Understanding the potential linkages between climate change and conflict in the Arab region

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Key Messages

Introduction

- The Arab region is one of the most vulnerable regions to climate change while, at the same time, has been a hotspot for conflicts during the last decade.
- The paper provides a conceptual framework for the linkages between climate change and conflict in order to improve the collective capacity of the region to address the negative impacts of climate change on peace and security.

1. Information on climate-conflict link

- Precipitation has a mixed relationship with conflict, and temperature has a stronger effect on smaller conflicts.
- The onset of civil conflicts is less related to climate hazards than ongoing conflicts or events.
- In contexts with high agricultural dependence, poverty and marginalization, there is consensus on a linkage between the effect of hazards and conflict.

2. Conceptual framework

- A direct causal link between climate change and armed conflict is difficult to argue.
- Climate change can indirectly increase the risk of conflict by exacerbating factors that can, in a complex interplay, lead to conflict.
- Macroeconomic contraction is arguably among the most important correlates of domestic armed conflict and one that is very likely a consequence of climate change.
- Moderators that include minimal social cleavages, effective political institutions and State capacity reduce the impact transmission mechanisms such as livelihood loss, macroeconomic contraction, migration, resource competition, and food insecurity have on conflict risk.

3. Conclusions and recommendations

- Climate change can indirectly exacerbate factors that may consequently lead to conflict; given the particularities of the Arab region, water scarcity and food security are particularly relevant.
- The role of agriculture emerges as a key sector in the Arab region to analyse how climate risk may translate into conflict risk.
- Operationalizations of hazard and vulnerability could support conflict-forecasting efforts, by using, among others, geographically disaggregated data on agriculture, water and food.

Contents

Glossary

Climate change: A change in the state of the climate that can be identified, for instance, by using statistical tests, by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.

Climate risk: The product of three interdependent determinants, namely, hazard, exposure and vulnerability. Climate risk is assumed to be the type of climate-driven negative impacts and human responses that can have adverse effects.

Climate variability: Variations in the mean state and other statistics, such as standard deviations, the occurrence of extremes, and others, of the climate on all spatial and temporal scales beyond that of individual weather events.

Conflict: Three forms of violent conflict are considered, namely, civil conflict where rebels fight government forces; one-sided violence where an organized party kills unarmed persons in non-combat situations; and non-State conflicts where non-State actors fight each other.

Conflict risk: Is broadly understood as the likelihood of a conflict materializing.

Conflict-specific capital: Factors such as the accessibility of weapons, safe havens (often in neighbouring countries), close-knit social networks, and other factors that increase the fighting capacity of potential rebels vis-à-vis the State.

Coping capacity: The ability of people, institutions, organizations, and systems to address, manage and overcome the negative impacts of a certain hazard and build resilience.

Exposure: The presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; and economic, social or cultural assets in places and settings that could be adversely affected. Exposure to hazards is largely shaped by demographic factors, such as population size and settlement patterns, but also by changes in these through population growth, urbanization and migration.

Food security: The physical, social, and economic access to nutritious, sufficient, and safe food that meets the dietary requirements for the wellbeing of the individual, and the potential threats to this status.

Hazard: The potential occurrence of climate-related physical events or trends with negative consequences. This can either be gradual and durable changes or short-term changes.

Mechanisms: The social processes that transmit the adverse impacts of climate risk into societies.

Moderators: Contextual elements present in the structure of societies and institutions that heavily shape the effect of mechanisms on conflict risk.

Vulnerability: The propensity to be adversely affected by a hazard. It encompasses diverse concepts including the lack of coping capacity

and sensitivity or susceptibility to harm. It may be explored at different social scales, from individuals and households to society at large.

Water security: The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.

Introduction

The effects of climate change are far-reaching. The pace and growing scale of disruptions caused by climate change underscore its potential to disrupt peace and security through its effect on livelihoods, resource competition, water accessibility, food prices, and migration. The Arab region is in a dire situation, being affected by a wide range of environmental issues that will be exacerbated by climate change, including the depletion of scarce natural resources such as water and arable land, increasing pollution levels and more frequent extreme weather events. It is one of the most vulnerable regions to climate change given its increasing water scarcity and dependence on agriculture and food imports. At the same time, the region has been a hotspot for conflicts during the last decades.

