drivers, causal pathways, and mechanisms that link the aforementioned variables. The methodology is revealed in the third chapter. I split it into two parts: one exposes the data collection method used, whereas the other exhibits data analysis methods. Some working hypotheses are outlined in the fourth chapter, while results are shown in the fifth chapter. Finally, the discussion and my conclusion are display in the sixth chapter. A special mention has to be made regarding the fifth chapter. I offer it into three parts. In the first part, the reader will navigate through a bunch of articles from a systematic literature review, whereby I show the most relevant authors, frameworks, and statistics together with drivers, causal pathways, and mechanisms. I beforehand apologize because of the encyclopedic narrative, which may be tiresome. Be patient, and if you get lost, I assume the blame. In the second part, I succinctly summarize more than 12 hours of video records and interviews. By this time, I hope you have already felt comfortable with the written. Finally, you and I will try to map out the seemingly inextricable joints linking the drivers, pathways, and mechanisms presented in this master thesis report.

Research Problem and State of the Art

The starting point of environmental degradation and conflict studies is developed by Homer – Dixon (Toronto Group) in their seminal works. Using case studies like in the Philippines and Nicaragua, Homer-Dixon acknowledged that migration, ethnicity, decreased economic growth, and agricultural productivity act as mediating variables in this relationship. (Homer-Dixon et al., 2011) (Homer-Dixon, 1994) However, he stressed the role of environmental degradation and resource scarcity as the main drivers. Hence, he proposed a model to frame the causal relationship based on natural resource scarcity. He mentioned three key elements: 1) supply-induced scarcity: lack of natural resources caused by environmental degradation; 2) demand-induced scarcity: shortages caused by overpopulation or more consumption; and 3) structural-

[2] https://www.independent.co.uk/environment/climate-change-fuelling-global-wars-conflict-world-syria-africa-global-warming-un-secretary-general-a7525431.html

induced scarcity: a dearth of natural resource, which implies traditional causes of conflict such as inequality and, social fragmentations (Homer-Dixon, 1991).

These three elements interact in two processes, namely: A) 'resource capture,' wherein demand-induced scarcity (overpopulation) and supply-induced scarcity (environmental degradation) generate structural-induced scarcity (misallocation and capture in favor of elites) and B) 'ecological marginalization,' therein structural-induced scarcity (unequal land distribution), and demand-induced scarcity (increasing land consumption) provoke supply-induced scarcity (land pollution and depletion) (Bernauer, Böhmelt, & Koubi, 2012). Resource capture processes and ecological marginalization outcomes generate deprivation, greed, and grievances, therefore creating or exacerbating conflicts (Fjelde & von Uexkull, 2012).

Conversely, Baechler (Zurich Group) stated that violent conflicts triggered by environmental degradation manifest themselves in socioeconomic crises insofar as social, ethnic, and political variables are involved (Baechler, 1998). In this scenario, not only environmental degradation may lead to conflicts, but also slow-onset and rapid-onset natural disasters[3] as well as substantial development projects such as dams (Froese & Schilling, 2019). Those augment the risk of socioeconomic crisis and therefore conflicts. (Spillmann & Bächler, 1995) According to Zurich group authors, not every conflict is an environmentally induced conflict. For example, disputes over agricultural land are environmental only if a land dispute is related to soil erosion, river flow patterns, or other environmental variables. Hence, conflicts involving land tenure rights would not be considered environmental-induced conflicts unless an environmental variable or project changes property and tenure patterns (Libiszewski, 1992).

Hence, drawing a line about what an environmental-induced conflict is or not is eminently challenging. For this research, environmentally motivated conflicts are caused by short-term climate variability, natural resource abundance or scarcity, natural resource degradation, natural resource depletion, and natural disasters. Also, temperature and precipitation anomaly, differences from 30 years' average (climate change), are considered environmentally motivated conflicts: climate changed-induced conflicts. Climate change triggers environmental degradation, natural hazards, and other socioeconomic variables, thereby hastening the probability of scarcity, floods, migration, or economic shocks.

Thus, it is necessary to distinguish climate-induced and particularly climate change-induced conflicts from other forms of environmentally induced conflicts (Meierding, 2013). For example, either long-term or short-term weather variation affects freshwater availability, which would generate scarcity or degradation. However, water availability can also be affected directly by human activities such as pollution. Unlike the former climate-induced conflicts, the latter are human-induced environmental degradation conflicts.

Another important distinction is what kind of natural resources are more prone to generate conflicts. Scholars find that abundant non-renewable natural resources are directly linked to conflicts (Mildner et al., 2011). Nonetheless, the question of whether renewable resource scarcity leads to conflicts is still open-ended (Gleditsch & Nordås, 2014). The "traditional assumption is that conflict is linked to non-renewable resources through abundance, while renewables may have a destabilizing effect for societies only when they become scarce." (Vesco et al., 2020). Moreover, not all renewable resource scarcity is due to environmental degradation or weather changes. For example, a growing population (demand-induced scarcity) and unequal

[3] The FAO's Technical Handbook Emergency Activities indicates that "rapid-onset emergencies are usually the result of sudden natural events such as wind storms, floods, wild fires, landslides, avalanches, earthquakes and volcanic eruptions. Slow-onset emergencies include those resulting from crop failure due to drought, the spread of an agricultural pest or disease." Retrieved from http://www.fao.org/3/X6868E/x6868e00.htm#d

resource allocation (structural-induced scarcity) lead to a shortage (supply-induced scarcity), whose effects (ecological marginalization) could fuel conflicts. The dependent variable (conflict) also poses some challenges since the pathways whereby conflict occurs are deeply disparate depending on what definition of conflict is used. Thus, the relationship between climate change, environment, and conflict raises some questions. (Gleditsch, 2012).

As much as new and better datasets become available, quantitative studies have improved their methodology and results. Miguel et al. (2004) found that economic growth is negatively related to civil conflict regardless of how rich, democratic, or ethnically diverse countries are (Miguel et al., 2004). They used short-term rainfall variability as an instrumental variable for economic growth in 41 African countries over 20 years. Burke et al. (2009) conducted a regression model that links several historical climate variables with civil wars in Africa, conditional on country fixed effect and time trends. They found out strong linkages between civil wars and warmer years. They projected "a roughly 54% increase in armed conflict incidence by 2030" (M. B. Burke et al., 2009, p. 70).

Furthermore, new meta-analysis approaches have confirmed that climate change could lead to either interpersonal conflicts or intergroup conflict. Interpersonal conflict encompasses violent crime, robbery and, intimate partner violence. In contrast, intergroup conflict refers to collective disputes such as wars, civil conflicts, riots, political violence, and communal conflicts (Carleton et al., 2016) (M. Burke et al., 2015a).

Nevertheless, empirical findings face some problems in establishing convincingly causal relationships (Mildner et al., 2011). For instance, some studies used proxies of climate change, such as short-term data on weather and extreme weather events, instead of the long-term average variability of temperature, precipitation, and other climatic variables (Scheffran et al., 2012). Using short-term data would help answer how environmental degradation triggers interpersonal and intergroup conflicts by heatwaves or sudden-onset natural disasters such as floods. However, short-term data do not adequately help answer climate change questions or slow-onset disasters such as drought leading to conflicts. Besides, some studies do not consider the political, social, and cultural context of conflicts. Other studies failed to encompass the intervening and confounder variables' complexity. (Theisen et al., 2013).

Despite no clear consensus about how the relationship between climate change, environmental degradation, and conflict works (Gleditsch, 2014), the predictions about increasing global warming highlight the importance of addressing links between climate change, environmental degradation, and conflict. Much can be done to mitigate impacts and avoid fatalist determinisms (Salehyan, 2008). For instance, framing climate change impacts as a security problem could redirect military budgets to help the most vulnerable people to cope with climate change (Detraz, 2011).

The scientific relevance of the research problem

In a nutshell, climate change, weather variability, and environmental degradation could increase the probability of conflicts by threatening other intermediate variables such as food availability (Gregory et al., 2005), water supply (Bernauer & Siegfried, 2012), or income. Droughts lead to the loss of pasture resources that change local community migration patterns (Theisen, 2017). Irregular rain periods have a high impact on agriculture production, pushing Brazil's communities to migrate and invade private and public land in an already very uneven country (Hidalgo et al., 2010). Climate change could act indirectly over disputes by altering the conditions where specific institutional, social, and economic interactions occur (M. Burke et al., 2015a).

Hence, untangling this issue needs to be addressed carefully. Pathways from climate change and environmental degradation to conflicts involve many variables and levels of analysis since the effects of climate change are complex and multidimensional. Societies evolve faster than climate variability trends (M. Burke et al., 2015a). While no conflict occurs in a vacuum space, several conditions may trigger conflict-onset or intensify the ongoing conflicts in regions where climate change and conflicts coexist. Furthermore, climate change implies uncertainties and ambiguities about the consequences of their effects on different systems (Meierding, 2013).

Those uncertainties resulting from complexity systems "coupled with the lack of consensus about a topic make any prescription or potential course of action highly contentious" (J. Fisher & Rucki, 2017, p. 271). As a result, the apparent absence of causal evidence could lead to inaction to tackle this issue. Instead of focusing on the causal links, we should move forward to understand that this relationship is highly contextual and, in many cases, with endogenous causality and loops. Therefore, looking for new analytical frameworks will help understand how climate change and environmental degradation may act as peace inhibitors or threat multipliers of conflicts (Bowles et al., 2015).

The social relevance of the research problem

In his book "The Better Angels of our Nature," Steven Pinker shows that death rates because of wars have declined through the years (Gleditsch et al., 2013). However, some local conflicts have remained unsolved, and new contests have been arising. As climate change could affect conflict onset, duration, and timing, Pinker's statement faces a new challenge. Certainly, smallholders, indigenous peoples, and the poorest are the most at risk. Those have been exposed to diminishing income and capital, thereby reducing their capabilities to store seed or feed their families (Läderach & Souha, 2020). Climate change yields unforeseen fluctuation in the price of commodities and financial products (Läderach & Souha, 2020). Furthermore, vulnerable people are more likely to be affected by conflicts, which undermines development, breaks social bonds, and produces well-known physical and psychological effects.

General Research Objective

To understand to what extent climate change triggers conflicts by conducting a systematic literature review and a qualitative analysis, identifying the main drivers, causal pathways, and mechanisms that link climate change, weather variability, environmental degradation, and conflicts.

General Research Question

What is the general agreement regarding the relationship between climate change, environmental degradation, and conflict?

Sub research questions

- How has the literature addressed the relationship between climate change, environmental degradation, and conflicts? Which are their main findings?

- Which are the conflict drivers triggered by climate change, weather variability, and environmental degradation?
- What are the relevant causal pathways, mechanisms, and networks linked to those drivers with conflict?
- How does this relationship work? Is it one way? Are there reinforcing mechanisms?
- How do practitioners have experienced the effects of climate change on conflict? Which are their main agreement and disagreement within and with scholars?

Methodology

This chapter is divided into two sections. In the first section, I show my data collection methods, including a systematic literature review, data collected from a series of Webinars, and interviews with practitioners. The climate-security group from the Research Program in Climate Change, Agriculture, and Food Security (CCAFS) launched Webinars to address this issue. CCAFS[4] aims to marshal the science and expertise from the Consortium of International Agricultural Research Centers (CGIAR), a global research partnership looking to "reducing poverty, enhancing food and nutrition security, and improving natural resources." [5] The climate-security group aims to integrate a science perspective into the conflict-climate debate by finding common ground between scientists and public policy practitioners. I participated as a master student in some sessions in this group. The second section shows my data analysis method based on the bibliometric approach and analysis of discourses and narratives from webinars and expert interviews' main results. All this information was integrated into a theory of change.

Methods for data collection: Systematic literature review, Webinars, and Interviews.

A systematic literature review (Piper, 2013) allows us to identify and synthesize the scientific literature that meets pre-specified eligibility criteria to answer the research questions. I chose this method since there is much controversy among scholars regarding direct, indirect, or interacted effects of climate change and conflict. By doing systematic literature, I aim to integrate the entire state of the art on the topic from different perspectives. This review helps me see how the relationship between climate change, environmental degradation, and conflicts has been addressed in academia through time. This method also shows the main conflict drivers and causal pathways mentioned therein and the scholars' relevant disagreements.

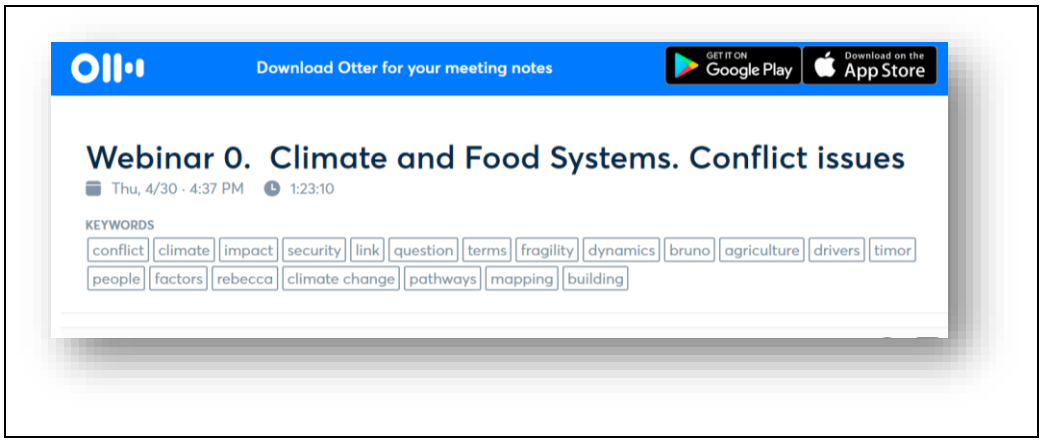
One of the essential criteria in a systematic literature review is the use of keywords for guaranteeing robust results. I chose the keywords based on the literature review using the thesis's proposal and the webinar 0 organized by (CCAFS). All webinars are uploaded on YouTube, but webinar 0 was a pilot. CCAFS granted me access to webinar 0. I recorded webinars using the AI machine learning app Otter.ai, a platform that transcripts speech to text. Table 1 shows the keywords selected by the otter.ai app in Webinar Zero.

[4] https://ccafs.cgiar.org/

[5] https://www.cgiar.org/

With those keywords in mind, I divided the searching into two stages. In the first stage, I sought keywords **(conflict and "climate change")** as an overarching searching. In the second stage, I based on Xu (Xu et al., 2016) for creating a file of keywords to systematically and comprehensively check the state of the topic. Every keyword was crossed against each other using the operators "OR" "AND." I used Scopus and Web of Science Core Collection (WoSC) databases because those are among the most crucial data repository of peer review articles. I looked at their search string, which included the article title, abstract, author keywords, and expanded keywords. Figure 2 shows the keywords chosen.

Table 1. Keywords selected by Otter.ai from webinar zero



Once the keywords were defined, articles were chosen based on the following criteria:

a) I included articles published in peer review journals from 2010 to the present.

b) I used exclusively articles written in English.

c) I eliminated repetitive articles.

d) I included articles whose primary focus is whether or how climate change, weather variability, or environmental degradation leads to conflict. This criterion was met by looking at the abstract of each piece.

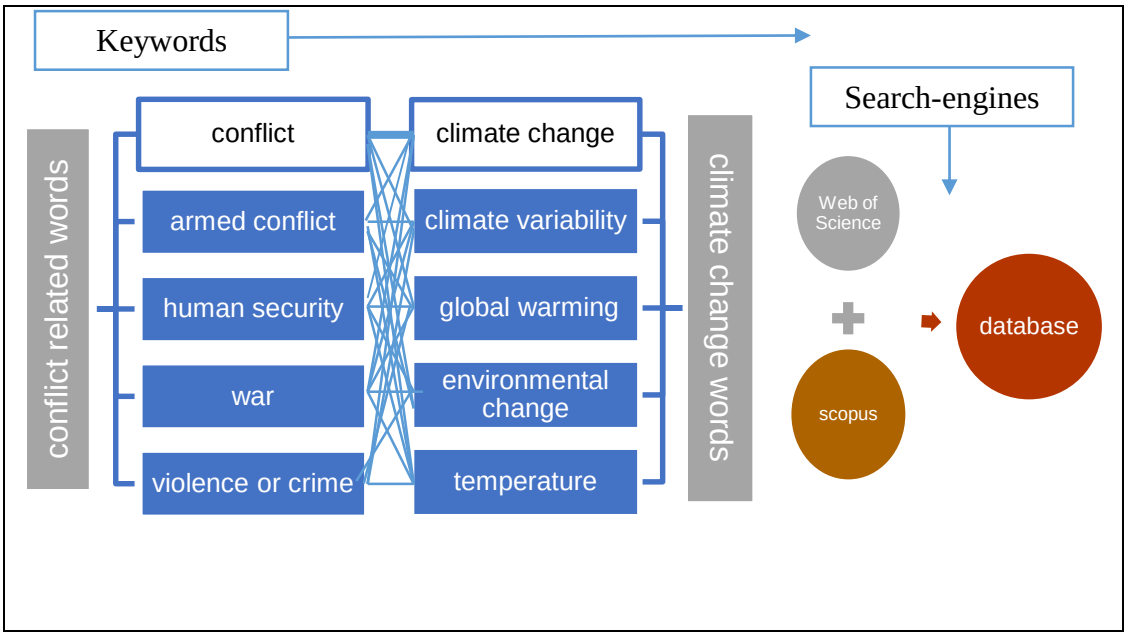
e) I excluded articles which, in their abstract, do not aim to study human conflicts. For example, reports that link climate change with wildlife-human conflicts.

f) Despite their nexus climate conflict, I excluded articles when climate change rose conflicts in the medieval era or led to disputes in the Aztec or Chinese ancient empire. In general, non-man-made climate change articles were not included. The period from 1800 AD to the present was fixed due to some studies point out that greenhouse gases began warming the world's oceans in the early 1800s (Abram et al., 2016).

On June 15th, 2020, I started the search using the overarching keywords selected ("climate change" and conflict). I read an average of 211 abstracts per day for the two stages till July 23rd, 2020. In this first stage, overarching keywords provided a considerable amount of articles. Using criteria, a) and b), Scopus brought back 2284, and WoSC reported 2971 items. I identified 518 articles out of the 5255 using criteria d) and e). From which, I selected 265 from Scopus and 253 from WoSC. I checked my results twice, deleted 131 items (criterion e), 11 papers because of standards b) d) and e) and 22 using the f) criterion. For those articles whose abstract can be

misleading, I scanned and scrutinized the article's body. In total, I excluded 127 articles due to criteria d). Finally, I obtained 227 items. I stored them in an EndNote Library Database.

Figure 2.Graph-based on Xu et al. (2016)



For the other keywords (war and "climate change") or (violence and temperature) and so forth, Scopus brought back 4603 and WoSC 4622 items. In this second stage, I chose 1115 articles. I eliminated 229 repetitive from Scopus and 369 from WoSC. Besides, when combining both Scopus and WoSC databases, I deleted 194 redundant items. Articles from this search were stored in a Mendeley Library Database. Comparing with the 227 articles from the "climate change" and "conflict" overarching Endnote database, I got 96 new items on the Mendeley Library, most of them (69) relating to climate change effects on crime. Overall, I got 327 items. I combined Endnote first stage database and Mendeley second stage database in a unique database in Mendeley. However, only 315 articles were granted access for reading.

I collected additional data through two data sources, a) webinar workshops organized by CCAFS and b) some interviews with practitioners to whom I asked about climate change and conflict findings.

The webinars launched by CCAFS are (0) climate and food systems: Conflict issues (30th April 2020); (1) the role of climate and food systems science in conflict preventing and peacebuilding (4th June 2020); (2) the importance of data and disruptive technologies for climate security (18th June 2020); (3) sustainable finance for peace (2nd July 2020); (4) climate security in the Sahel (3rd September 2020); (5) climate security in Colombia (17th September 2020); (5) a partnership plan for climate security (1th October 2020).

I used Webinar zero, first, two, fourth, and sixth to add information about my systematic literature review's principal findings. I excluded webinars two, three, and five since there was no discussion regarding climate change and conflict interactions. Webinars were hosted by Diego Osorio, head of resource-mobilization and partnerships at CCAFS, and Mark Leon Golberg, the global affairs blog U.N. Dispatch editor. Practitioners chosen by CCGIAR are well-known experts in the field. They are leaders of institutions such as the World Bank, PRIO, Crisis International Group, International Committee of Red Cross, CGIAR, UN world program Food and,

Institute for Security Studies. Also, some of them represent essential donors, such as Norway Government. Table 2 shows chosen webinars and their participants.