There is growing concern that climate change increases the probability of unrest and conflict. In fact, on several occasions, the United Nations Security Council has emphasized the need to analyse how climate change and conflict might be associated in Somalia,[1] the Sudan[2] and the neighbouring West Africa and Sahel.[3] These resolutions also request the operationalization of the climate-conflict risks through adequate risk assessments and strategies. The academic debate has also explored the links between climate change, conflict and unrest in the Arab region. For example, it has been argued that droughts in major global grain-producing countries caused food prices to increase, possibly contributing to the unrest in several Arab States in 2010.[4] The climatic arguments about the conflicts in Darfur and the Syrian civil war have also been notable, proving the importance of investigating the connection between climate and security risks. With few notable exceptions, little fieldwork-based information and other data on intermediate mechanisms hamper our understanding of the conflicts in Darfur and the Syrian Arab Republic,

1 United Nations, 2019. Security Council Resolution 2461 (S/RES/2461), March 27. Available at https://undocs.org/S/RES/2461(2019).

2 United Nations, 2018. Security Council Resolution 2429 (S/RES/2429), July 13. Available at https://undocs.org/en/S/RES/2429(2018).

3 Ibid.

4 De Juan, A., 2015. Long-term environmental change and geographical patterns of violence in Darfur, 2003-2005. *Political Geography*, vol. 45, pp. 22-33. Available at https://doi.org/10.1016/j.polgeo.2014.09.001; Kelley, C. P. and others, 2015. Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, No. 112, vol. 11, pp. 3241-3246. Available at https://doi.org/10.1073/pnas.1421533112; Selby, J. and others, 2017. Climate change and the Syrian civil war revisited. *Political Geography*, vol. 60, pp. 232-244. Available at https://doi.org/10.1016/j.polgeo.2017.05.007; Selby, J. and C. Hoffmann, 2014. Beyond scarcity: Rethinking water, climate change and conflict in the Sudans. *Global Environmental Change*, vol. 29, pp. 360-370. Available at https://doi.org/10.1016/j.gloenvcha.2014.01.008; Soffiantini, G., 2020. Food insecurity and political instability during the Arab Spring. *Global Food Security*, vol. 26, 100400. Available at https://doi.org/10.1016/j.gfs.2020.100400.

in particular when it comes to understanding why the conflicts escalated.[5]

This document aims to provide a conceptual framework for the linkages between climate change and conflict, with particular attention to the case of the Arab region; and assess the degree to which quantitative indicators of climate change can be incorporated into quantitative models predicting violent conflict in the Arab region. This is important in order to improve the collective capacity of the region to address the negative impacts of climate change on peace and security. This paper, first, reviews the climate-conflict literature, focusing on global and regional studies covering the Arab region or at least one country within it; and, second, it provides a conceptual overview of the theorized relationship between climate risks and conflict by combining a generic climate risk framework with the literature on civil conflict. The final section sums up the main points of agreement in the literature and outlines which plausible climate-conflict mechanisms can currently be pursued using the Violence Early Warning System (ViEWS) framework. For the latter, considerations about data selection and operationalization are also briefly discussed, pointing to the most promising avenues for future work separating between what is currently feasible and what is not.

5 Bromwich, B., 2018. Power, contested institutions and land: repoliticising analysis of natural resources and conflict in Darfur. *Journal of Eastern African Studies*, vol. 12, Issue 1, pp. 1-21. Available at https://doi.org/10.1080/17531055.2017.1403782; Daoudy, M., 2020. *The Origins of the Syrian Conflict: Climate Change and Human Security*. Cambridge University Press; De Waal, A. and J. Flint, 2008. *Darfur: A Short History of a Long War*. Zed Books; Fröhlich, C. J., 2016. Climate migrants as protestors? Dispelling misconceptions about global environmental change in pre-revolutionary Syria. *Contemporary Levant*, vol. 1, Issue 1, pp. 38-50. Available at https://doi.org/10.1080/20581831.2016.1149355.