Table 2. Webinar participants

Date	Webinar	Participants
April 30th, 2020	0. Climate and food systems: Conflict issues	• Peter Läderach, leader for Climate-Smart Technologies and Practices at CCAFS; • Grazia Pacillo, senior economist at CCAFS, • Teresa Liebig, Post-Doctoral Student in Climate change and Security at CCGIAR. • Bruno Charbonneau, Director of the Center Francopaix in conflict resolution and peace mission[6] and Professor of International Studies at the Royal Military College in Canada. • Rebeca Engels, Professor of the University of York in Canada.
June 11th, 2020	1. The role of climate and food systems science in conflict preventing and peacebuilding	• Dr. Sonja Vermeulen, Global Food scientist and Director of programs at CGIAR System • Dan Smith, Director of the Stockholm International Peace Research Institute (SIPRI)[7] and Ex-Director of PRIO[8].
June 18th, 2020	2. The importance of data and disruptive technologies for climate security	• Elizabeth Gilmore, Associate Professor in the environmental science and policy program in the international development community and environment at Clark University. She is also a senior associate researcher at the Peace Research Institute Oslo PRIO. • Andy Jarvis is an Associate of CGIAR and Director-General research and strategy and innovation with Bioversity International's alliance. • Enrica Porcary, Chief Innovation Officer and director of technology at the UN World Food Program[9]. • Martin van Aalts, director of the International Federation of the Red Cross Climate Center[10].

[6] The center is a research project from the "Chaire Raoul-Dandurand en études stratégiques et diplomatiques", which bundle together expertise from academics and diplomatists on political science topics. Retrieved from https://dandurand.uqam.ca/centre-francopaix/

[7] SIPRI is "an independent international institute dedicated to research into conflict, armaments, arms control and disarmament." Retrieved from https://sipri.org/about

[8] "The Peace Research Institute Oslo (PRIO) conducts research on the conditions for peaceful relations between states, groups and people." Retrieved from https://www.prio.org/

[9] "WFP is one of the first agencies on the ground in global emergencies caused by conflict, climate shocks, pandemics and other disasters." Retrieved from https://www.wfp.org/

[10] "The Climate Centre, is a specialist reference center of the International Federation of Red Cross and Red Crescent Societies (IFRC). Our mission is to help the Red Cross and Red Crescent Movement and its partners reduce the impacts of climate change and extreme-weather events on vulnerable people." Retrieved from https://www.climatecentre.org/

September 3rd, 2020	4. Climate security in the Sahel	• her Excellency, Rigmor Elianne Koty, Norway's Special Representative for the Sahel; • Robert Zougmoré, African Director of CGIAR research program on Climate Change Agriculture and Food Security; • Ornella Moderan, Head of Sahel Programme from the Institute for Security Studies[11]; • Bruno Charbonneau, and; • Catherine-Lune Grayson, senior policy advisor at the International Committee of the Red Cross[12].
October 1st, 2020	6. A partnership plan for climate security	• Frank Bousquet, Senior Director Fragility, Conflict, and Violence Group – World Bank[13]; • Claudia Sadoff, Management Director of CGIAR research program on delivery and impact; • Hans Olav Ibrekk policy director of the section for Energy, Climate and Food Security – Norwegian Ministry of Foreign Affairs and; • Robert Malley, President, and CEO Crisis International Group[14].

I did three online interviews through the Zoom platform and recorded them using the Otter.ai app. Interviewees were chosen using a practitioners' snowball sampling from several meetings into the Climate Change and Security Group. First, I reached out to Dan Smith, with whom I had an interview on 30th June 2020. He recommended two people for follow-up interviews: a) Janani Vivekananda, Head of Programme Climate Diplomacy and Security in Adelphi and, b) Florian Krampe, principal research at SIPRI. Only Janani Vivekananda answered back to my emails. However, it was not possible to arrange a meeting with her. She redirected me to Chitra Nagarajan.[15] I had an interview with her on 2nd October 2020. I interviewed Bruno Charbonneau on 26th August 2020. I additionally contacted Elizabeth Gilmore and Ingrid Boas[16]. I did not receive an email from Elizabeth Gilmore. Ingrid Boas sent an email with some literature regarding climate-migration-conflicts links. Additionally, Dan Smith and Brunno Charbonneau interviews were done alongside Lawrence Copson, a Manchester University student. He carried

[11] "The ISS is an African organization which enhances human security by providing authoritative research, expert policy advice and capacity building." Retrieved from https://issafrica.org/

[12] "The International Committee of the Red Cross (ICRC) ensuring humanitarian protection and assistance for victims of war and other situations of violence." Retrieved from https://www.icrc.org/

[13] This group at World Bank "addressing fragility, conflict, and violence is a strategic priority to achieve our twin goals— end extreme poverty and promote shared prosperity." Retrieved from https://www.worldbank.org/en/topic/fragilityconflictviolence

[14]It is an independent organization working to prevent wars and shape policies that will build a more peaceful world. Retrieved from: https://www.crisisgroup.org/

[15] She is a writer and activist, working on peacebuilding in Nigeria. She specializes herself in women and human rights. Retrieved from https://www.theguardian.com/profile/chitra-nagarajan

[16] She is s an Associate Professor at the Environmental Policy Group at Wageningen University. Retrieved from https://www.wur.nl/en/Persons/Ingrid-dr.-IJC-Ingrid-Boas.htm

out a thesis about the nexus of climate change and conflict and its effects on the humanitarian agenda.

Methods for data analysis: Bibliometric, narrative, and theory of change (ToC).

The main findings of the systematic literature review were drawn using the bibliometric technique. Bibliometrics helps us understand the history of a research field, different schools of thought, and the most critical patterns or barriers from a research community. (Aria et al., 2020). I exported data from the unique Mendeley database into a Scopus set list. Then, I downloaded a CSV file for working in R software. Only 308 articles had complete information about authors, keywords, and other R program requirements. As a result, the systematic literature review is based on those 308 articles.

To analyze and visualize the main findings in the systematic literature review, I used the R packages bibliometric and biblioshiny. Bibliometrics is an open-source software in R for quantitative research in scientometrics developed by Massimo Aria and Corrado Cuccurullo. Biblioshiny is an app that allows showing results without coding experience. I also used Vos-viewer visualization software. Vos-viewer is software to visualize bibliometric networks extracted from the literature review meta-data. The Centre for Science and Technology Studies of Leiden University developed the software. To analyze webinars and interviews, I use a narrative approach to address some knowledge gaps from the systematic literature review. I checked twice interviews and webinars. I redrafted Otter.ai transcriptions when mistakes were made. Also, I used an additional webinar launched by the Oxford Climate Society to draw some conclusions.[17]

To build causal pathways and mechanisms from climate change to conflict, I created an excel database with the principal drivers extracted from every article. This database and its codification are based on Peter Läderach and Theresa Liebig's previous work, affiliated with CGIAR. Climate – Security group from CGIAR identified drivers from 60 articles, grouping them into social, economic, environmental, and institutional categories. Each category has several drivers. Figure 3 shows a visualization pattern of principal drivers found by CCGIAR. The original database from the climate-security group was enlarged based on the systematic literature review findings. I added new categories and drivers. Table 3 shows 15 categories and 52 drivers identified from the systematic literature review.

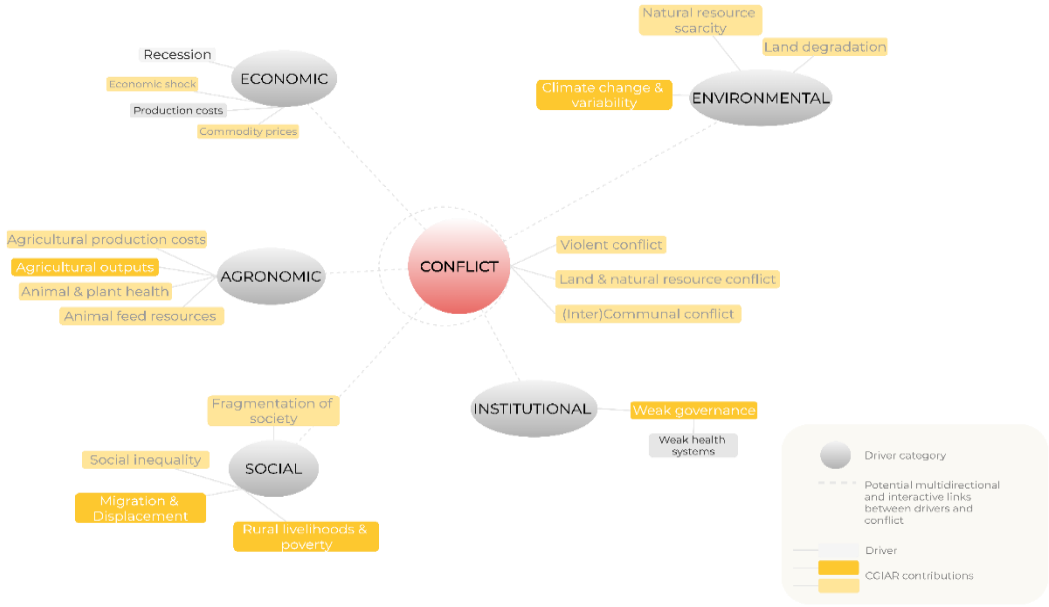
I filter the excel database to use exclusively quantitative, qualitative, and mixed studies since the authors collected the drivers using either fieldwork or statistical methods. Articles that account only for narratives, such as literature reviews, were excluded for drawing patterns. Overall, I drew drivers that showed statistically significant or reported as relevant in survey-based or case studies from 204 articles. Definitions of drivers were taken from different sources such as National Oceanic and Atmospheric Administration, UN System Institutions, etc. I filled a maximum of 15 excel columns of drivers for each study analyzed. In most cases, 4 or 5 columns were enough. For instance, Rainfall changes -> Agricultural Output -> Poverty -> Conflict.

Consequently, I used ToC as a framework to analyze those causal pathways. ToC is a dialogue-based process that generates a series of events aiming at a particular result (Vogel, 2012). Therefore, it is both a process and an outcome. Initially, the ToC method is used to understand how and why a program or policy works (Wholey et al., 2010). It outlines causal linkages through

[17] https://www.youtube.com/watch?v=qEGytLvQK0A&t=2908s

contextual factors, data collection, outputs, direct outcomes, 'intermediate states,' and long-term outcomes (Evaluation Office of UN Environment, 2017).

Figure 3. Visualization of drivers by CCGIAR, climate security program.



Source: https://climatesecurity.cgiar.org/?tab=portfolio

As climate change impacts have several confounding and intermediate factors, Toc is an alternative to think problems outside the Log-frame linear box. Toc describes the "push and pull of multiple processes" and "the complexity of non-linear feedback loops, which involve a myriad of actions and interactions that trigger unpredictable and unforeseen impacts" (van Es et al., 2015, p. 7). As a result, ToC allows to reflect better the reality of complex impacts (De Silva et al., 2014) and stimulates stakeholders' participation (Connell & Kubisch, 1998). Toc has been using for evaluating Cochrane or Campbell systematic literature reviews[18]. Hence, I use Toc to answer what relevant mechanism linked climate change, environmental degradation with conflict, and how this relationship works. "The gold standard is embedding a rigorous analysis of effects into a broader analysis of the causal chain based on a theory of change" (White, 2018, p. 17). Figure 4 shows the layout of the process. I show my findings using R software on Network analysis, developed by Katya Ognyanova.[19](Ognyanova, 2019)

[18] Cochrane is a global network of health and social care stakeholders who promote evidence-informed decision making by producing systematic reviews and other synthesized research evidence https://training.cochrane.org/handbook/current

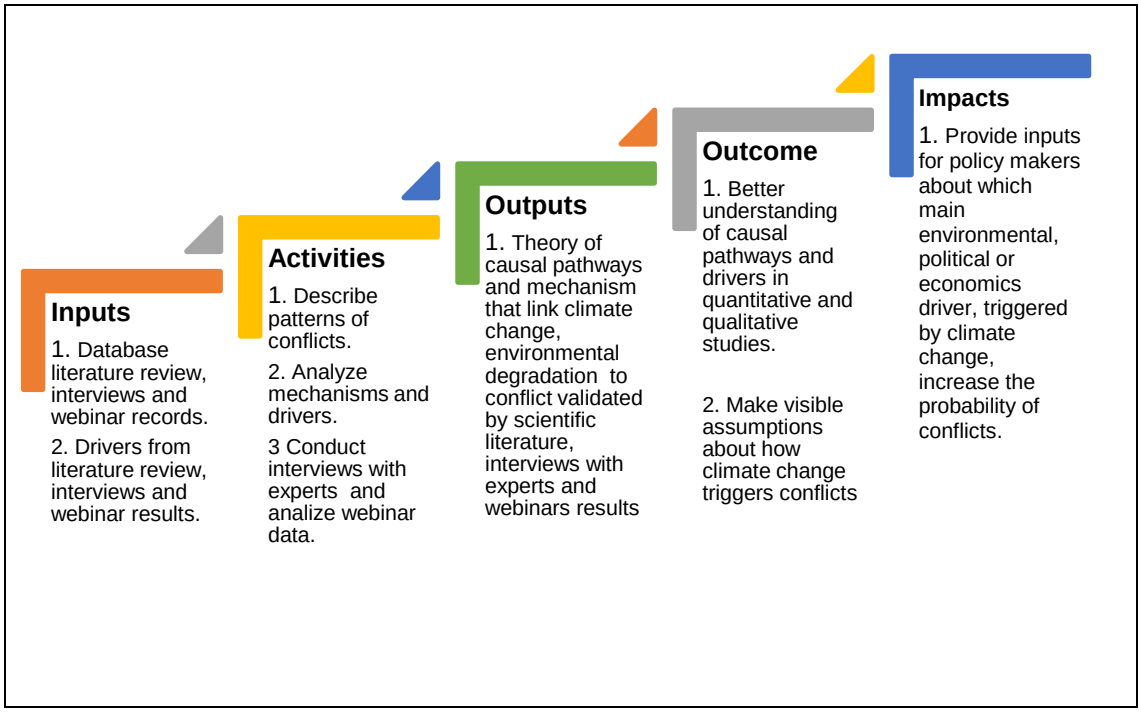
Campbell Collaboration is an international social science research network that produces policy-relevant evidence and systematic literature reviews. https://www.campbellcollaboration.org/what-is-a-systematic-review.html

[19] https://kateto.net/

Table 3. Drivers from the systematic literature review

Category	Driver
Natural Resource Scarcity	*Natural resource scarcity*
	Water scarcity
	Pasture scarcity
Natural Resource Degradation	*Depletion and degradation*
	Pollution
	Erosion
	Deforestation
	Ocean acidification
Climate Change and Weather Variability	*Temperature anomaly*
	Climate oscillation
	Precipitation anomaly
	Rainfall changes
	Hot temperatures/heatwaves
	Ocean, land, air warming
	Sea Level Rising
Natural Hazards	*Natural Hazard*
	Drought
	Floods
Climate Change Adaptation & Mitigation Measures	*Mitigation measures*
	Adaptation measures
Economic variables	*Commodity price*
	Economic shock
	Production costs
	Economic Development/Index
	Industrial production
	Unemployment
Agricultural variables	*Agricultural production costs*
	Agricultural outputs
Marine and Aquacultural variables	*Marine primary productivity*
	Marine fish stock
Population variables	*Overpopulation/overcrowding*
	Poverty
	Demographic variables
	Food insecurity
Inequality	*Inequality*
	Income Inequality
	Land ownership Inequality
	Gender inequality
	Fragmentation of society
	Migration & Displacement
Institutional variables	*Weak governance/Failing institutions*
	Poor infrastructure
	Democratization
	Adaptive capacity
	Fragile state-citizen relations
	Access to public and social services
	The prior existence of a conflict.
Psychological and Behavior incentives reasons	*Stress and Aggressiveness*
	The opportunity cost of being violent
	Increasing in social interaction
Biological reasons	*Neurotransmitters*
	Hormones

Figure 4. Layout theory of change



Working Hypothesis

1. Climate change drivers such as water scarcity or land degradation and climate-specific environmental degradation patterns are “thread multiplier” of conflicts.

2. Traditional drivers of conflict interact with environmental drivers. However, these conventional drivers, such as economic shocks, political conditions, are the leading causes of conflicts.

Results

I present my results in four sections. In the first section, I show some statistics facts from the systematic literature review. I identify the discussion among principal authors, their common topics, and shared understandings. I also identify what critical points and lines divide their conclusions. In the second section, I study which drivers, causal mechanisms, and pathways have been found in the literature and cluster them to analyze climate change, environmental degradation and conflict. I develop a chapter for each cluster. In the third section, I analyze the information collected from webinars and interviews and contrast it with the systematic literature review's main findings. Finally, I show my theory of change visualization.

Systematic Literature Review Statistics

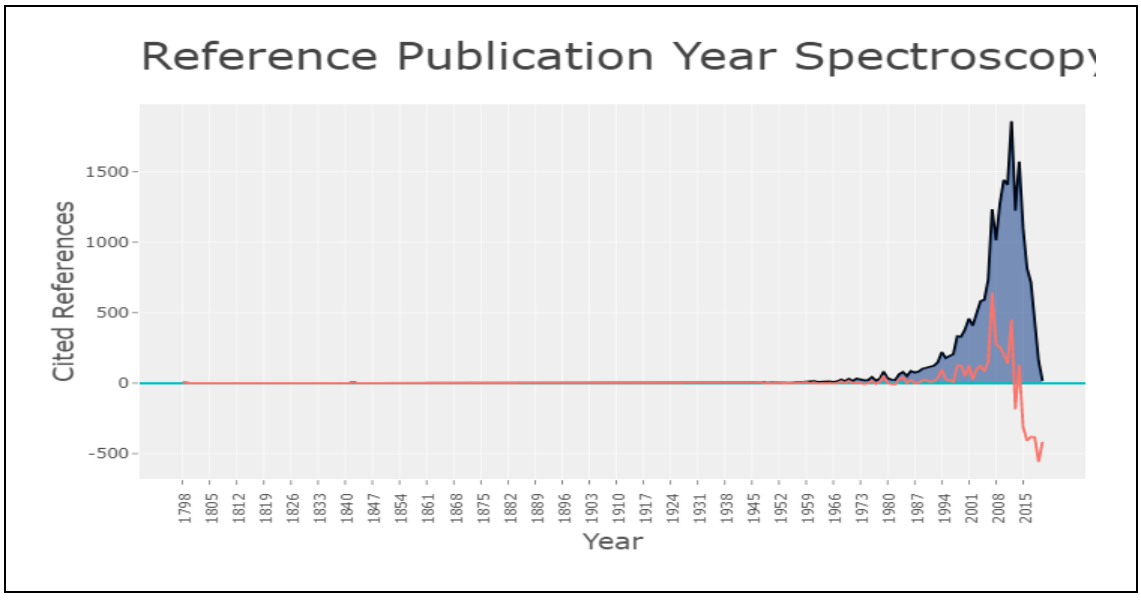
Table 4 shows some descriptive statistics of the data, including journal sources, citation per document and year, keywords from articles, and collaboration among authors. I mainly based

my analysis on those descriptive statistics to draw some relevant facts regarding the historical trends and current discussion in the climate and conflict research agenda.

Table 4. Descriptive Statistics

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2010:2020
Sources (Journals, Books, etc)	164
Documents	313
Average years from publication	4.21
Average citations per documents	31.88
Average citations per year per doc	5.009
References	19661
DOCUMENT TYPES	
article	270
conference paper	2
editorial	1
note	1
review	39
DOCUMENT CONTENTS	
Keywords Plus (ID)	1137
Author's Keywords (DE)	643
AUTHORS	
Authors	627
Author Appearances	865
Authors of single-authored documents	83
Authors of multi-authored documents	544
AUTHORS COLLABORATION	
Single-authored documents	100
Documents per Author	0.499
Authors per Document	2
Co-Authors per Documents	2.76
Collaboration Index	2.55

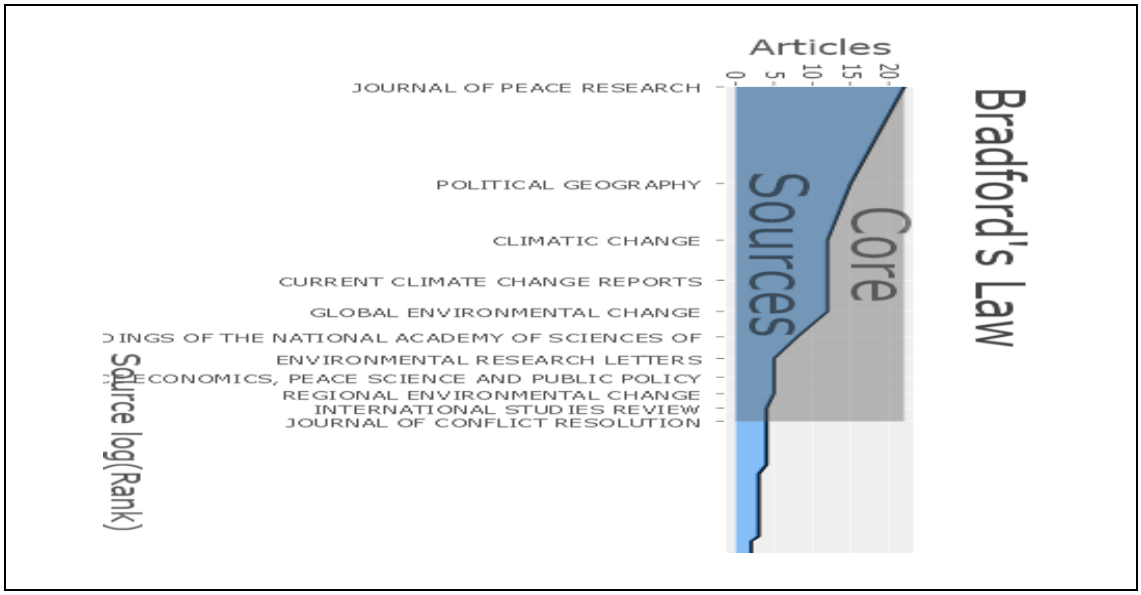
Figure 5. Cited references per year from articles selected.