1. Information on the climate-conflict link

This section provides a discussion of recent studies and assesses their correspondence as well as single empirical studies deemed particularly important. While not exhaustive, it sets the stage for the conceptual model by discussing the most central findings. The review of the general literature is sourced from recent review and prominent studies. The review also focuses on research that covers case studies from the Arab States. For the latter, studies are included that fulfil either of the following criteria, which are statistical studies on climate and conflict outcomes in the region or parts of the region; and non-statistical case studies of conflict-affected countries in the region, with demonstrations or turbulence as the outcome. The following types of papers were excluded: statistical studies at the global level, covering Africa as a whole or single African countries not part of the Arab region; opinion pieces on cases in the Arab region which have no unique new data, including studies on hypothetical future developments; other review papers on the Arab region; and papers central to the Food and Water reports. Papers whose abstract did not specify quantitative models specific for the region or fresh qualitative data for the Arab region or countries were not read further to see if they contained such models.[6]

For the review, three forms of violent conflict are considered, namely, civil conflict where rebels fight Government forces; one-sided violence where an organized party kills unarmed persons in non-combat situations; and non-State conflicts where non-State actors fight each other.[7] Inter-State conflicts are not included since they are rare and so are generalist studies on the issue, apart from studies on predominantly non-violent conflict and transboundary rivers detecting mixed effects of climate variables. While other forms of non-violent political conflict, such as non-violent resistance campaigns, demonstrations and non-violent regime change may be affected by climatic factors, these phenomena have much less detrimental social outcomes – they might actually improve security – and are, therefore, outside the scope of this report.[8] Unless specified otherwise, the term 'conflict' is used throughout to cover any of the three outcomes defined above but not lesser, non-violent forms of social contention such as conflicting interests. The major areas of focus found in the literature have been grouped in the following section.

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6 The Middle East is what is most commonly used in research, while the Arab region is less commonly used in the research community and would have, therefore, generated fewer hits.

7 For further details, see Pettersson, T. and M. Öberg, 2020. Organized violence, 1989-2019. *Journal of Peace Research*, vol. 57, Issue 4, pp. 597-613. Available at https://doi.org/10.1177/0022343320934986.

8 Abbs, L. (2019). The hunger games: Food prices, ethnic cleavages and nonviolent unrest in Africa. *Journal of Peace Research*, vol. 57, pp. 281-296. Available at https://journals.sagepub.com/doi/10.1177/0022343319866487; Aidt, T. and G. Leon (2016). The Democratic Window of Opportunity: Evidence from Riots in Sub-Saharan Africa. *Journal of Conflict Resolution*, vol. 60, Issue 4, pp. 694-717. Available at https://journals.sagepub.com/doi/10.1177/0022002714564014; Brückner, M. and A. Ciccone, 2011. Rain and the Democratic Window of Opportunity. *Econometrica*, vol. 79, Issue 3, pp. 923-947. Available at https://doi.org/10.3982/ECTA8183.

A. Recipitation and temperature

1. Globally

Most quantitative studies on climate change and conflict across contexts analyse the effect of anomalies in weather, such as dry or hot years, flooding and others. Although anomalously high temperature has some link to civil violence, it seems to exert a stronger effect on the risk of less intense conflicts. Similarly, precipitation is, in some studies, found to increase and in others to decrease, but in most studies, to have no effect on civil conflict. Regarding sudden-onset hazards, there are indications that they increase conflict risk generally, but not the onset of civil conflict. Although there might be an association between climate anomalies and violent conflict in the average study, subtleties and countertrends prevent establishing robust associations.[9] Studies that use current data to forecast near-future events rely on more data and a larger range of statistical models than most other studies, making them more suitable to capture general effects. The ViEWS model, one such forecasting effort, found data on climate hazards somewhat helpful in forecasting civil conflict incidence in Africa, but only in combination with indicators of populations' vulnerability to such change. Recent conflict, poor economic performance, low levels of development, recent regime change, proximity to international borders, and high population density are more useful for predicting future conflict.[10]