The oldest reference is Malthus' book "An essay on the principle of population," published in 1798. In his book, Malthus stated that the population exponentially grows while resources do it at an arithmetical ratio. Hence, the initial success on food production productivity leads to population growth, especially among the poorest, which boosts famine. Figure 5 traces back the cited references using the publication year.

The burgeoning literature between climate, environment, and conflict explodes from 1997 to 2007 (Redline –figure 5- shows deviation from the 5-year mean) because of investigations from (Miguel et al., 2004) and (Hauge & Ellingsen, 1998). The Environment, Scarcity, and Violence book from Homer-Dixon (Homer-Dixon, 1994) and the Nobel peace prize to Al Gore and the IPCC (2007) (Theisen, 2008) are also significant milestones. From 2010-2020, studies have been increasing at an annual growth rate of 11.61%. Few journals concentrate the majority of the publications on the topic: Journal of Peace Research (SAGE - PRIO) from Oslo; Political Geography from UK (Elsevier); Climate Change (Springer), and Current Climate Change Reports (Springer). (Figure 6)

Figure 6. Sources. Eleven journals publish about a third of the entire collection of 163 journals.



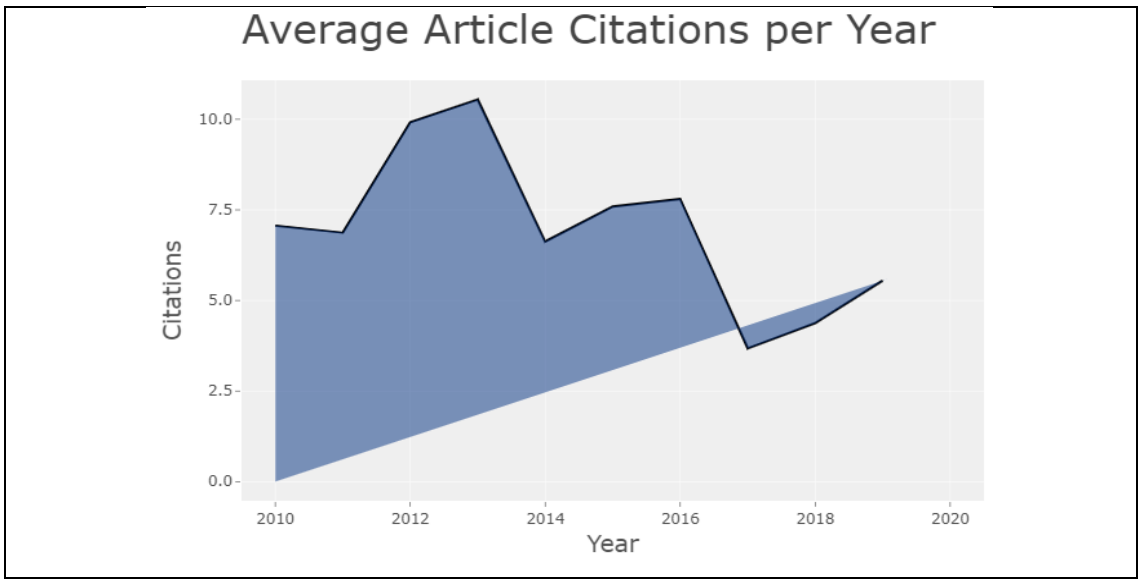
In Nature magazine., Hsiang et al. (2011) published one of the most important articles of the collection. They used climatologic planetary-scale phenomena El Niño and La Niña (ENSO) data from 1950 to 2004 as quasi-experiment. They investigated the probability of civil conflict onsets. Coding 'conflict onset' as the Armed Conflict Dataset of the Uppsala Conflict Data Program and the Peace Research Institute Oslo (UCDP-PRIO) records it. UCDP-PRIO sets a minimum of 25 battle-related deaths per year between government forces and another rebellious or partisan group. (Scheffran et al., 2012). They show that the likelihood of civil disputes arising throughout the tropics doubles during El Nino years relative to La Nina years (Hsiang et al., 2011). Leaving out African countries, they showed that results remain significant. By investigating ENSO, they avoided most critics regarding studies that use short-term climate variability as a proxy of climate change. Nevertheless, they acknowledge that long-term climate variability studies can be biased because several confounders mediate in the possibility of conflicts.

As shown in Figure 7, 2012 and 2013 have the highest average article citation per year. Milestone papers were published in those years. For instance, the special edition of the Journal of Peace Research made a crucial contribution by looking to disentangle causal chains between climate change and conflict. It includes some of the most cited articles (Figure 8) within the collection

analyzed, i.e. (Hendrix & Salehyan, 2012) (Raleigh & Kniveton, 2012) (Gleditsch, 2012). By 2012, most of the research focused on long-scale conflicts such as civil wars (Gleditsch, 2012) due to the UCDP-PRIO data's availability. Some other conflicts and patterns such as sea level rising and migration, urban conflict, or the melting of the Himalayan glaciers have received little attention. (Gleditsch, 2012).

However, new studies shed light on communal violence in Africa owing to new data sets. For instance, the Armed Conflict Location and Event Data (ACLED) provides information on communal conflicts. The Social Conflict in Africa Database (SCAD) includes information on low violence levels (Bernauer, Böhmelt, & Koubi, 2012).

Figure 7. Density plot average article citations per year.



Communal violence is often understood as an "ethnically based, small rural bands engaged in the violent contest" (Raleigh & Kniveton, 2012, p. 53). It is essentially collective violence in East Africa and the Sahel. Usually, it encompasses farmer-herder (pastoralist) events that sometimes escalate into insurgent activities. Raleigh and Kniveton (2012) found rebellion actions respond to either positive or negative rainfall variation. In contrast, communal conflict is more conflict-prone in wetter periods than in drier (Raleigh & Kniveton, 2012). Conversely, other authors found that only negative deviations in rainfall correlates with communal conflict, accentuated by ethnic divisions and poverty (Fjelde & von Uexkull, 2012). Besides, low-intensity intergroup conflicts such as riots, demonstrations, and strikes could be associated with water scarcity through rainfall shocks.

In 2013, Salomon Hsiang, Marshal Burke, and Edward Miguel (Hsiang et al., 2013), from Princeton and Berkeley, published in Science Magazine their paper "Quantifying the Influence of Climate on Human Conflict," the most cited article within the library and in overall (Figures 8 and 9). They carried out the most comprehensive meta-analysis to date of climate variability and different conflicts such as interpersonal, intergroup, institutional breakdown, and civilization collapse. Based on 60 "natural experiments" studies, they collected findings across several periods spanning. They found that "deviations, from normal precipitation and mild temperatures systematically increase the risk of conflict" (Hsiang et al., 2013, p. 1). Temperatures and intergroup conflicts (armed, civil, and communal conflicts) had a more massive effect rather than precipitation (rainfall) and interpersonal violence (assault, robbery,

homicide). They concluded that there is more agreement among studies about climate change's effects on human conflicts over time. (Hsiang et al., 2013)

Hsiang and Burke published another meta-analysis of 50 studies. Indeed, most studies analyzed conclude correlations between precipitation and temperature anomaly and conflicts. Consequently, they rejected the argument that causality between climate change and conflict can only see it when there is a complete causal chain of mechanisms (Hsiang & Burke, 2014). In its appendix, they proposed several mechanisms whereby climate change increases conflict: government capacity, labor market (opportunity cost of conflict), inequality, food prices, logistics, misattribution, psychological reasons, migration, and urbanization. Moreover, a replication of the Hsiang et al. (2013) article shows robust results. It provides little evidence that adaptation measures have diminished conflicts. The authors used a difference in difference approach to exploit the fact that in 1989, the first forecasting of ENSO was published to create a control and treatment group of adaptation mechanisms (Hicks & Maldonado, 2019).

Figure 8. It measures the number of citations a document has received from articles included in the systematic literature review

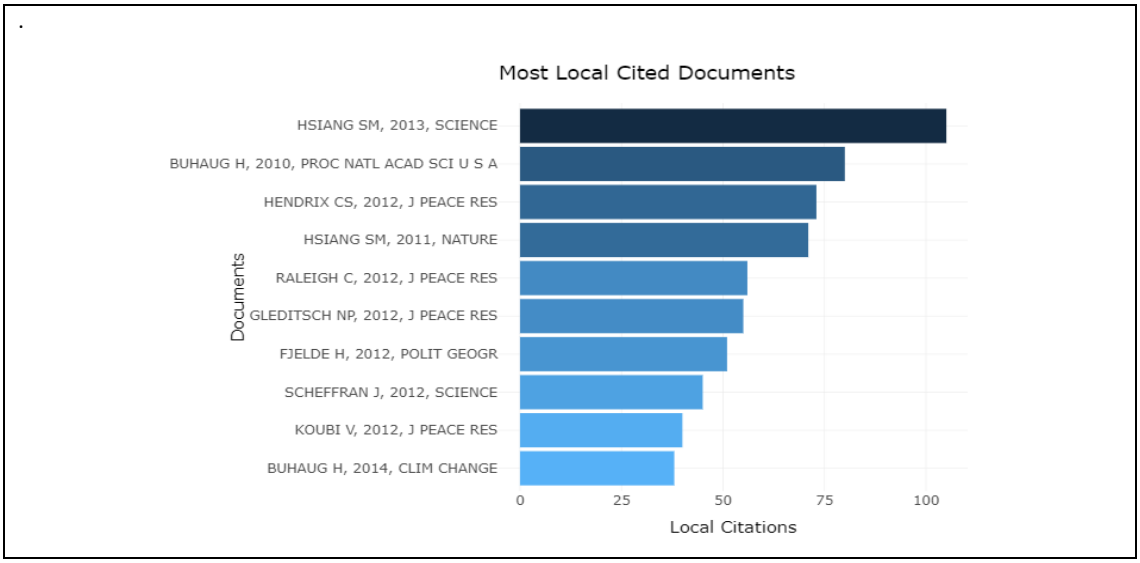
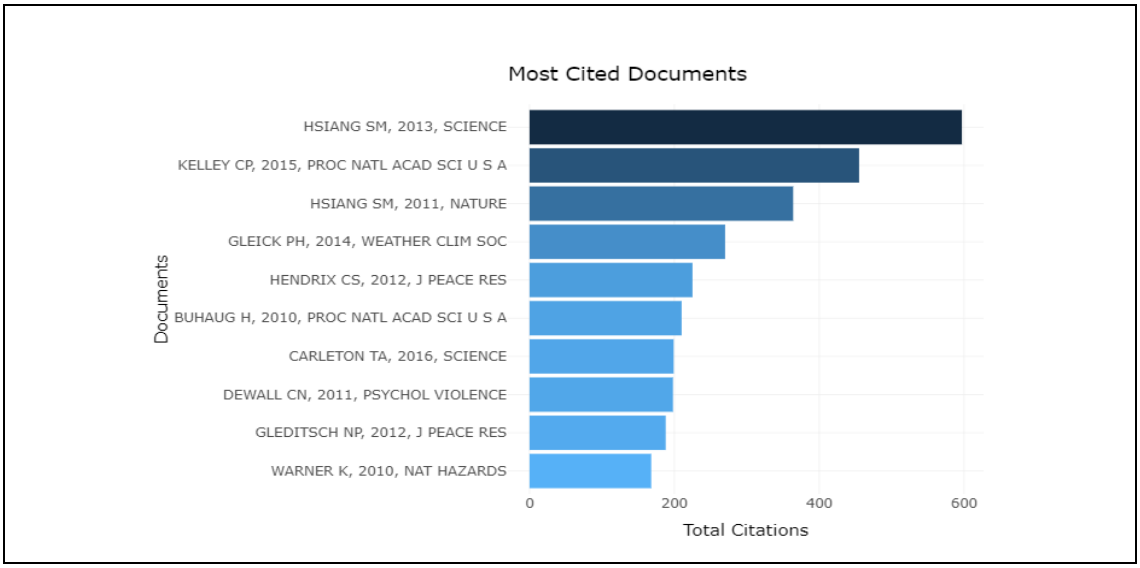


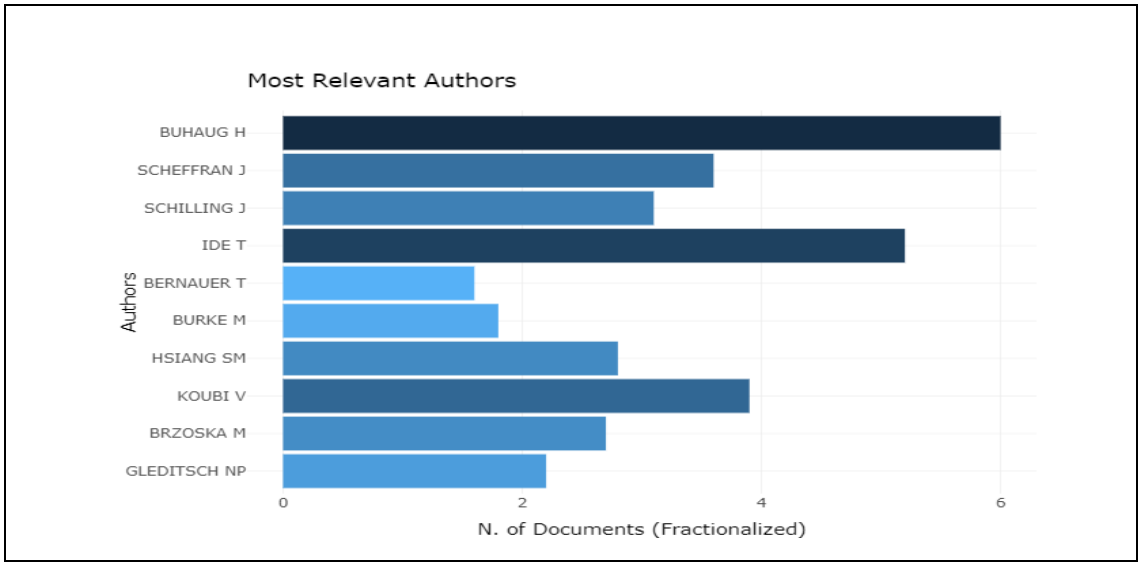
Figure 9. It shows the citation a document has received in the overall Scopus Database from 2010 – 2020.



However, frontline authors (Figure 10) such as Buhaug; Koubi; Theisen; Bernauer; Feldje; Gleditsch; Scheffran; Schilling; Urdal, and; Uexkull criticized the meta-analyses done by Miguel, Burke, and Hsiang (Hsiang & Burke, 2014) (Hsiang et al., 2013). The authors updated and replicated meta-analysis results, finding no quantification of the average effect of climate on violent conflict. (H. Buhaug et al., 2014)

They increased the analytical consistency and representativeness of Hsiang et al., (2013) paper. Nevertheless, they found that causal pathway problems remain mostly unaddressed. For instance, the sample of intergroup conflict using in Hsiang et al. (2013) investigation covers a wide range of conflicts, "from non-violent urban riots to major civil war; a wide range of climatic events, from heatwaves to global ENSO cycles and; a wide range of spatial scales, from municipalities to the entire world." (H. Buhaug et al., 2014, p. 393) They stated that unlike meta-analyses of medical treatment studies, which are based on similar individual-level investigations from independent samples, climate and conflict meta-analysis "bundle together partly overlapping observations at different spatial and temporal scales in an inconsistent and atheoretical fashion." (H. Buhaug et al., 2014, p. 395). In reply to H. Buhaug et al. (2014) critics, Hsiang, Miguel and Burke reported that even if there is a strong correlation between data across studies, in (Hsiang & Burke, 2014) and (Hsiang et al., 2013), results remain significant. (Hsiang et al., 2014).

Figure 10. The fractionalized frequency index assumes an individual author's contribution to a set of papers is uniform through all co-authors at each document (Aria & Cuccurullo, 2017).



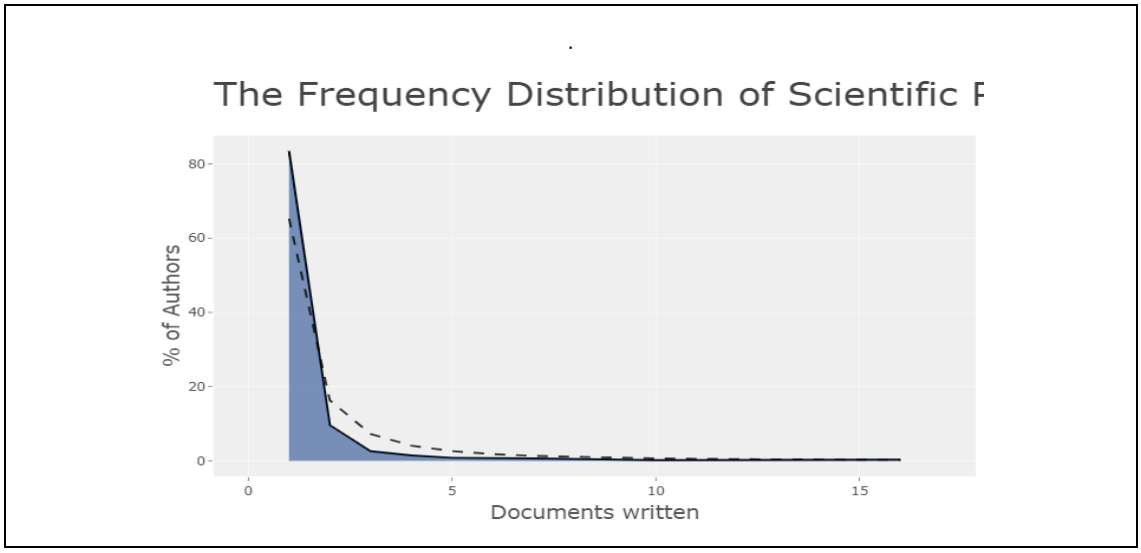
As of 2015, Hsiang, Burke, and Miguel (2015a) did a new hierarchical meta-analysis of 60 articles. They left out studies that analyze civilization collapse because it avoids checking for exclusions used as confounders. Also, they left out cross-sectional studies that use social variables such as income or political stability as controls (inadequate control theory). They insisted that understanding every mechanism is not essential for taking action; therefore, humanitarian organizations can act over forecasts without understanding all the underlying mechanisms (M. Burke et al., 2015a). Furthermore, the authors identified some drawbacks from empirical studies. For instance, cross-sectional studies do not take into account the differences between countries. Some studies that use climate variables as instruments are not instrumental variable approaches. Climate events affect many socioeconomic outcomes that fuel conflicts such as income, human health, and migration. As a result, they assert that the best way to address this relationship is through panel data. Using time-series data, research can follow the independent

variable across time while controlling unobserved time-invariant confounders (country-fixed effects) and time-variant confounders (country-specific trends).

Carleton et al. (2016) used the same approach as Burke et al. (2015a). They concluded a strong link between climate variability and conflicts. They acknowledged that quantitative studies' principal challenge is separating "the causal effect of climate from all other complex and interacting drivers of conflict, such as economic hardship, social norms, and political institutions" (Carleton et al., 2016, p. 490). They identified two causal pathways: a) climate shock reduces productivity. The latter lowers the opportunity cost of conflict and b) when temperatures rise, serotonin levels fall, inducing people to disputes. Low levels of neurotransmitters are associated with aggressiveness. Moreover, they introduced adaptation expected patterns as an ameliorating effect in projections of conflicts. Both Miguel et al. (2015) and Carleton et al. (2016) call for a better understanding of causal mechanisms that link climate change and conflict to identify potential adaptation pathways.

Figure 11 shows that debates regarding climate change and conflict are highly concentrated in those academics, albeit these relevant authors (Figure 10) represent less than 0.033% of the total authors. More than 80% of the overall 623 authors are occasional authors, with only one document published.

Figure 11. It shows the frequency distribution of scientific author productivity, based on Lotka's Law, which states the number of authors writing several articles, X's is a fraction of the number writing a single one



Consequently, I establish two subgroups of core authors. One that I call the USA school and the other one that I call the European School. Unlike Burke, Hsiang, and Miguel (USA school), who consistently find an association between climate variability and conflict (Baysan et al., 2019) or between mediate factors (M. Burke et al., 2015b); other core authors (European School) are cautious in their findings (Koubi et al., 2018)(Koubi, 2018a)(Koubi, 2018b)(Koubi et al., 2012) (Theisen et al., 2013) (Halvard Buhaug, 2016)(Halvard Buhaug, 2015)(Benjaminsen et al., 2012) (H. Buhaug et al., 2014) (Wischnath & Buhaug, 2014a) (Halvard Buhaug et al., 2015) (Gilmore et al., 2018) (Hegre et al., 2016) (Bernauer, Böhmelt, Buhaug, et al., 2012) (Von Uexkull et al., 2016) (Halvard Buhaug, 2010) (Wischnath & Buhaug, 2014b) (Böhmelt et al., 2014).

For instance, notwithstanding Burke conclusions (M. B. Burke et al., 2009), Buhaug's replication of that paper found that generic structural and contextual conditions explain better African civil

wars: widespread ethnopolitical exclusion, low national economy, and the collapse of the Cold War system are the most likely causes (Halvard Buhaug, 2010). The USA school responded by correcting some supposed mistakes in Buhaug's paper (Hsiang & Meng, 2014). A literature review of quantitative studies found that most of these studies primarily provided inconclusive insight into short-term climate/environmental change on armed conflicts. Authors left out studies that analyze hot temperature and aggressions because they are not related to the scarcity-conflict thesis, which is the standard analytical framework for intergroup conflicts (Theisen et al., 2013).

The USA school relies on statistical and individualistic-based-motivations to analyze either long-term or short-term precipitation and temperature variability. They focus not only on intergroup conflict but also on interpersonal conflicts such as crime or gangs (Allen et al., 2018). Regarding intergroup conflict, USA schools reckon that groups, like individuals, "have enduring motivations, attitudes, values, and beliefs" (DeWall et al., 2011, p. 248). Dewall et al. (2011) said that climate change is a significant risk factor for social disorder, eco-migration, and war, acting through different mechanisms. First, it directly affects aggressive inclinations by heatwaves and rising temperatures. Second, many environmental risk factors such as flooding, tropical storms, glacial melt, and drought result in food and water shortage. Lack of basic needs affects pre and postnatal nutrition that "increases the likelihood of a child growing up to be an aggression-prone adult" (DeWall et al., 2011, p. 250). Third, climate change will intensify civil disorder, political instability, and war, primarily by resource shortages that lead to eco-migration.

Conversely, the European school is more prone to analyze and differentiate the characteristics of intergroup conflicts. For instance, they reject the idea that civil strife can be merely explained by climate variability, eco-migration, and scarcity thesis. They also remark on the importance of understanding the pathways and contextual factors that lead to conflicts. Thus, they champion integrating qualitative studies as they enriched the research. Additionally, they accentuate the role of institutional factors, ethnic divisions, and inequality as the leading causes of conflicts.

For European Scholars, the literature is far from offering clarification about what kind of environmental change and conflicts are involved due to a lack of plausible explanations. There is no certainty about how, when, and which ecological variables interact with political and socioeconomic events, especially economic shocks and migration. (Bernauer, Böhmelt, & Koubi, 2012). For instance, by 2012, less research had been done on the role that played 1) adaptation and mitigation mechanisms (Work, 2019) and 2) vulnerabilities to climate change. Instead of prompting conflicts, some of these items will diminish risk or impulse cooperation (Scheffran et al., 2012). Scheffran et al. (2012) call for models based on complexity science, multi-agent systems, and social network analysis to understand the complex dynamics between climate change and conflict.

Figure 12 shows a tree plot that links the authors' affiliation, authors, and most crucial article's keywords. On the one hand, temperature, crime, and violence are positively associated with Hsiang and Burke's investigations. On the other hand, Africa, droughts, and vulnerability are related to authors affiliated to European conflict study centers such as Hamburg and Uppsala Universities.

Another way to show the different criteria that those authors have in order to evaluate climate change incidence on conflict is by a network of co-citations. Figure 13 demonstrates that Anderson, which developed a model to understand climate-aggression-crime patterns, is highly cited by Miguel and Hsiang. In contrast, Anderson's papers are barely cited by those who address conflict as intergroup clashes. Hence, there are few studies to look for addressing psychological variables in intergroup conflict studies.

Likewise, the concentration of this topic by country shows that the USA, Germany, Norway, UK, Sweden, and Switzerland are the most prolific scientific producer centers (Figure 14). However, only Germany and the UK show high international collaboration among authors. Hence, American scholars tend to investigate the climate – conflict relationship by themselves without cooperation with authors from other countries. This result is mainly because of the weight that conflict-crime scenario has across the USA.

Figure 12. Three-Fields Plot. Left Field: Affiliations. Middle Field: Authors. Right fields: Keywords

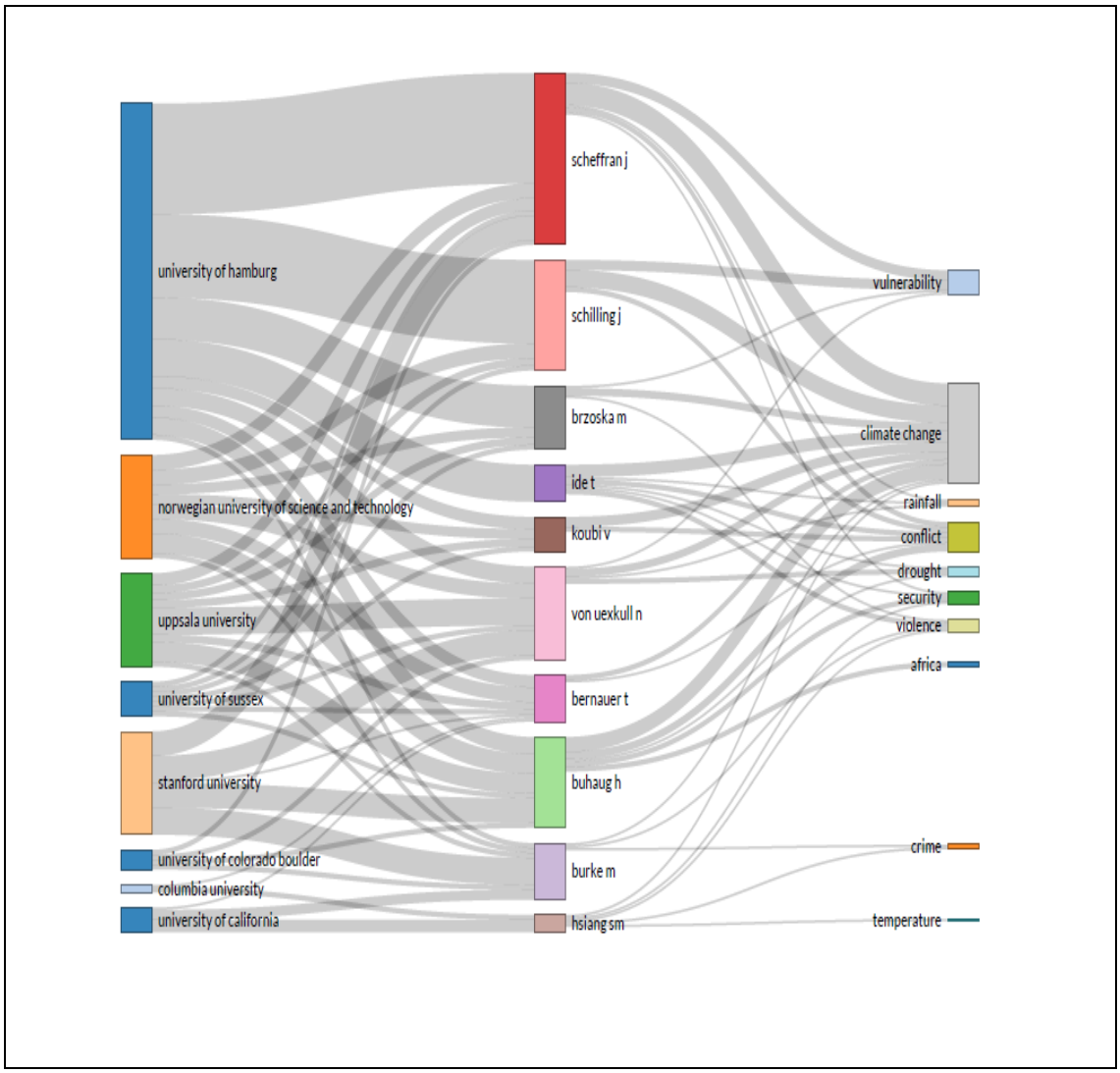


Figure 13. Author's co-citation network

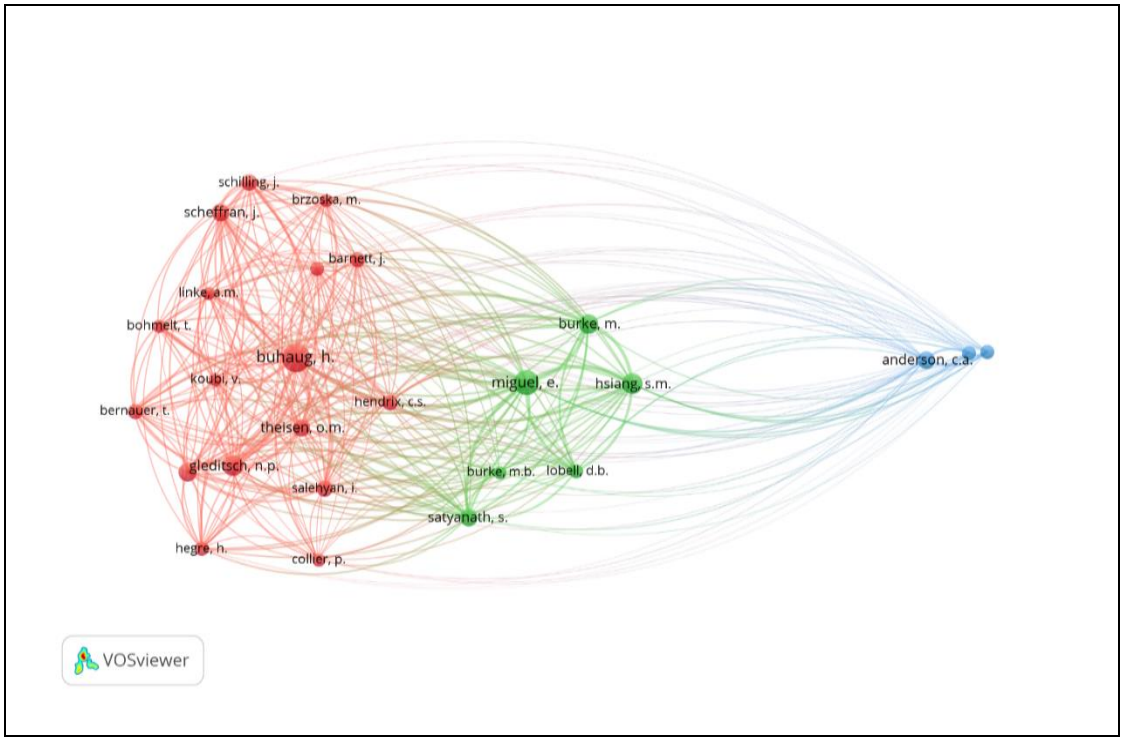
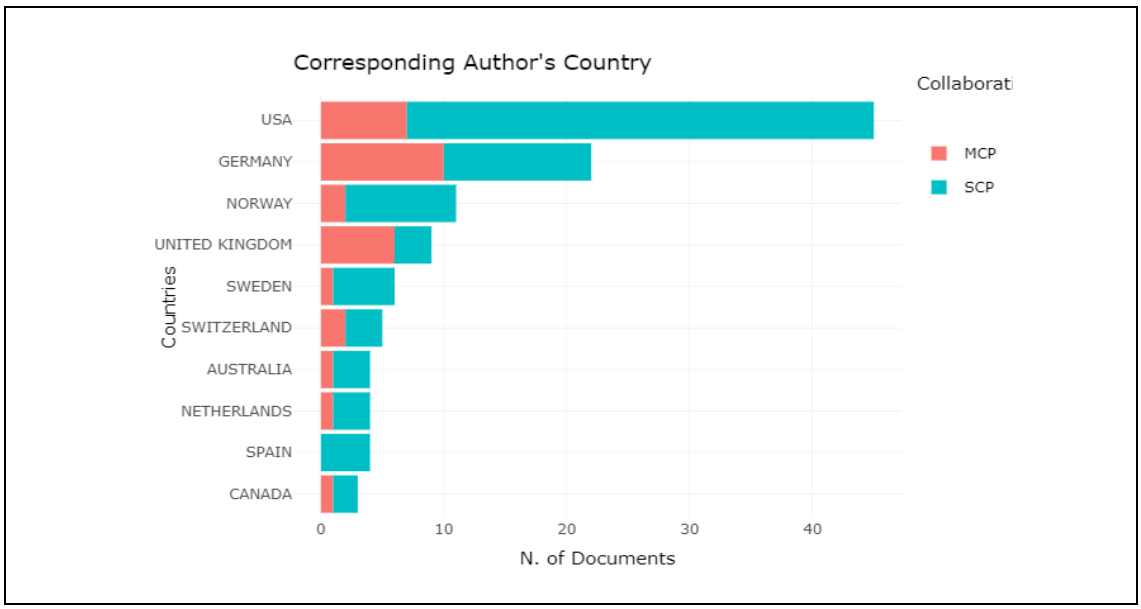
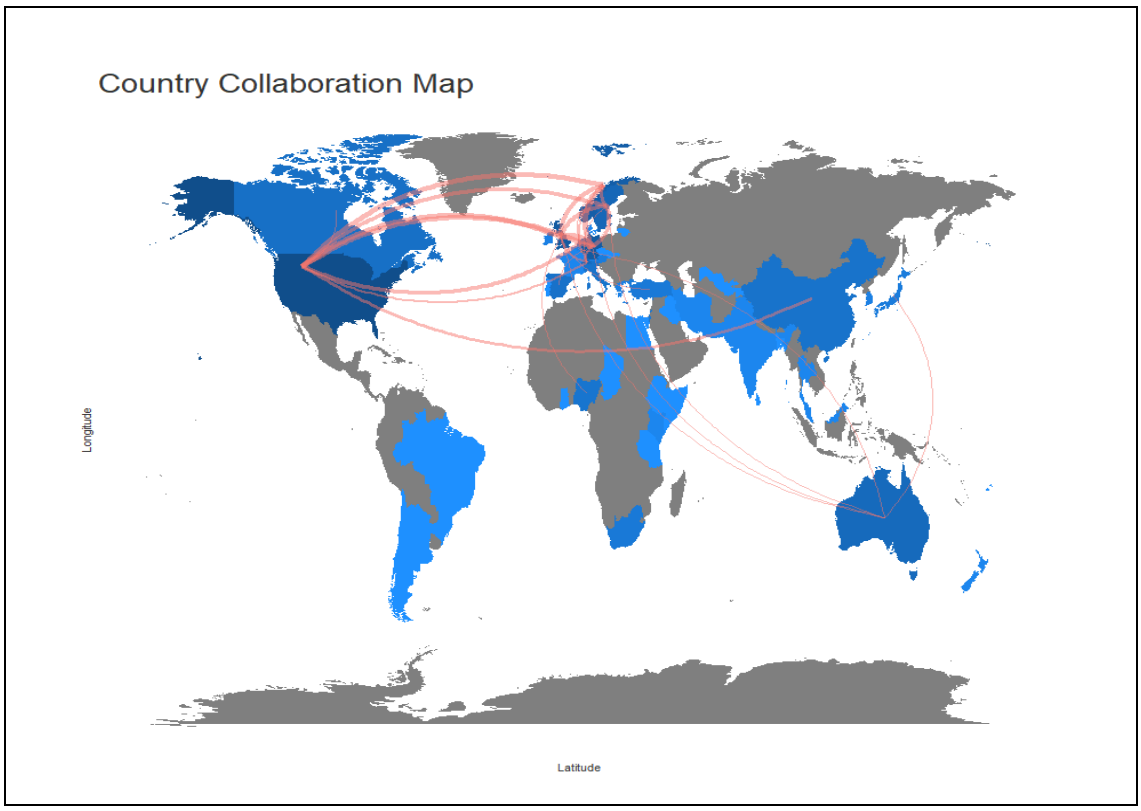


Figure 14. The graph shows a collaboration net among authors. MCP: Multiple Countries Publication. SCP Single Country Publication.



Institutions such as PRIO, Hamburg University, and the University of Sussex study the effect of environmental degradation and climate change, mainly in the global south. However, their collaboration net between authors and institutions is entirely developed in western countries. (Figure 15) Countries that can be seriously affected by climate change have few papers published in this area, i.e., Latin America, Africa, and Southeast Asia. Most of the funding sponsors are located in the global north: Norges forskningsråd, Deutsche Forschungsgemeinschaft, National Science Foundation, Army Research Laboratory.

Figure 15. The country collaboration map shows western countries have done most research.



Recently, some efforts were made to address the different criteria, lack of collaboration, and disagreement among core authors. In 2019, most prominent scholars, including Buhaug, Burke, and Scheffran, met at Stanford University to analyze how much climate change influences armed conflicts within countries. Experts used an expert elicitation method, employing semi-structured interviews. They concluded that variables such as socio-economic development, state capacity, inequalities, the prior existence of conflicts, among others, are more influential drivers of armed conflict. Climate change, whose mechanisms linked to battles remain in uncertainness, was puzzled out as less important. (Mach et al., 2019).

Main findings in the systematic literature review: Drivers, mechanism, and causal pathways

Scientists usually focus their attention on different topics of a given domain. By highlighting the different research agenda's themes, I show which topics have raised awareness from scientists and how the literature has developed through time. Also, I present the most important drivers, mechanisms, causal pathways, and the differences among scholars regarding how to address climate change, environmental degradation, and conflict issues. Figure 16 shows trends in the systematic literature review. As can be seen, the first year's authors focused on the resource scarcity effects on civil conflict and human security issues. Later on, studies turned to investigate the impact of agriculture shocks, especially in Africa, on different kinds of matches, not only armed conflicts. By 2016 and 2017, scholars concentrated on the relationship between temperature rise, migration, and conflict, particularly in the middle east. Finally, the last years have brought more studies on climate variability, aggression, and crime trends.

From qualitative case studies, the literature has turned into more quantitative studies. Quantitative studies category includes logistical and binomial regression methods, difference in

differences, instrumental variable and two-stage regressions, principal component analysis, geographically weighted regression, index variable clusters, conditional probability bayesian models, lab experiments and, quasi-experiments randomized control trial, among others. Most of the mixed studies include survey-based cases, qualitative comparative analysis, cascade event coincidence analysis, or studies that combine case studies with regression methods. Figure 17 shows studies by category in the literature.

Most of the research on climate change and conflict has been done in Africa, Asia, and the Middle East. Studies done in North America and Oceania are related to interpersonal conflict and criminal activities. Few studies have been done in Latin America. Figure 18 shows empirical studies done by region.

To draw some articles' patterns, I cluster them using bibliometric based on the article's keywords. Figure 19 shows clusters of items by colors using the factorial approach method. In bibliometric, the factorial approach is a data reduction technique that shows the proximity of corresponding words to a shared topic. For instance, keywords are close to each other if many articles use those keywords together. Keyword distant means a small number of articles treat those themes together (Aria & Cuccurullo, 2017).