Regarding other forms of internal conflict, there are mixed findings with regard to massacres of civilians, with some studies finding drier conditions increasing the risk, while others finding a lowered risk under drought conditions.[11] Another strand of research builds on arguments over disputes between ethnic or other identity groups through uncertainty over access to renewable resources, such as land and water, and subsequent violence resulting from intergroup competition. Scholars suggest that the degradation of environmental conditions worsens intergroup relations at the local level as access to land and water resources is often conditional on local power relations rather than the State. Yet, while studies suggest that rainfall anomalies might increase disputes, there is still debate over how this could induce political violence at the local level. There are mixed findings about the probability of changes in weather conditions, be it drier or wetter than normal, increasing risk. Moreover, there is more consensus on conditional effects of climatic variables on conflict via socioeconomic factors.

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9 Koubi, V., 2019. Climate Change and Conflict. *Annual Review of Political Science*, vol. 22, Issue 1, pp. 343-360. Available at https://doi.org/10.1146/annurev-polisci-050317-070830; Sakaguchi, K., A. Varughese and G. Auld, 2017. Climate Wars? A Systematic Review of Empirical Analyses on the Links between Climate Change and Violent Conflict. *International Studies Review*, vol. 19, Issue 4, pp. 622-645. Available at https://doi.org/10.1093/isr/vix022; Theisen, O. M., 2017. Climate Change and Violence: Insights from Political Science. *Current Climate Change Reports*, vol. 3, Issue 4, pp. 210-221. Available at https://doi.org/10.1007/s40641-017-0079-5.

10 Hegre, H. and others, 2019. ViEWS: A political violence early-warning system. *Journal of Peace Research*, vol. 56, Issue 2, pp. 155-174. Available at https://doi.org/10.1177/0022343319823860; Hegre, H. and others, 2021. ViEWS2020: Revising and evaluating the ViEWS political Violence Early-Warning System. *Journal of Peace Research*, vol. 58, Issue 3, pp. 599-611. Available at https://doi.org/10.1177/0022343320962157. The first study reports similar effects for non-State and one-sided conflict events.

11 Harari, M. and E. La Ferrara, 2018. Conflict, Climate, and Cells: A Disaggregated Analysis. *The Review of Economics and Statistics*, vol. 100, Issue 4, pp. 594-608. Available at https://doi.org/10.1162/rest_a_00730; Landis, S. T. and others, 2017. Fording differences? Conditions mitigating water insecurity in the Niger River Basin. *Political Geography*, vol. 56, pp. 77-90. Available at https://doi.org/10.1016/j.polgeo.2016.10.002.

For example, pastoralist contexts might be particularly susceptible to having conflict dynamics affected by water-related factors.[12]

2. The Arab region

Few statistical studies testing the effects of precipitation and temperature on the Middle East and North African (MENA) region exist. One study of non-State conflicts finds that anomalously high temperatures decrease conflict risk in the Middle East – opposite to the results for Sub-Saharan Africa – and also that conflict risk peaks at about 32°C suggesting that warm temperatures increase aggression to a certain point beyond which it reduces aggression.[13] More in line with expectations, more rainfall and an above-average vegetation decrease risk. Their very heterogeneous findings lead them to caution against broad conclusions on climate-conflict links. Another study finds that for all countries in the Arab region, either temperature or precipitation changes increases political instability and/or violent conflict.[14] A third study of Africa and the Middle East finds anomalously warm years to increase the number of conflict events in areas already experiencing conflict, particularly for warmer locations, suggesting a negative long-term effect of warming, but it fails to detect a general relationship between long-term warming and conflict.[15] A study of subnational units of Somalia finds the intensity and duration of drought to increase the risk of conflict incidence. [16] Acknowledging the high number of pastoralist communities in Somalia, they find that droughts depress cattle prices which in turn reduce the opportunity cost of violence, with the temperature component of drought driving changes in cattle prices. A similar study of the Sudan and South Sudan finds temperature shocks, but not precipitation shocks, to increase