Figure 16. Trend topics based on the article's keywords

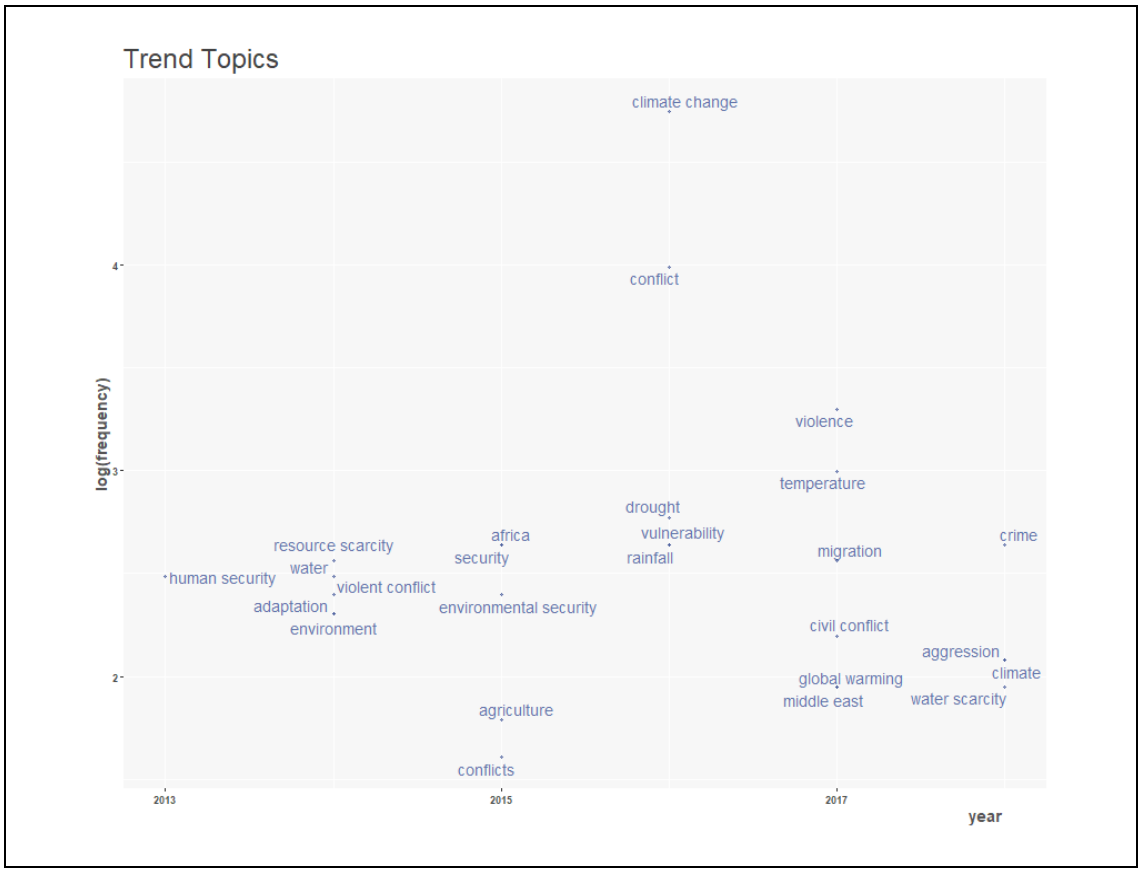


Figure 17. Type of studies

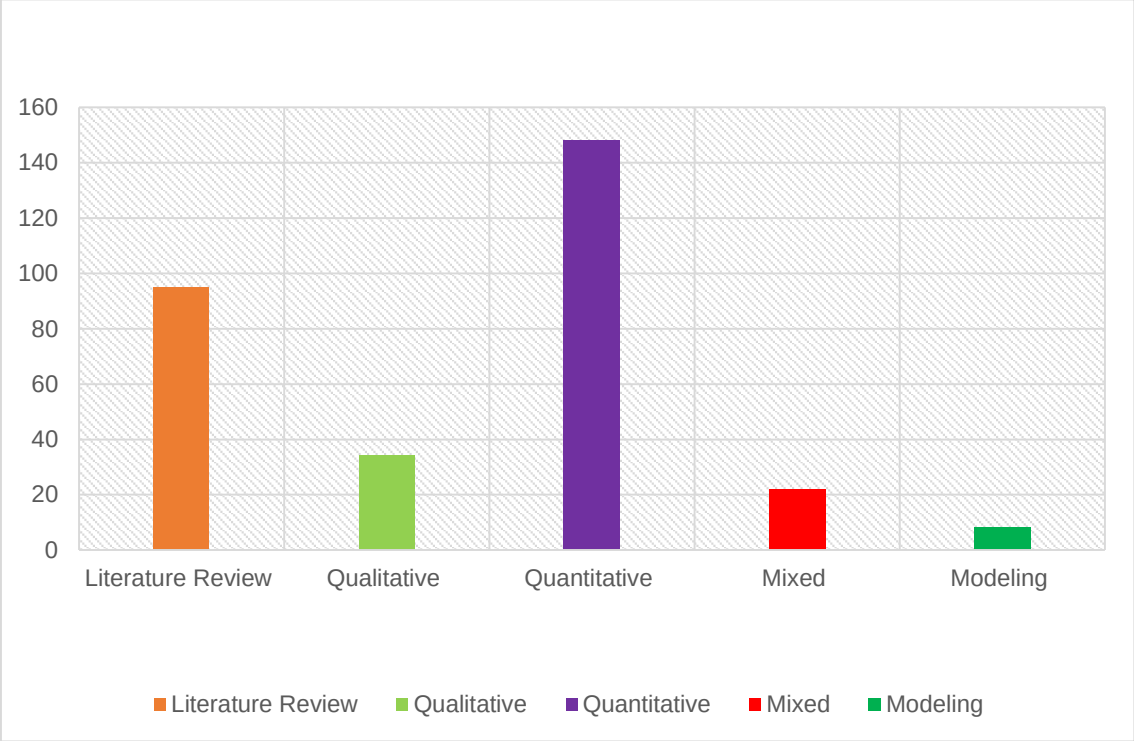


Figure 18. Chart of studies by region shows most research has been done in Africa and Asia

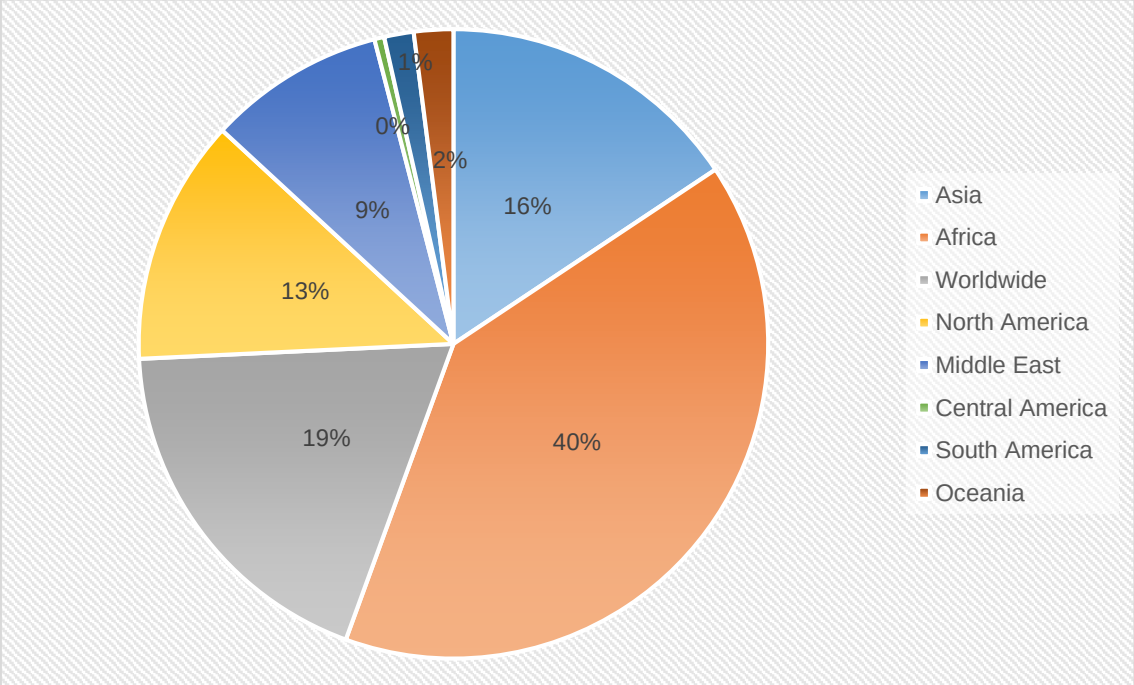
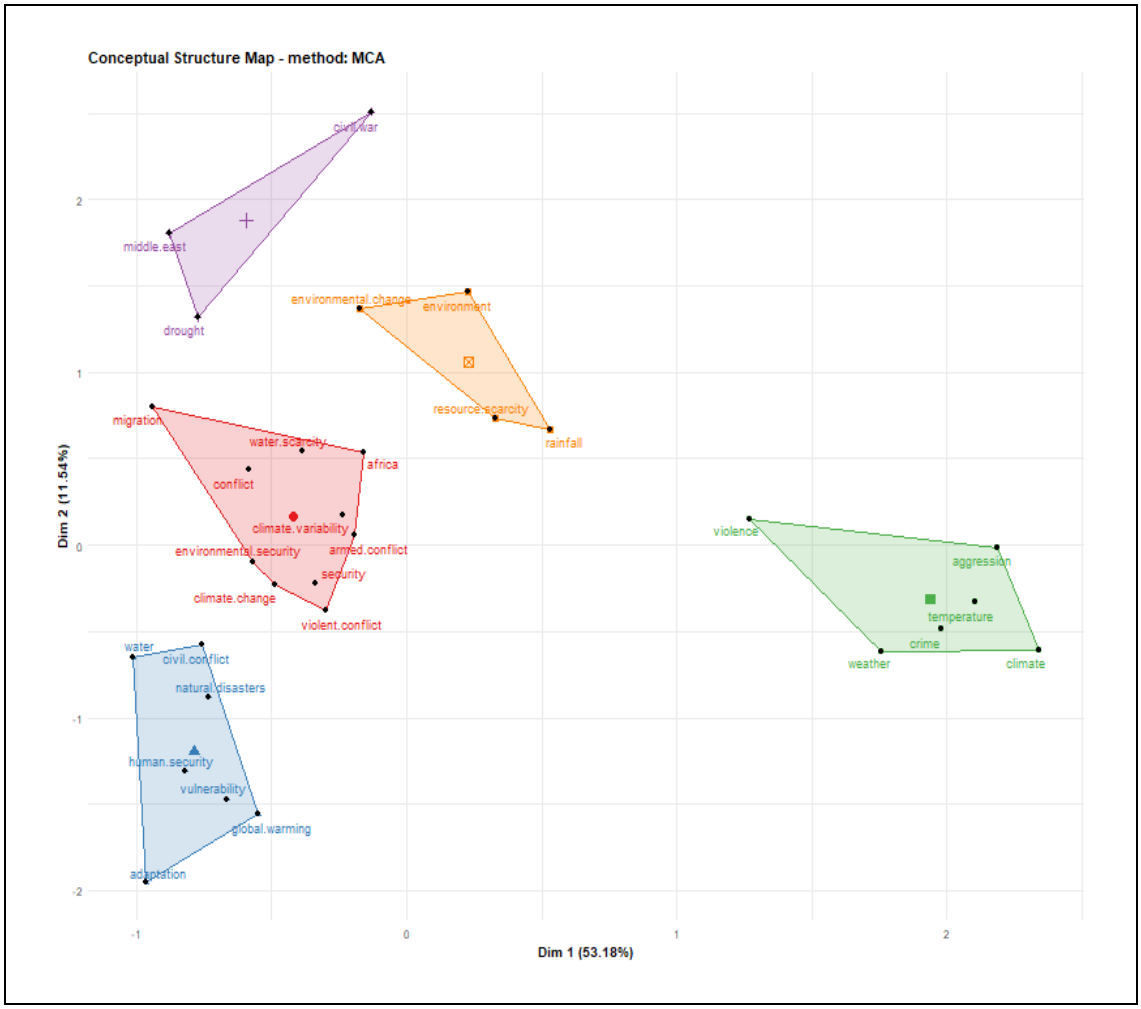


Figure 19. A cluster of climate-change conflict relationship by correspondence analysis

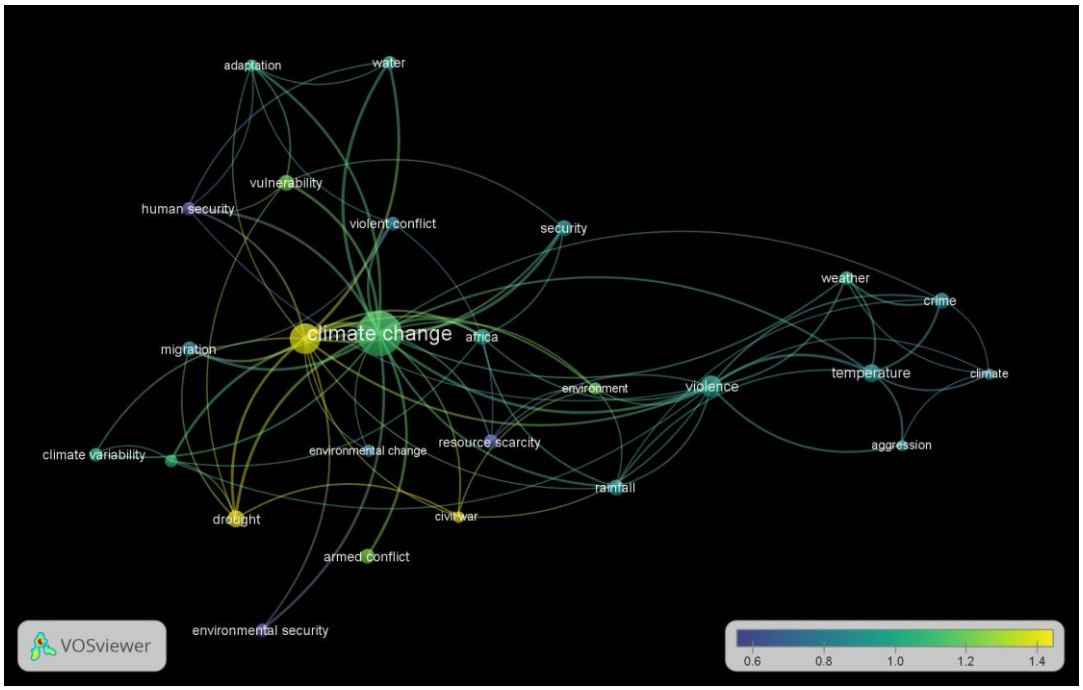


The first cluster (red color) is the closest to the origin (0,0). Therefore, it represents the research field's center (Aria & Cuccurullo, 2017). This cluster shows a broader pattern of drivers such as climate variability, water scarcity, and migration on high-intensity conflicts, especially in Africa. Those drivers have been wrapped up in the environmental security concept. The second cluster (violet color) shows the influence of natural disasters such as droughts on demonstrations and riot turning into civil wars, especially in the middle east, a region prone to water shortages. The third cluster (orange color) analyzes the effect of rainfall and temperature variability patterns on agricultural or economic shocks. The fourth cluster (blue color) merges water-related conflicts' effects on human security. Finally, the fifth cluster demonstrates the influence of weather and temperature on aggression behavior, which increases interpersonal and intergroup conflicts. As can be seen, this last cluster is far away from the others. Hence, even when aggressive behavior entails intergroup conflict, most scholars understand those events as different phenomena.

In figure 20, I use a network approach based on Vosviewer. The network approach shapes a web of co-occurrences interrelations. The circle's size is determined by the item's weight (van Eck & Waltman, 2013). The color bar shows a normalized average co-occurrence of cited keywords, from violet (less intensity) to yellow color (most intensity). Climate change and conflict are the most prominent circles and appear in the center of the graphic. In this case, four clusters were created. The first cluster shows a relationship between climate variability, droughts, civil protests, and conflicts, which unleashes migration. The second cluster shows a relationship

between rainfall changes and civil wars, especially in Africa, explained by the resource scarcity theory. The third cluster conflates water scarcity issues with conflicts affected by adaptation mechanisms, human security, and vulnerability threats. The fourth cluster is the same as a green cluster in the conceptual structural map. Unlike the conceptual structural map, the network approach provides less differentiation among clusters; only the crime and conflict cluster can be seen as a very different phenomenon.

Figure 20. A cluster of climate-change conflict relationships based on the network approach.



Those clusters are merely a taxonomy of themes in the literature and a way to address and classify drivers, mechanisms, and causal pathways; therefore, clustering is not a perfect classification. It mainly depends on the intertwined pathways and mechanisms between climate change and conflict and its technique. As can be seen from Figure 18, some different patterns were drawn from Vosviewer. In the next section, I use my analysis from Bibliometric clusters to describe the main drivers, mechanism causal pathways found in the systematic literature review.

Climate change, armed conflicts, and environmental security

Pathways from climate change to civil and armed conflict are described through resource abundance (Vesco et al., 2020), resource scarcity (Salehyan & Hendrix, 2014), and migration (Agnew, 2012) mechanisms. Some authors have proposed the environmental security framework to address those pathways. Environmental security may be defined as the intersection of environmental threats on national security (Allenby, 2000). Those authors stress the role that plays military and diplomatic bodies such as the UN security council to deal with the effects of climate change, environmental degradation, and armed conflict.

The “looting rebels model” explains that an abundance of lootable resources such as minerals and timber may lead to the onset/intensification of armed conflicts. Rebels can easily extract

those resources because they spread around broad state-uncontrolled areas and are produced by many small operators. Gold or silver flourishing mining resources lead to the Dutch disease (Vesco et al., 2020); that, combine with corruption, provoke conflicts. Oil production (Koubi et al., 2012) and wetter years (Hendrix & Salehyan, 2012) have positives effect on civil conflicts. Illegal crops "are the ones that most often led to civil war between 1990 and 2000." (Mildner et al., 2011, p. 166). Effects from abundance to conflicts are mediated by many factors such as economic growth and state capacities. The more economic growth due to resource abundance, the better state organization – other vital factors intervene - (Gizelis & Wooden, 2010); therefore, the lesser likely to happen conflicts (Mildner et al., 2011). For instance, high carbon fuel consumption levels reduced interstate conflicts during the European Industrialization onset. (Gartzke, 2012).

Climate anomalies and weather variability may increase civil war risk through economic shocks that lead to scarcity. Scarcity reduces the opportunity cost of engaging in a rebellion or lowering public revenues (Koubi et al., 2012) (Theisen et al., 2011) (Couttenier & Soubeyran, 2012). Positive temperature changes are linked to riots in areas with "immigration and fast (presumably migration-related) population growth." (Breckner & Sunde, 2019, p. 3). Eco-migration leads to crimes in unprepared migration areas because of preexisting social divisions, when migrants are economically deprived and stressed young males. (Agnew, 2012). Temperature extremes may cause civil conflicts in agricultural regions that experience out-migration and population loss. (Breckner & Sunde, 2019). Effects from scarcity to conflict are also mediated by economic growth and state capacities: a) The more economic growth, the more degradation occurs; therefore, scarcity emerges. b) However, economic growth strengthens states' capacity, becoming a mitigation factor of scarcity. For instance, in conflict regions such as in Afghanistan (Přívara & Přívarová, 2019) or in Israel and Palestine (Feitelson et al., 2012) (Tubi & Feitelson, 2019), droughts and floods interact with pre-existing migration patterns, and their effects are enormously depending on state responses. Refugees' flows show that asylum-seeking raises from unstable countries where conflict manifests as discontent towards climate change government responses (Abel et al., 2019).

In summary, both resource abundance and resource scarcity pathways seemingly show an inverted U-shape relationship with conflicts. This relationship is mediated by state capacities, economic growth, thereby implying non-linear effects. Nevertheless, some critics state that narratives linked civil conflicts through the resource scarcity lens underemphasize the role of more relevant causal pathways (Selby & Hoffmann, 2012). Moreover, climate-migration patterns are inconclusive. The over-estimation of climate-migration patterns may lead to xenophobic behaviors towards refugees. Overall, effects from climate change and environmental degradation on civil or armed conflict are still highly doubtful (Theisen, 2012) (Slettebak, 2012) (Mach et al., 2019) because of multiple and deeply intertwined linkages (Hermans & Ide, 2019) (Backhaus et al., 2015). Finally, environmental security as a framework is still a vague concept among scholars[20] (Homer-Dixon, 2001). Frame environment problems as national security problems entangle some drawbacks that justify political and military

[20] In that talk to the question "PRB: Do you have a working definition of the term "environmental security?" Homer-Dixon said: "No. I avoid that term because I think it is too open to misinterpretation. My research has focused on the relationship between environmental stress and specific kinds of violence — insurgencies, ethnic clashes, and rebellions in particular. Environmental stress we define in terms of the environmental scarcity that arises from ecological degradation, population growth, or skewed access to natural resources. But I have stayed away from trying to define "environmental security." You can define security however you want, and I find that attempts to redefine or expand our concept of security often leave you with a term that is so broad that it is not very useful."

interventions. Hence, we should be more concerned with inequalities that systematically restrict access to renewables and non-renewables natural resources (Deligiannis, 2012) rather than focus on climate change as a threat to states' stability (Elliott, 2015).

Natural disasters and civil uprisings.

According to the emergency events database (EM-DAT), natural disasters affected around 187 million people worldwide (Busby et al., 2013) from 1999 to 2010. Climate changes will undoubtedly increase the number of natural disasters that may harm food security (Koren, 2018).[21] Floods, surges, cyclones, and severe storms may harm economic growth regardless of population size and regime characteristics (Bergholt & Lujala, 2012). Droughts alongside a high-density population may stimulate individuals' propensity to engage in disruptive activities and aggressive behaviors. (Feizi et al., 2019). Moreover, droughts, measure through the Palmer severity index of droughts (PDSI), upsurge local food prices (Raleigh et al., 2015), and lessens cereal yield. However, those effects do not immediately transmit income and civil unrest (Couttenier & Soubeyran, 2012). Finally, climate-related natural disasters may increase "the risk of riots and politically motivated violence, but that the effect hinges on levels of development" (Slettebak, 2013, p. 261). At high development levels, riots become likely, whereas political violence falls. Urban populations correlated with literacy rates are highly vulnerable to riots, whereas rural areas to political violence. When literacy rates go up, the likelihood of post-disaster riots rises. Conversely, when literacy levels are lower, politically motivated conflicts increase. (Slettebak, 2013).

Syria's conflict is the most analyzed case study of Arab Spring unrest, caused partly by basic unmet needs (Schilling et al., 2020) that turn into a civil conflict. Syria's conflict was mediated by migration and political instability patterns (Caruso, 2017) (Fröhlich, 2016)(Karnieli et al., 2019)(Selby, 2019)(Ide, 2018) (Selby et al., 2017) (Feitelson & Tubi, 2017) (Gleick, 2014). Kelley et al. (2015), the second most globally cited article in the literature, used three different datasets and 16 Coupled Model's Representative Concentration Pathways Intercomparison Project CMIP5[22]. They show that greenhouse emissions caused the most severe drought in the greater Fertile Crescent (2006/2007). Syria's drought caused the migration of at least as many as 1.5 million people from rural to urban areas, putting much pressure on social variables that underpinned Syria into war. (Kelley et al., 2015). Nevertheless, prominent critics of Syria's climate-conflict approach (Selby et al., 2017) found that Syria's migration process was due to the removal of government subsidies and economic liberalization. The pre-civil war agrarian crisis in Syria's northeast Jazira was triggered by water degradation, mainly because of social variables such as ineffective water management. (Selby, 2019). Indeed, winter-rainfed conditions and cereal production, before war onset, were good for Syrian farmers. The irrigation water scarcity and agricultural collapse in the regions were due to the Turkish policy of diverting the Euphrates, resulting in overexploitation of groundwater and reservoir. (Karnieli et al., 2019).

To sum up, natural disasters could increase the probability of riots and civil unrest by mainly some mediate factors: changes in income or economic shocks; internal migration; food insecurity; demographic and population characteristics, political fragmentations and, level of

[21] Food security encompasses four pillars: Availability (calories needs per person and calories available), Access (market infrastructure and individual access per day), Stability (food imports, price variability, and irrigation land), and Utilization (wasting, stunting, and indicators of calories use in diet) (Martin-Shields & Stojetz, 2019).

[22] https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip5

development. The most common pathway wherein climate change would increase riots and protests is through food prices. Even though the literature has found an association between natural disasters on food prices and riots, those subsequently effects on civil conflicts are doubted (Natalini et al., 2015). Finally, the Syrian conflict is the most remarkable example of an environmental and climate-induced civil uprising turning into a civil conflict. Yet, conclusions are contested. From a political-ecological perspective, overemphasis on drought as the leading cause of Syrian conflicts blurs responsibility from atrocities made by Assad's regime.

Climate variability, agricultural or economic shocks, and violent conflicts

As shown in the first cluster, climate change results on civil and armed conflict are highly contested. However, new researches have studied climate change and weather variability effects via economic and agricultural shocks on other kinds of intergroup conflicts such as communal conflicts, political and religiously motivated, and violent conflicts. Economic shocks also link climate variables to interpersonal conflicts such as intimate partner violence (IPV). A common causal pathway goes from climate variability, poor harvests in rainfall-dependent agricultural countries to economic shocks (Wischnath & Buhaug, 2014b) (Keels, 2019). Hence, Sub-Saharan Africa is once more the most represented area of study because its agricultural production builds exceedingly upon rainfall (Fjelde & von Uexkull, 2012) (Devitt & Tol, 2012). In rain-fed agrarian societies, economic shock effects are highly dependent on different variables. (1) Inequalities such as uneven land distribution that contributes to land invasions (Hidalgo et al., 2010); (2) the existence of prior conflicts and weather links (van Weezel, 2020); (3) alternative sources of water availability such as groundwater and glacial runoffs (Pritchard, 2019); (4) institutional factors such as extensive irrigation and canal systems (Pritchard, 2019); (5) individual perception of conflicts (Bakhsh et al., 2020); (6) prior living conditions (Vestby, 2019) (7) democratization levels and; (8) demographic variables such as gender, among others. For instance, rainfall shocks could increase reported physical (IPV) risk towards women, especially among adolescent girls and unemployed women. Droughts may reduce agricultural production, food supply, and savings, leading to shocks on household income, which is negative associated with male stress. (Epstein et al., 2020).

Nevertheless, some studies done in Asia, which has the highest conflict rate per country, are at odds with agricultural and economic shocks. (Wischnath & Buhaug, 2014a). Indeed, some argue the claim that climate variability affects economic growth has no support unless a non-democrat regime is mediated in this relationship (Koubi et al., 2012). Another study found that little evidence lends to this relationship even conditional on income or political regimes. (Klomp & Bulte, 2013). The collective, temporary and random nature of the income loss due to droughts may trigger cooperation, less aggressive behavior, and even strengthen social norms between intimate partners. (Cools et al., 2020)

In conclusion, most of the studies analyzed in this section rely on econometric approaches to study climate change and weather variability patterns in rain-fed dependent societies. Rainfall data allow researchers to avoid endogeneity. It is a widespread problem that causes reverse causality or unobserved confounding factors. However, some critics can be done to these models. First, "the model's complexity is further increased because climate change - the increased concentration of carbon dioxide and other greenhouse gases in the earth's atmosphere—does not only lead to environmental scarcity" (Meierding, 2013, p. 189). Second, most of the casual links on climate effect on conflict lent arguments from civil war literature based on Collier and Hoeffler's study, emphasizing economic measures such as changes in per capita income, employing this variable as an intermediate factor. Indeed, predicting climate change effects on economic variables is high uncertainty because those effects on national or

household income and agricultural output depend on a myriad of socio-economic factors. As shown in climate and environmental motivated civil unrest, the interaction with climate variables is heterogeneous. Hence, in some cases, results are contested.

Water conflicts, human security, and vulnerabilities

Water-related conflicts have been a preeminent study topic in climate change and conflict areas. Most of the literature focuses on interstate diplomacy and transboundary water conflicts.[23] Nevertheless, some academics undertake studies regarding low-intensity, either violent or non-violent water-related disputes, especially in Sub-Saharan Africa and the Middle East and North Africa Countries (MENA). For instance, pastoralists are positively affected by water scarcity that leads to cattle rustling in East Africa (Butler & Gates, 2012). Water shortages in South Sudan led to increasing crop failure and shrinking pasture availability, causing forced migration for cattle herders to locations with more abundant pastures (Knight, 2013). Furthermore, North Africa's water availability has worsened (Schilling et al., 2020) due to Its agricultural sector, whose production takes 80% of freshwater. Therefore, that region is highly susceptible to water conflicts through to food insecurity. (Schilling et al., 2012). In MENA countries, climate change acts in combination with many variables: (a) grown population, (b) water mismanagement, (c) lack of groundwater access (Döring, 2020), (d) political instability (Sofuoglu et al., 2020), and (e) ethnic marginalization.

However, it is unclear to what extend water conflicts respond to climate change and environmental degradation variables. Farmer-herders conflicts can be traced back to ethnic disputes (McNeely, 2011), colonial administration's policies (Mbih, 2020), and unequal distribution of resources (Walwa, 2020) in the Sahel and the Horn of Africa. Consequently, restricted mobility for pastoralists, political negligence, and rent-seeking, rather than climate change, are the leading cause of Sub-Saharan Africa conflicts. (Benjaminsen et al., 2012) (O'Loughlin et al., 2012). In scarcity time, people may show cooperative behavior (Bernauer, Böhmelt, Buhaug, et al., 2012), whereas violent livestock raiding occurs in wet seasons (abundance pattern) (Adano et al., 2012). Finally, political regimes play an essential role in explaining water low-insensitive conflicts. Counter-intuitively, non-violent water conflicts are common in democracies (Bernauer, Böhmelt, Buhaug, et al., 2012). In contrast, violent water conflicts are highly skewed to non-democratic regimes but infrequent. (Böhmelt et al., 2014).

Nowadays, scholars center on the human security framework. Human security is "the ability of human systems to respond to and mitigate the shocks or stressors from environmental changes" (P. B. Fisher, 2011, p. 296). Climate and socioeconomic variables yield either violent or non-violent conflicts (Busby et al., 2013). Poverty coupled with climate change destroys livelihoods and increases disease burden (Elliott, 2015) (Gleditsch & de Soysa, 2000) (Deligiannis, 2012). Ongoing conflicts can increase climate vulnerabilities. Hence, the vulnerability concept, as the amount of adverse risks that communities bear (Raleigh, 2010), is key to dealing with a) climate change effect exposures, b) the sensitivity to those effects – which depend on the political-economic context, the natural capital and, technologies available -, and c) the potential adaptive capacity to anticipate and respond to detected changes (Germond & Mazaris, 2019). For instance, vast areas in Africa, even though they face lower physical exposure to climate change than MENA countries, have the most significant vulnerabilities (Busby et al., 2013). Herders in Nigeria move to less vulnerable regions, diminishing conflicts in the native regions and increasing vulnerability in the hosted regions without conflict growing. (Madu & Nwankwo, 2020).

[23] I left out these investigations from the review since they address legal issues (criteria d)

In a nutshell, some academics broaden the framework to understand how climate change, natural disasters, and water mismanagement may cause communal conflicts or cooperative processes. It is essential to realize that low-intensive violent and not violent conflict is rooted in ethnic and political fragmentations. Conflicts are also accentuated by weak governance and fragile state-citizen relations. Scholars wrapped up all these variables in the human security concept rather than use an environmental security approach to understand how different vulnerabilities lead to low-intensity conflicts.

Weather, aggression, and crime

Heatwaves/hot temperatures and seasonal temperature increments could raise the number of interpersonal or intergroup conflicts through aggression[24] (Butke & Sheridan, 2010) (DeWall et al., 2011). Researchers have come up with some theories to explained that relationship: First, biological factors accentuate the role that the amygdala, hormones, neurotransmitters, and other thermoregulation mechanisms play in the heat-stress response, although few studies have tested this pattern, mainly because it requires lab experiments (Tiihonen et al., 2017) or randomized control trial (Younan et al., 2018). For instance, citing a study done by Wilkowski et al., in 2009, researchers showed that participants exposed to heat in a lab experiment were more likely to judge neutral facial expressions as aggressive (Miles-Novelo & Anderson, 2019).

Second, routine activity theory states that illegal activities are rooted in daily activities due to opportunity costs to commit crimes lessen in summers. In summer, people spend time outside (Anderson & Anderson, 1998). As long as owners do not keep an eye on their belongs, offenders look for their targets where "routine activities" occur. As a result, domestic, sexual, and robbery violent assaults increase in summers (Butke & Sheridan, 2010). Likewise, shootings are more likely to happen during weekends and holidays (Ruderman & Cohn, 2020) (Reeping & Hemenway, 2020). Third, the Negative Affect Escape Model state as temperature increases, aggression goes up until a reaching point, and then it decreases despite hotter weather. Aggression and temperature show an inverted U-shape relationship because people attempt to escape extreme temperatures, diminishing social interactions (Butke & Sheridan, 2010). For instance, daily mean ambient temperature shows a curvilinear threshold to daily rates of violent crime. (Gamble & Hess, 2012). Fourth, the General Aggression Model (GAM) emphasizes three stages in the aggression cycle as a consequence of personal and situation insights (personality traits); cognition, arousal and brain activity internal states (biological and cognitive traits), and outcomes of appraisal and decision-making processes (social traits) (DeWall et al., 2011). GAM was developed in laboratory tests to understand aggression as adaptive behavior that explain from intimate partner violence, crime to intergroup conflict. Fifth, Climate, Aggression, and Self Control Model (CLASH) highlights that cultures located in regions with colder climates and seasonal variation focus more on the future. In northern countries, people are more self-controlled and have a slower life history strategy than cultures in warmer climates (M Van Lange et al., 2017)(van Lange et al., 2018). All of those traits diminish aggression.

Even though there is a broad consensus regarding high temperatures' effects on criminality (Horrocks & Menclova, 2011), the channels through which temperature increases crime are still unclear. Some mediating factors such as unemployment, alcohol consumption (Otrachshenko et al., 2020), poverty, racial heterogeneity, residential mobility, family disruption (Jung et al., 2020), or neighborhoods with higher social disadvantage levels (D. Mares, 2013b) play a role in this relationship. However, most studies analyzed in the systematic literature review leave out

[24] Anderson and DeWall (2011) define aggression as a behavior that looks for harming another person who wants not to be harmed and violence as any aggressive behavior that produces physical harm.

controls and perform direct regressions from temperature or rainfall changes to crime based on cross-sectional data.

Furthermore, high temperatures in western countries are determined by seasonality. Hence, some studies have dismissed that high temperatures can account for the overall effect on crime without considering seasonal variation (Butke & Sheridan, 2010). For instance, criminal patterns "are not explainable by monthly temperature differences between areas, but seasonality and temperature variations do interact with each other." (McDowall et al., 2012, p. 389). This seasonality component affects the reliability (D. M. Mares & Moffett, 2019). A study found that warmer temperatures in the winter season affect crime. By doing so, the author isolates summer seasonality effects (D. Mares, 2013a).

Few studies have shown no relationship between climate factors and crime (McDowall et al., 2012) (Dong et al., 2017) (Lynch et al., 2020). It seems the temperature-aggression model is incapable of explaining the long-term pattern of homicide rates in tropical areas. (Pereira et al., 2016). However, those studies are remarkably fewer than those showing significance. Other studies innovate methods, such as forecasting criminality based on air surface temperature scenarios from CMIP6 (Harp & Karnauskas, 2020) or the number of crimes based on extreme weather events in one period coupled with clean water and food access linked to the average temperature in an early period (Barlett et al., 2020). Both studies found strong predictor patterns.

Overall, most of the studies analyzed in this section are heavily grounded on quantitative and econometric approaches and found a correlation between short-term temperature increments and heat waves on crime. The most common framework linked to temperature effects is the routine activities theory. Making distinctions between weather patterns and seasonal effects on crime is challenging. Likewise, few studies that link climate with biological stressors have been done up to date due to strict requirements.

Practitioner and Expert Opinions

This section presents the most critical results from Webinars data extracted and interviews done during my research. Regarding interviews, my interest in Dan Smith is due to his long experience as an academic at PRIO and practitioner at SIPRI. Likewise, Bruno Charbonneau, as an academic and Chitra Nagarajan practitioner, gave me some insights about critics of climate-security approaches. The main goal is to complement the systematic literature review information and understand how practitioners have experienced climate change effects on conflicts. These data help me bridge some knowledge gaps that I identified from the literature: 1) Scientific's and practitioner's agreements and 2) disagreements. 3) Lack of studies in Latin America, a region vulnerable to climate change and research opportunities. 4) Importance of finding causal pathways for humanitarian and governmental action. 5) critics of climate-conflict approaches.

Webinars and Interviews

I summarized the most critical insights from Webinars and Interviews shown in Table 5, according to knowledge gaps identified, as it follows:

1) Academics and practitioners agree on 1.1) climate change will have significant effects on food systems, mainly droughts impact on crop failures and migration. These patterns probably will worsen due to the loss of biodiversity. Food systems and agricultural output are vulnerable to different variables, making it difficult to find causal pathways. 1.2) Finding causal pathways depends on the specific political and economic contexts such as institutional failures, lack of public goods, and prior grievances, as in the Yemen conflict (Weiss, 2015);

2) Academic and practitioners disagree on the role of resource scarcity theory. Practitioners, especially those who work on climate security issues, are more likeability to trust Malthusian theories such as competition for scarce resources. Academics still debate on that. The European school's academics have profoundly criticized resource scarcity theory on climate-conflict links;

3) Practitioners, especially those who work in humanitarian and governmental organisms, believes that it is not so relevant to find completely causal pathways or causal chain mechanisms to address interventions, a common ground shared with USA school scholars; therefore, it is better to map out drivers to inform which can be the most feasible triggers of conflicts, such as the role that psychological decisions play when people loss of income;

4) As a region prone to climate change effects, Latin America shows research opportunities, especially in the dry corridor (Central America) and Andean region. For instance, Peru water supply based heavily on glacial runoff, a driver that still has not been studying in the literature;

5) Some practitioners and academics (Verhoeven, 2014) (Kallis & Zografos, 2014) (Selby, 2014) (Livingstone, 2015) also criticize the environmental security approach. It can lead to over-securitized climate conflict agenda. In some cases, not hold accountable governments for their responsibility in environmentally driven conflicts and reproduce some prejudices to people in Africa or Asia as violent as a consequence of temperatures.

Table 5. Webinars and interview insights.

Knowledge Gaps	**Participant/ interviewee**	**Quote**	**Source**
Practitioners and academics agreements	Sonja Vermeulen, on droughts impact on food systems and crop failures.	"And indeed, with many people having to migrate (…) either because temperatures have become impossible to live in, or otherwise farming has become impossible for some reason or another (…) we are looking at across Africa, particularly maize, beans, and banana systems being really compromised in the next decade (…) So such frequent crop failures, that really they will not be able to depend on maize as the staple crop any longer."	Webinar 1 (CCAFS Program Management Unit, 2020d)
	Ornella Moderan, on institutional drivers of conflicts	"(…) the overwhelming majority of conflicts in the Sahel region, arise, locally, and the failure to settle them peacefully at a local level, leads to escalation and to violence. This is also the failure of state justice systems to handle local conflicts."	Webinar 4 (CCAFS Program Management Unit, 2020e)
Practitioners and academics disagreements	Robert Mulley, on resource scarcity approach from practitioners	"But the point is that there is almost undeniable connection between great changes in temperature (…) and conflict because we know that conflict is generated by a competition for scarce resources and climate change, by definition, affects the availability of these resources. (…)"	Webinar 6 (CCAFS Program Management Unit, 2020b)
	Ornella Moderan, on resource scarcity approach from practitioners	"Another important aspect, I believe, is that the communities are increasingly coated with a scarcity of these resources due to climate change and demographic pressure. (…) if I may take this particular example high levels of competitions and widespread communal violence"	Webinar 4 (CCAFS Program Management Unit, 2020e)

	Elizabeth Gilmore, on critics to resource scarcity approach from academics	"(…) You saw the Neo Malthusian models being largely dismissed by the by the Peace and Conflict community. And they refocused on root causes where environmental stressors, act in existing pathways. Things such as exclusionary institutions or pre-existing ethnic tensions (…) but increasingly we are circling back again (…) So, in short, we are not necessarily looking at a model where climate change will lead to more conflict, but it will certainly add fuel (…)"	Webinar 2 (CCAFS Program Management Unit, 2020a)
Relevance of findings causal pathways for practitioners	Diego Osorio, on World Bank approach to conflict.	"let's look at the model of the World Bank (…) we had been trying to determine which one is the golden vector in conflict. We were going on institutions, we went on security, we went on rule of law (…) but at the same time, reality forces them to accept that any intervention needs to be understood in systemic elements."	Webinar 0 (CCAFS Program Management Unit, 2020c)
	Dan Smith, on integrate more behavioral approach on communal conflicts.	"science doesn't really tell (…) if it is going to be drought if it is going to be a flood. But what we know is that in those circumstances, just as Sonia was saying about Sudan, people take very, very short term economic decisions (…) that provide the opportunity for Al Shabaab, jihadi group to come (…) to be recruiting and so on. Now, if we could understand better how and why people are taking the decisions (…) we would be able to help them be taking decisions which wouldn't lead to an increasing risk of escalating conflict."	Webinar 1 (CCAFS Program Management Unit, 2020d)
Latin-America research opportunities	Dan Smith, on Latin-research opportunities	"But there is a genuine problem in the dry card or in Central America (…) a trend that was slow to develop, and it's pretty clear at the moment, and then you have Peru, which is essentially dependent on glacial runoff for its water supply."	Dan Smith interview (Ricaurte, 2020c)
Critics to climate-security approach	Brunno Charbonneau, on critics to environmental-security approach	"climate security in that field is tied to or being tied to the rise of the counterterrorism agenda and counterinsurgency. (…) if you approach the effects of climate change from a counterterrorism or counterinsurgency agenda or perspective, are you going to do, is contain these people or fight them right. You don't want them to show up near borders as in the European migration crisis of 2015. (…) our work for us is to make sure that the climate security agenda doesn't impact negatively (…) humanitarian agenda."	Brunno Charbonneau interview (Ricaurte, 2020a)
	Chitra Nagarajan, on critics to environmental-security approach	"some governments use climate change either to evade responsibility for their own governance or to justify you know overly militarized approaches that they say (…) a solution."	Chitra Nagarajan interview (Ricaurte, 2020b)

ToC visualization that links climate change, weather variability, and environmental degradation to conflict.

Out of 204 quantitative and mixed studies, 39 studies did not report any influence of climate change or environmental degradation variables on conflict. From those 39 studies, some found an association between temperatures or rainfall patterns and economic shocks, but not between weather variables and conflict (Ahrens, 2015) (van Weezel, 2015) (van Weezel, 2019) (Wischnath & Buhaug, 2014a). Likewise, no association with drought and floods was established by some authors (Owain & Maslin, 2018) (Ghimire et al., 2015). Some other studies even reject the thesis that climate variables affect economic growth (Koubi et al., 2012). Finally, no conflict perception among farmers who suffered climate change consequences was found by some authors (Linke et al., 2015) (Abid et al., 2016). Those 39 studies were left out to build causal pathways and drivers.

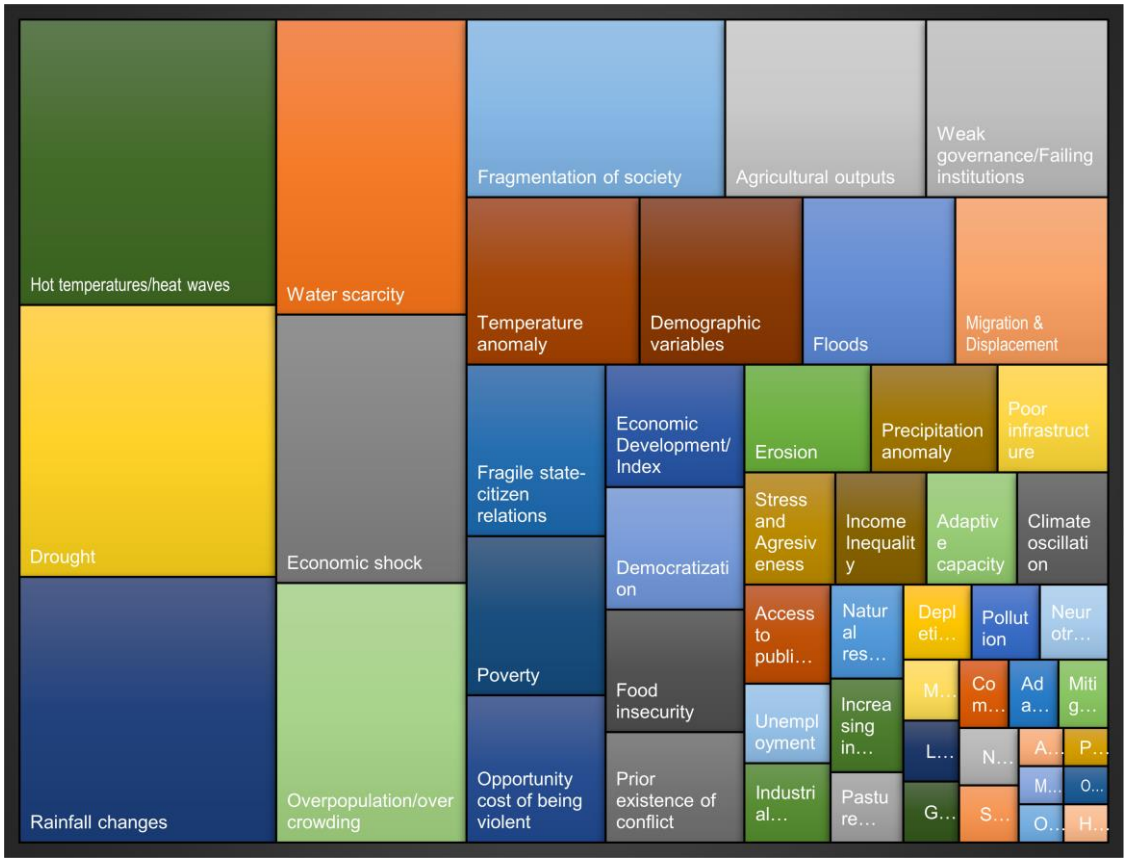
Because of webinars results, I decided to present ToC as a driver network rather than a traditional Toc representation of causal pathways. Network analysis has gained some attention among academics because allowing to draw patterns from a complex system that involves multiple feedbacks. The network's core features are nodes, a structure of variables forming a net of relationships through edges, essentially a linkage structure. Networks are referred to as graphs, whereas nodes are referred to as vertices and edges as links. Each node has different importance levels since some variables are more relevant than others. This concept is known as

centrality (Hevey, 2018). To account for each node's influence, I coded each driver and assigned an ID from S01 to S52. I counted the number of times ID was shown as relevant in each study. Figure 21 shows the driver's counting.

Due to the high amount of drivers (52) identified in the literature, I only show the most relevant. I visualize those nodes and their links using the R program, packages "igraph," "network," "sna," "ggraph," #visNetwork," "three," "networkD3", "ndtv." Figure 23 shows a heat map showing the most relevant socio-economic drivers interacting with climate change and weather variables.

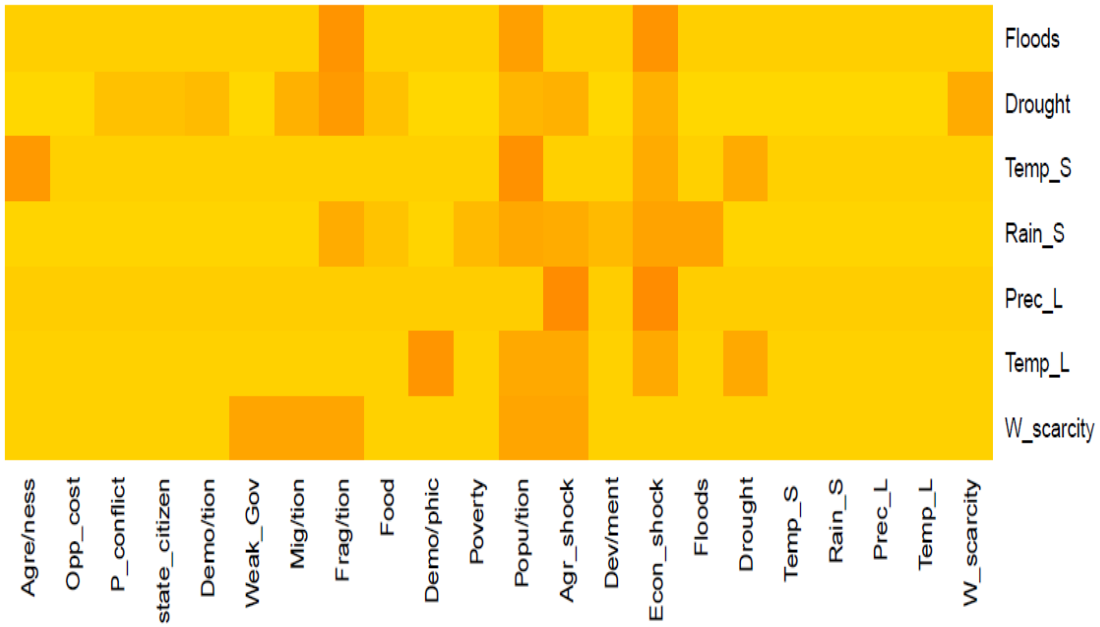
As shown in figures 22 y 23, agricultural (Agr_schocks) and economic shocks are the most relevant mediating factors. Population variables such as overpopulation (Population density, number of inhabitants) (Popu/tion in the graphs), poverty, other demographic (Demo/phics in the graphs) variables (sex, education levels) have significant interaction effects with climate variables, particularly on migration (Mig/tion in the graphs). Inequality measures such as migration and fragmentation of society[25] (Frag/tion in the graphs) also have relevant interaction effects. In contrast, scholars have barely addressed income inequality in the literature. Institutional variables such as weak governance/failing institutions, democratization - political rights, stability and regime types (political disputes) (Demo/tion in the graphs), and the prior existence of conflict are shown as important contextual factors. Finally, behavioral patterns are addressed by the opportunity cost of being violent theory (Opp-cost). However, few studies research properly how this driver interacts with climate variables. (Figure 23)

Figure 21. Drivers' count shows the centrality of each node.



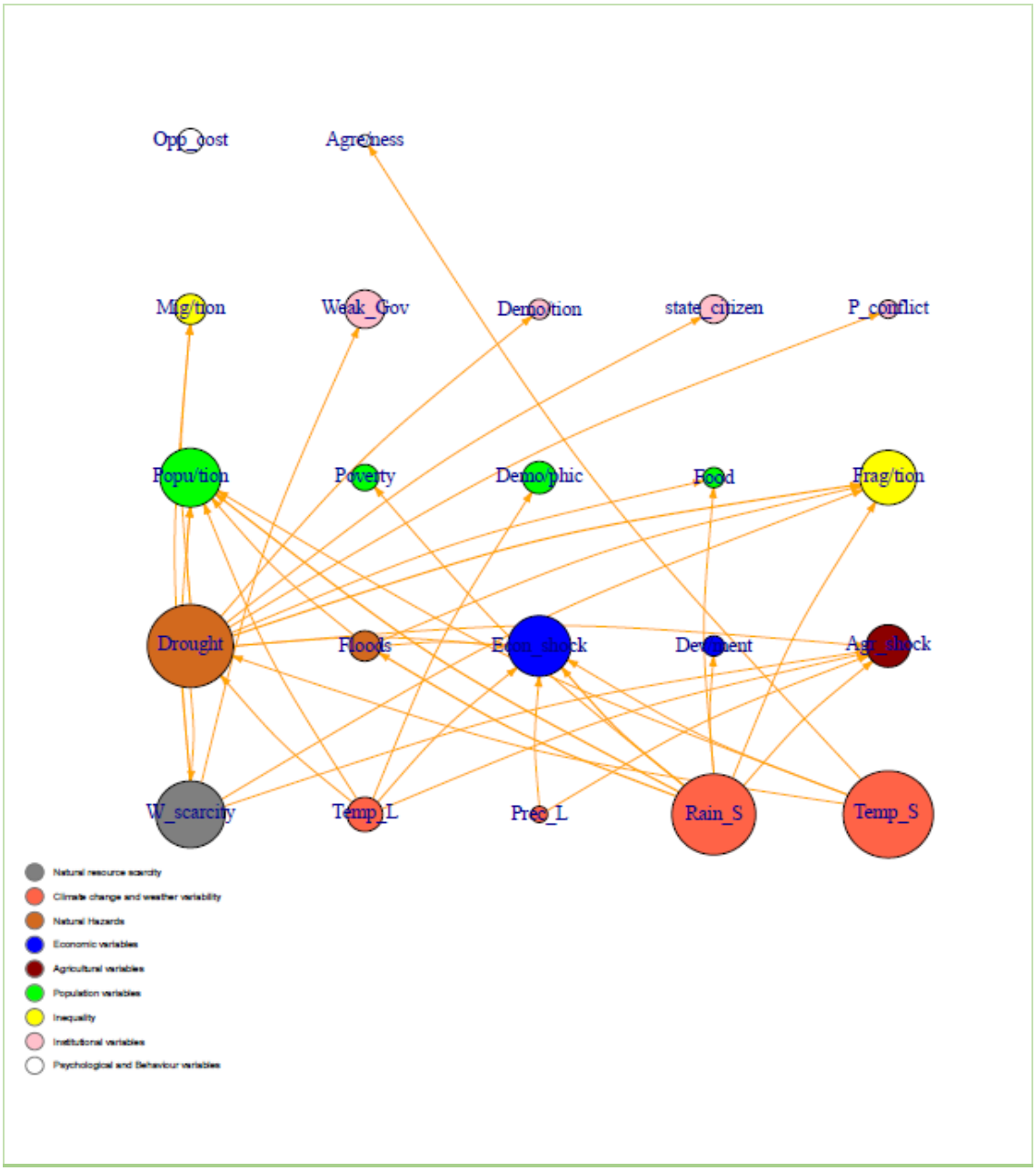
[25] Lack developed connections due to race, religion, or any other kind of discrimination - ethnic disputes

Figure 22. Heat Map of driver's interactions



Studies that used short-term weather variability measures (hot temperature/heatwaves – Temp_S and rainfall changes – Rainf_S) still outnumber studies that use long-term climate change variables (temperature (Temp_L) and precipitation anomaly (Prec_L) and climate oscillations), mainly because of the effect of weather – aggression studies. Rainfall variability is the most common (Harp & Karnauskas, 2018) (Blakeslee & Fishman, 2018) way to measure droughts and, therefore, water scarcity (Gangopadhyay & Nilakantan, 2018) and floods. However, water scarcity is additionally measured through different indexes such as freshwater resources stock per capita (Mohamed & Nageye, 2019), rain-fed water supply and irrigation (Ang & Gupta, 2018), and water access and water surface dependence (Sanchez et al., 2018). Natural disasters are also measured through different mechanisms, such as the International Disaster Database Survey (Koubi et al., 2018) and the NatCatSERVICE database (Schleussner et al., 2016). SPI (Koren, 2018) and Standardized Precipitation Evapotranspiration Index (SPEI) are better droughts indicators.

Figure 23. ToC drivers and mechanism visualization



Discussion and Conclusions

In one of the first literature review done by Gleditsch (1998), it is summarized the problem of climate-conflict agenda in (1) confusion in the level of analysis; (2) failing to distinguish types of conflict; (3) anticipation to the future without empirical evidence; (4) lack of peer-review papers, most of the links are based on gray literature from intergovernmental or private agencies. (Nordås & Gleditsch, 2007); (5) more polemical statements rather than analysis; (6) neglecting the importance of political and economic factors as mediators; (7) lack of clarity over what an environmental conflict is; (8) complexity of the models; (9) reverse causality and; (10) bias in case studies (Gleditsch, 1998).

Some of those problems mentioned by Gleditsh (1998) have been addressed successfully by academics. Better level of analysis (1) regarding how to measure climate change variables effectively and separate them from weather variables. New databases have improved the capacity of distinguishing the type of conflicts (2) affected by climate change and environmental degradation. Quantitative studies have increased the capacity of forecasting future impacts based on evidence (3) because the (4) amount of peer-review papers has grown steadily. Those peer-reviews have shown how complex and interrelated this topic is (5). More studies have integrated political and economic factors as mediating variables (6) on intergroup conflicts.

Although much work has been done in more than 20 years of research, some problems identified by Gleditsch (1998) remain in this research area. For instance, (7) differentiate between climate change, environmental variables, and socio-economic ones is a herculean effort. As Dan Smith mentioned in Webinar 1, every conflict involving natural resources can be framed as an environmental conflict. It implies how society distributes those natural resources; therefore, more socioecological approaches are needed. Consequently, (8) the complexity of the models has increased. The complexity of models can be seen as good news because the robustness of models has also increased. For instance, recent studies have innovated to overcome statistics and case studies methods drawbacks. New techniques such as field surveys that investigate individual-level – motivation conditions (Mbih, 2020), Qualitative Comparative Analysis (QCA) (Ide, Lopez, et al., 2020) (Ide, Brzoska, et al., 2020) (Plänitz, 2020), and Agent-based models (ABMs) (Hermans & Ide, 2019) (Natalini et al., 2019) (Roche et al., 2020) have shown promising results.[26]

In Oxford Climate Change talks, Buhaug explained that (9) reverse causality is still a persistent problem. Most studies that analyze climate change-armed conflicts used data from already vulnerable countries (Oxford Climate Society, 2020). Climate change is not likely in the foreseeable future to cause conflict in otherwise stable societies. However, climatic conditions may accentuate risks in societies already prone to conflict. Yet, bias in the dependent variable (10) still has been finding out on intergroup conflicts (Adams et al., 2018). However, results indicate that even more academics agree that climate change, environmental degradation, and conflict agendas close their gaps. (von Uexkull & Buhaug, 2021).

The division among academics persists as a re-edition of the old debate between Toronto Group (Malthusian) and Zurich Group. Although I showed that those differences encompass political viewpoints about climate-security issues and analysis frameworks more than an unfathomable separation among academics about climate change consequences. The USA and European scholars agree on climate change have some indirect impacts on conflict. However, those academics disagree on how much the effect can be evidenced or which kind of conflicts are more prone to be affected by climate variables.

In armed conflict, traditional socioeconomic drivers have been consistently showing more significance as explanatory variables. Nevertheless, experts agreed that when climate change triggers those important socioeconomic drivers, from 3% to 20% of armed conflict risk can result from climate variability. They also judged economic shocks and natural resources' dependence as the most common factor mediating climate-armed conflict effects. (Mach et al., 2019)

Regarding communal conflict and other forms of violent conflicts such as civil unrest, there seems to be more consistent evidence connecting climate change and weather variables interacting with many socio-economic conditions (Oxford Climate Society, 2020) (von Uexkull &

[26] QCA looks to integrate several case studies into a quantitative approach based on Boolean algebra and ABM based its results on simulations that look for describing behavior patterns from agents

Buhaug, 2021). However, academics have been cautious due to the persistence of indirect heterogeneous effects.

To understand those indirect effects, experts called for: a) using mixed methods to explore in deep climate- economic shocks-conflict pathways; b) integrating different research designs; c) analyzing future conflict risks; and d) focusing on "interventions that might break the links between climate change, armed conflict, and instability, as emphasized by practitioners managing these risks in intergovernmental, national, and local contexts" (Mach et al., 2020, p. 4)

Additionally, academics can learn from practitioners regarding the importance of focusing on successful interventions without proving the complete causal chains. Also, Practitioners should innovate in the way they address climate and conflict explanation. Resource Scarcity is no longer a unified theory to address these complex links (Verhoeven, 2011) (Ludwig et al., 2011) (DuBois & Zografos, 2012) (Selby & Hoffmann, 2012) (Krakowka et al., 2012) (Schweizer, 2019). As a result, the gap among academics and practitioners can close if a human vulnerability approach is adopted. It brings up people at the center of the discussion rather than an environmental security one. Furthermore, practitioners and academics should look beyond Africa due to the "streetlight effect" (Koubi, 2018a).

I showed that a plausible approach to understanding this relationship is through a pattern network that includes institutional and socioeconomic variables interacting with climate variables that increase human vulnerabilities. Yet, we are far from offering a chain of causalities. Another important conclusion is that the climate-aggressive behavior-crime pattern seems to be separate from the intergroup conflicts research agenda. Both approaches can be integrated. On the one, Dan Smith raises awareness regarding the lack of studies incorporating psychological or aggressive behavior into intergroup conflicts. On the other hand, climate-crime academics, rather than regress data from developed countries, can embrace new approaches. They can aim at entailing more complex socioeconomic intervention on criminal patterns. The Climate-crime agenda can improve its results if it broadens the scope to more complex scenarios in the third world. Central America presents a vital research avenue because it entails intergroup conflicts with gang activities.

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Annex: Articles from the literature review

Authors	Title	Year	Source title
Uexkull N.V., d'Errico M., Jackson J.	Drought, Resilience, and Support for Violence: Household Survey Evidence from DR Congo	2020	Journal of Conflict Resolution
Mach K.J., Adger W.N., Buhaug H., Burke M., Fearon J.D., Field C.B., Hendrix C.S., Kraan C.M., Maystadt J.-F., O'Loughlin J., Roessler P., Scheffran J., Schultz K.A., von Uexkull N.	Directions for Research on Climate and Conflict	2020	Earth's Future
Bakhsh K., Abbas K., Hassan S., Yasin M.A., Ali R., Ahmad N., Chattha M.W.A.	Climate change–induced human conflicts and economic costs in Pakistani Punjab	2020	Environmental Science and Pollution Research
Mendenhall E., Hendrix C., Nyman E., Roberts P.M., Hoopes J.R., Watson J.R., Lam V.W.Y.,	Climate change increases the risk of fisheries conflict	2020	Marine Policy
Reeping P.M., Hemenway D.	The association between weather and the number of daily shootings in Chicago (2012-2016)	2020	Injury Epidemiology
Vesco P., Dasgupta S., De Cian E., Carraro C.	Natural resources and conflict: A meta-analysis of the empirical literature	2020	Ecological Economics
Borgomeo E., Fawzi N.A.-M., Hall J.W., Jägerskog A., Nicol A., Sadoff C.W., Salman	Tackling the Trickle: Ensuring Sustainable Water Management in the Arab Region	2020	Earth's Future
Cools S., Flatø M., Kotsadam A.	Rainfall shocks and intimate partner violence in sub-Saharan Africa	2020	Journal of Peace Research
Ide T., Brzoska M., Donges J.F., Schleussner C.-F.	Multi-method evidence for when and how climate-related disasters contribute to armed conflict risk	2020	Global Environmental Change
Plänitz E.	Natural Disasters and Political Disorder: Why Urban Flooding Turns Violent. Applying a Fuzzy-set Qualitative Comparative Analysis	2020	Peace Economics, Peace Science and Public Policy
Sofuoğlu E., Ay A.	The relationship between climate change and political instability: the case of MENA countries (1985:01–2016:12)	2020	Environmental Science and Pollution Research
Epstein A., Bendavid E., Nash D., Charlebois E.D., Weiser S.D.	Drought and intimate partner violence towards women in 19 countries in sub-saharan Africa during 2011-2018: A population-based study	2020	PLoS Medicine
Schilling J., Hertig E., Tramblay Y., Scheffran J.	Climate change vulnerability, water resources and social implications in North Africa	2020	Regional Environmental Change
Walwa W.J.	Growing farmer-herder conflicts in Tanzania: the licenced exclusions of pastoral communities interests over access to resources	2020	Journal of Peasant Studies
van Weezel S.	Local warming and violent armed conflict in Africa	2020	World Development
Jung Y., Kim D., Piquero A.R.	Spatiotemporal Association Between Temperature and Assaults: A Generalized Linear Mixed-Model Approach	2020	Crime and Delinquency
Roche K.R., Müller-Itten M., Dralle D.N., Bolster D., Müller M.F.	Climate change and the opportunity cost of conflict	2020	Proceedings of the National Academy of Sciences of the
Wu C.Y.H., Lee H.F., Liu H.	Effect of temperature and precipitation change on crime in the metropolitan area in Virginia, USA	2020	Asian Geographer
Otrachshenko V., Popova O., Tavares J.	EXTREME TEMPERATURE AND EXTREME VIOLENCE: EVIDENCE FROM RUSSIA	2020	Economic Inquiry
Ruderman D., Cohn E.G.	Predictive Extrinsic Factors in Multiple Victim Shootings	2020	Journal of Primary Prevention
Ide T., Lopez M.R., Fröhlich C., Scheffran J.	Pathways to water conflict during drought in the MENA region	2020	Journal of Peace Research
Cruz E., D'Alessio S.J., Stolzenberg L.	The Effect of Maximum Daily Temperature on Outdoor Violence	2020	Crime and Delinquency
Madu I.A., Nwankwo C.F.	Spatial pattern of climate change and farmer–herder conflict vulnerabilities in Nigeria	2020	GeoJournal
Harp R.D., Karnauskas K.B.	Global warming to increase violent crime in the United States	2020	Environmental Research
Mbih R.A.	The politics of farmer–herder conflicts and alternative conflict management in Northwest Cameroon	2020	African Geographical Review
Barlett C.P., DeWitt C.C., Madison C.S., Heath J.B., Maronna B., Kirkpatrick S.M.	Hot temperatures and even hotter tempers: Sociological mediators in the relationship between global climate change and homicide	2020	Psychology of Violence
Döring S.	Come rain, or come wells: How access to groundwater affects communal violence	2020	Political Geography
Gates A., Klein M., Acquaotta F., Garland R.M., Scovronick N.	Short-term association between ambient temperature and homicide in South Africa: A case-crossover study	2019	Environmental Health: A Global Access Science Source
Baysan C., Burke M., González F., Hsiang S., Miguel E.	Non-economic factors in violence: Evidence from organized crime, suicides and climate in Mexico	2019	Journal of Economic Behavior and Organization
Plänitz E.	Neglecting the urban? Exploring rural-urban disparities in the climate change–conflict literature on Sub-Sahara Africa	2019	Urban Climate
Furini G.	The influence of climate change on the escalating communal conflict between herdsmen and farmers: The case of the fulani ethnic group in Nigeria	2019	Janus.net
Burkhardt J., Bayham J., Wilson A., Carter E., Berman J.D., O'Dell K., Ford B., Fischer E.V.,	The effect of pollution on crime: Evidence from data on particulate matter and ozone	2019	Journal of Environmental Economics and Management
Berman J.D., Burkhardt J., Bayham J., Carter E., Wilson A.	Acute air pollution exposure and the risk of violent behavior in the United States	2019	Epidemiology
Breckner M., Sunde U.	Temperature extremes, global warming, and armed conflict: new insights from high resolution data	2019	World Development
Přívara A., Přívarová M.	Nexus between climate change, displacement and conflict: Afghanistan case	2019	Sustainability (Switzerland)
Natalini D., Bravo G., Jones A.W.	Global food security and food riots – an agent-based modelling approach	2019	Food Security
Feizi M., Janatabadi N.H., Torshizi A.S.	Rainfall and social disputes in Iran	2019	Water Policy
Mach K.J., Kraan C.M., Adger W.N., Buhaug H., Burke M., Fearon J.D., Field C.B., Hendrix C.S., Maystadt J.-F., O'Loughlin J., Roessler P.,	Climate as a risk factor for armed conflict	2019	Nature
Seiyefa E.	How climate change impacts on regional security in West Africa: Exploring the link to organised crime	2019	African Security Review

van Weezel S.	On climate and conflict: Precipitation decline and communal conflict in Ethiopia and Kenya	2019	Journal of Peace Research
Martin-Shields C.P., Stojetz W.	Food security and conflict: Empirical challenges and future opportunities for research and policy making on food security and conflict	2019	World Development
Quick M., Law J., Li G.	Time-varying relationships between land use and crime: A spatio-temporal analysis of small-area seasonal property crime trends	2019	Environment and Planning B: Urban Analytics and City
Hicks D.L., Maldonado B.	Is there adaptation to predictable climate change along the temperature-conflict nexus? Evidence from the El Niño Southern Oscillation	2019	Applied Economics Letters
Brzoska M.	Understanding the disaster-migration-violent conflict nexus in a warming world: The importance of international policy interventions	2019	Social Sciences
Mares D.M., Moffett K.W.	Climate Change and Crime Revisited: An Exploration of Monthly Temperature Anomalies and UCR Crime Data	2019	Environment and Behavior
Stevens H.R., Beggs P.J., Graham P.L., Chang H.-C.	Hot and bothered? Associations between temperature and crime in Australia	2019	International Journal of Biometeorology
Work C.	Climate change and conflict: Global insecurity and the road less traveled	2019	Geoforum
Koubi V.	Climate change and conflict	2019	Annual Review of Political
Prudkov P.N., Rodina O.N.	Cold temperatures, stress, and violence	2019	Heliyon
Vestby J.	Climate variability and individual motivations for participating in political violence	2019	Global Environmental Change
Khavarian-Garmsir A.R., Pourahmad A., Hataminejad H., Farhoodi R.	Climate change and environmental degradation and the drivers of migration in the context of shrinking cities: A case study of Khuzestan province, Iran	2019	Sustainable Cities and Society
Mehta L., Huff A., Allouche J.	The new politics and geographies of scarcity	2019	Geoforum
Selby J.	Climate change and the Syrian civil war, Part II: The Jazira's agrarian crisis	2019	Geoforum
Schweizer V.	Scenarios and Decision Support for Security and Conflict Risks in the Context of Climate Change	2019	Current Climate Change Reports
Ahmed K.J., Haq S.M.A., Bartiaux F.	The nexus between extreme weather events, sexual violence, and early marriage: a study of vulnerable populations in Bangladesh	2019	Population and Environment
Miles-Novelo A., Anderson C.A.	Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression	2019	Current Climate Change Reports
Froese R., Schilling J.	The Nexus of Climate Change, Land Use, and Conflicts	2019	Current Climate Change
Tubi A., Feitelson E.	Changing drought vulnerabilities of marginalized resource-dependent groups: a long-term perspective of Israel's Negev Bedouin	2019	Regional Environmental Change
Evans G.W.	Projected Behavioral Impacts of Global Climate Change	2019	Annual Review of Psychology
Keels E.	Praying for Rain? Water Scarcity and the Duration and Outcomes of Civil Wars	2019	Defence and Peace Economics
Trujillo J.C., Howley P.	The Effect of Weather on Crime in a Torrid Urban Zone	2019	Environment and Behavior
Mohamed A.A., Nageye A.I.	Relationship between environmental degradation, resource scarcity, and civil conflicts in Somalia	2019	Journal of Environmental Management and Tourism
Okewu E., Misra S., Fernandez Sanz L., Ayeni F., Mbarika V., Damaševičius R.	Deep neural networks for curbing climate change-induced farmers-herdsmen clashes in a sustainable social inclusion initiative [Wykorzystanie głębokich sieci neuronowych w ograniczaniu zmian klimatycznych związanych z konfliktem farmerów i pasterzy w ramach inicjatywy na rzecz zrównoważonej integracji społecznej]	2019	Problemy Ekorozwoju
Karnieli A., Shtein A., Panov N., Weisbrod N., Tal A.	Was drought really the trigger behind the Syrian Civil War in 2011?	2019	Water (Switzerland)
Chersich M.F., Swift C.P., Edelstein I., Breetzke G., Scorgie F., Schutte F., Wright C.Y.	Violence in hot weather: Will climate change exacerbate rates of violence in South Africa?	2019	South African Medical Journal
Hermans K., Ide T.	Advancing research on climate change, conflict and migration	2019	Erde
Craig C.M., Overbeek R.W., Niedbala E.M.	A Global Analysis of Temperature, Terrorist Attacks, and Fatalities	2019	Studies in Conflict and
Abel G.J., Brottrager M., Crespo Cuaresma J.,	Climate, conflict and forced migration	2019	Global Environmental Change
Germond B., Mazaris A.D.	Climate change and maritime security	2019	Marine Policy
Sanz-Barbero B., Linares C., Vives-Cases C., González J.L., López-Ossorio J.J., Díaz J.	Heat wave and the risk of intimate partner violence	2018	Science of the Total Environment
Ali F., Khan T.A., Alamgir A., Khan M.A.	Climate Change-Induced Conflicts in Pakistan: From National to Individual Level	2018	Earth Systems and Environment
Sommer A.J., Lee M., Bind M.-A.C.	Comparing apples to apples: an environmental criminology analysis of the effects of heat and rain on violent crimes in Boston	2018	Palgrave Communications
Owain E.L., Maslin M.A.	Assessing the relative contribution of economic, political and environmental factors on past conflict and the displacement of people in East Africa	2018	Palgrave Communications
Gilmore E.A., Herzer Risi L., Tennant E.,	Bridging Research and Policy on Climate Change and Conflict	2018	Current Climate Change
Brzoska M.	Weather Extremes, Disasters, and Collective Violence: Conditions, Mechanisms, and Disaster-Related Policies in Recent Research	2018	Current Climate Change Reports
Busby J.	Taking Stock: the Field of Climate and Security	2018	Current Climate Change
Ide T.	Climate War in the Middle East? Drought, the Syrian Civil War and the State of Climate-Conflict Research	2018	Current Climate Change Reports
Ang J.B., Gupta S.K.	Agricultural yield and conflict	2018	Journal of Environmental
Branch A.	From disaster to devastation: drought as war in northern Uganda	2018	Disasters

Linke A.M., Witmer F.D.W., O'Loughlin J., McCabe J.T., Tir J.	The consequences of relocating in response to drought: Human mobility and conflict in contemporary Kenya	2018	Environmental Research Letters
Koubi V., Böhmelt T., Spilker G., Schaffer L.	The Determinants of Environmental Migrants' Conflict Perception	2018	International Organization
Spijkers J., Morrison T.H., Blasiak R., Cumming G.S., Osborne M., Watson J., Österblom H.	Marine fisheries and future ocean conflict	2018	Fish and Fisheries
Iqbal M.W., Donjadee S., Kwanyuen B., Liu S.-Y.	Farmers' perceptions of and adaptations to drought in Herat Province, Afghanistan	2018	Journal of Mountain Science
Linke A.M., Witmer F.D.W., O'Loughlin J., McCabe J.T., Tir J.	Drought, Local Institutional Contexts, and Support for Violence in Kenya	2018	Journal of Conflict Resolution
Schutte F.H., Breetzke G.D.	The influence of extreme weather conditions on the magnitude and spatial distribution of crime in tshwane (2001–2006)	2018	South African Geographical Journal
Koubi V.	Exploring the relationship between climate change and violent conflict	2018	Chinese Journal of Population Resources and
Koren O.	Food abundance and violent conflict in Africa	2018	American Journal of
Blakeslee D.S., Fishman R.	Weather shocks, agriculture, and crime: Evidence from India	2018	Journal of Human Resources
Alfonso Sánchez G.R.	When the taps run dry: Water stress and social unrest revisited [Cuando las fuentes se agotan: Estrés hídrico y agitación social. Una revision]	2018	Revista UNISCI
Phillis Y.A., Chairetis N., Grigoroudis E., Kanellos F.D., Kouikoglou V.S.	Climate security assessment of countries	2018	Climatic Change
van Lange P.A.M., Rinderu M.I., Bushman B.J.	CLASH: Climate (change) and cultural evolution of intergroup conflict	2018	Group Processes and Intergroup Relations
Malamud M.	The Environment as a Factor in Small Wars*	2018	Small Wars and Insurgencies
Gangopadhyay P., Nilakantan R.	Estimating the Effects of Climate Shocks on Collective Violence: ARDL Evidence from India	2018	Journal of Development Studies
Adams C., Ide T., Barnett J., Detges A.	Sampling bias in climate-conflict research	2018	Nature Climate Change
Crost B., Duquennois C., Felter J.H., Rees D.I.	Climate change, agricultural production and civil conflict: Evidence from the Philippines	2018	Journal of Environmental Economics and Management
Eastin J.	Hell and high water: Precipitation shocks and conflict violence in the Philippines	2018	Political Geography
Solomon N., Birhane E., Gordon C., Haile M., Taheri F., Azadi H., Scheffran J.	Environmental impacts and causes of conflict in the Horn of Africa: A review	2018	Earth-Science Reviews
Allen J.J., Anderson C.A., Bushman B.J.	The General Aggression Model	2018	Current Opinion in
Seter H., Theisen O.M., Schilling J.	All about water and land? Resource-related conflicts in East and West Africa revisited	2018	GeoJournal
Marcantonio R.A., Attari S.Z., Evans T.P.	Farmer perceptions of conflict related to water in Zambia	2018	Sustainability (Switzerland)
Afon A.O., Badiora A.I.	The Dynamics of Crime Opportunities: Evidences from Weather Conditions and Spatial Pattern of Residential Neighborhood in Ibadan, Nigeria	2018	Papers in Applied Geography
van Baalen S., Mobjörk M.	Climate change and violent conflict in East Africa: Integrating qualitative and quantitative research to probe the mechanisms	2018	International Studies Review
Younan D., Li L., Tuvblad C., Wu J., Lurmann F., Franklin M., Berhane K., McConnell R., Wu	Long-term ambient temperature and externalizing behaviors in adolescents	2018	American Journal of Epidemiology
Karim M.E.	Exploring the Impact of Climate Change on the Outbreak of Early Twenty-First-Century Violence in the Middle East and North Africa and the Potential of Permaculture as an Effective Adaptation	2018	Weather, Climate, and Society
Hu X., Wu J., Chen P., Sun T., Li D.	Impact of climate variability and change on crime rates in Tangshan, China	2017	Science of the Total Environment
Theisen O.M.	Climate Change and Violence: Insights from Political Science	2017	Current Climate Change
Abrahams D., Carr E.R.	Understanding the Connections Between Climate Change and Conflict: Contributions From Geography and Political Ecology	2017	Current Climate Change Reports
Shaffer L.J.	An Anthropological Perspective on the Climate Change and Violence Relationship	2017	Current Climate Change Reports
Koubi V.	Climate Change, the Economy, and Conflict	2017	Current Climate Change
Gilmore E.A.	Introduction to Special Issue: Disciplinary Perspectives on Climate Change and Conflict	2017	Current Climate Change Reports
Sakaguchi K., Varughese A., Auld G.	Climate wars? A Systematic review of empirical analyses on the links between climate change and violent conflict	2017	International Studies Review
Cattaneo C., Bosetti V.	Climate-induced international migration and conflicts	2017	CESifo Economic Studies
Freeman L.	Environmental Change, Migration, and Conflict in Africa: A Critical Examination of the Interconnections	2017	Journal of Environment and Development
Schinasi L.H., Hamra G.B.	A Time Series Analysis of Associations between Daily Temperature and Crime Events in Philadelphia, Pennsylvania	2017	Journal of Urban Health
Coccia M.	A Theory of general causes of violent crime: Homicides, income inequality and deficiencies of the heat hypothesis and of the model of CLASH	2017	Aggression and Violent Behavior
Abbott M., Bazilian M., Egel D., Willis H.H.	Examining the food–energy–water and conflict nexus	2017	Current Opinion in Chemical
Yu C.-H., Mu J.E., Ding J., McCarl B.A.	Relationships between typhoons, climate and crime rates in Taiwan	2017	Natural Hazards
Lemon D.J., Partridge R., The Pan-Dorset Cardiff Model team	Is weather related to the number of assaults seen at emergency departments?	2017	Injury
Detges A.	Droughts, state-citizen relations and support for political violence in Sub-Saharan Africa: A micro-level analysis	2017	Political Geography

Habibullah M.S.	The effects of weather on crime rates in Malaysia	2017	International Journal of Business and Society
Goin D.E., Rudolph K.E., Ahern J.	Impact of drought on crime in California: A synthetic control approach	2017	PLoS ONE
Caruso V.	Water conflicts in a historical perspective. Environmental factors in the middle east crisis	2017	Global Environment
Dong K., Cao Y., Siercke B., Wilber M., McCalla	Advising caution in studying seasonal oscillations in crime rates	2017	PLoS ONE
Selby J., Dahi O.S., Fröhlich C., Hulme M.	Climate change and the Syrian civil war revisited	2017	Political Geography
Dossey L.	Hot and Bothered: Violence, Aggression, and Global Warming	2017	Explore
Chen C.W.S., Lee S.	Bayesian causality test for integer-valued time series models with applications to climate and crime data	2017	Journal of the Royal Statistical Society. Series C:
Bagozzi B.E., Koren O., Mukherjee B.	Droughts, land appropriation, and rebel violence in the developing world	2017	Journal of Politics
Hu X., Chen P., Huang H., Sun T., Li D.	Contrasting impacts of heat stress on violent and nonviolent robbery in Beijing, China	2017	Natural Hazards
Feitelson E., Tubi A.	A main driver or an intermediate variable? Climate change, water and security in the Middle East	2017	Global Environmental Change
Jun T.	Temperature, maize yield, and civil conflicts in sub-Saharan Africa	2017	Climatic Change
Ide T.	Research methods for exploring the links between climate change and conflict	2017	Wiley Interdisciplinary Reviews: Climate Change
Ng H.K.S., Chow T.S.	The effects of environmental resource and security on aggressive behavior	2017	Aggressive Behavior
Linning S.J., Andresen M.A., Ghaseminejad A.H., Brantingham P.J.	Crime seasonality across multiple jurisdictions in British Columbia, Canada	2017	Canadian Journal of Criminology and Criminal
Nordkvelle J., Rustad S.A., Salmivalli M.	Identifying the effect of climate variability on communal conflict through randomization	2017	Climatic Change
Levy B.S., Sidel V.W., Patz J.A.	Climate Change and Collective Violence	2017	Annual Review of Public
Okpara U.T., Stringer L.C., Dougill A.J.	Using a novel climate–water conflict vulnerability index to capture double exposures in Lake Chad	2017	Regional Environmental Change
Van Der Linden S.L.	The role of climate in human aggression and violence: Towards a broader conception	2017	Behavioral and Brain Sciences
Price G.N., Elu J.U.	Climate Change and Cross-State Islamist Terrorism in Nigeria	2017	Peace Economics, Peace
Weick M., Vasiljevic M., Uskul A.K., Moon C.	Stuck in the heat or stuck in the hierarchy? Power relations explain regional variations in violence	2017	Behavioral and Brain Sciences
Vivekananda J.	How are climate change and human security interrelated	2017	NATO Science for Peace and Security Series C:
Jones B.T., Mattiacci E., Braumoeller B.F.	Food scarcity and state vulnerability: Unpacking the link between climate variability and violent unrest	2017	Journal of Peace Research
Witmer F.D.W., Linke A.M., O'Loughlin J., Gettelman A., Laing A.	Subnational violent conflict forecasts for Sub-Saharan Africa, 2015-65, using climate-sensitive models	2017	Journal of Peace Research
Van Lange P.A.M., Rinderu M.I., Bushman B.J.	Aggression and violence around the world: A model of CLimate, Aggression, and Self-control in Humans (CLASH)	2017	Behavioral and Brain Sciences
Buhaug H.	Climate change and conflict: Taking stock	2016	Peace Economics, Peace
Von Uexkull N., Croicu M., Fjelde H., Buhaug H.	Civil conflict sensitivity to growing-season drought	2016	Proceedings of the National Academy of Sciences of the
Okpara U.T., Stringer L.C., Dougill A.J.	Lake drying and livelihood dynamics in Lake Chad: Unravelling the mechanisms, contexts and responses	2016	Ambio
Hsiang S.	Climate econometrics	2016	Annual Review of Resource
Brottem L.V.	Environmental Change and Farmer-Herder Conflict in Agro-Pastoral West Africa	2016	Human Ecology
Carleton T.A., Hsiang S.M.	Social and economic impacts of climate	2016	Science
Lee B.X.	Causes and cures VIII: Environmental violence	2016	Aggression and Violent
Schleussner C.-F., Donges J.F., Donner R.V., Schellnhuber H.J.	Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries	2016	Proceedings of the National Academy of Sciences of the
Zhang T.H.	Weather effects on social movements: Evidence from Washington, D.C., and New York City, 1960-95	2016	Weather, Climate, and Society
Ayana E.K., Ceccato P., Fisher J.R.B., DeFries R.	Examining the relationship between environmental factors and conflict in pastoralist areas of East Africa	2016	Science of the Total Environment
Seter H.	Connecting climate variability and conflict: Implications for empirical testing	2016	Political Geography
Pereira D.V.S., Andresen M.A., Mota C.M.M.	A temporal and spatial analysis of homicides	2016	Journal of Environmental
Breetzke G.D.	Examining the spatial periodicity of crime in South Africa using Fourier analysis	2016	South African Geographical Journal
Carleton T., Hsiang S.M., Burke M.	Conflict in a changing climate	2016	European Physical Journal:
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