12 Benjaminsen, T. A. and others, 2012. Does climate change drive land-use conflicts in the Sahel? *Journal of Peace Research*, vol. 49, Issue 1, pp. 97-111. Available at https://doi.org/10.1177/0022343311427343; Döring, S., 2020a. Come rain, or come wells: How access to groundwater affects communal violence. *Political Geography*, vol. 76, 102073. Available at https://doi.org/10.1016/j.polgeo.2019.102073; Fjelde, H. and N. von Uexkull, 2012. Climate triggers: Rainfall anomalies, vulnerability and communal conflict in Sub-Saharan Africa. *Political Geography*, vol. 31, Issue 7, pp. 444-453. Available at https://doi.org/10.1016/j.polgeo.2012.08.004; Linke, A. M. and others, 2015. Rainfall variability and violence in rural Kenya: Investigating the effects of drought and the role of local institutions with survey data. *Global Environmental Change*, vol. 34, pp. 35-47. Available at https://doi.org/10.1016/j.gloenvcha.2015.04.007; Mack, E. A. and others, 2021. Conflict and its relationship to climate variability in Sub-Saharan Africa. *Science of The Total Environment*, vol. 775, 145646. Available at https://doi.org/10.1016/j.scitotenv.2021.145646; Nordkvelle, J., S. A. Rustad and M. Salmivalli, 2017. Identifying the effect of climate variability on communal conflict through randomization. *Climatic Change*, vol. 141, Issue 4, pp. 627-639. Available at https://doi.org/10.1007/s10584-017-1914-3; Raleigh, C. and D. Kniveton, 2012. Come rain or shine: An analysis of conflict and climate variability in East Africa. *Journal of Peace Research*, vol. 49, Issue 1, pp. 51-64. Available at https://doi.org/10.1177/0022343311427754; Theisen, O. M., 2012. Climate clashes? Weather variability, land pressure, and organized violence in Kenya, 1989-2004. *Journal of Peace Research*, vol. 49, Issue 1, pp. 81-96. Available at https://doi.org/10.1177/0022343311425842; Witsenburg, K. M. and W. R. Adano, 2009. Of Rain and Raids: Violent Livestock Raiding in Northern Kenya. *Civil Wars*, vol. 11, Issue 4, pp. 514-538. Available at https://doi.org/10.1080/13698240903403915.

13 Helman, D., B. F. Zaitchik and C. Funk, 2020. Climate has contrasting direct and indirect effects on armed conflicts. *Environmental Research Letters*, vol. 15, Issue 10, 104017. Available at https://doi.org/10.1088/1748-9326/aba97d.

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

15 Sofuoğu, E. and A. Ay, 2020. The relationship between climate change and political instability: the case of MENA countries (1985:01-2016:12). *Environmental Science and Pollution Research*, vol. 27, Issue 12, pp. 14033-14043. Available at https://doi.org/10.1007/s11356-020-07937-8.

16 Maystadt, J.-F. and O. Ecker, 2014. Extreme Weather and Civil War: Does Drought Fuel Conflict in Somalia through Livestock Price Shocks? *American Journal of Agricultural Economics*, vol. 96, Issue 4, pp. 1157-1182. Available at https://doi.org/10.1093/ajae/aau010.

conflict risk, particularly in areas with pastoral activity and likely competition over water resources.[17]

One recent study on low-intensity (mostly non-violent) disputes finds that conflicts over water are context-specific and cannot be generally linked to drought.[18] However, pre-existing social cleavages in the presence of either water cuts or less open political systems separated cases experiencing conflicts and those that did not, while economic development was less relevant. Analysing the Mediterranean and North Africa region, one study finds low groundwater tables to increase the chance of both conflictive and cooperative events over water, as well as State- and non-State-initiated cooperative events with effects being more pronounced for the non-European, namely the Arab, region.[19] For non-State-initiated cooperative events, the effect of groundwater only holds for regimes with lower political participation. Neither precipitation nor agricultural drought affects any of the three outcomes. Moreover, State-initiated cooperative events are more likely in areas that have recently experienced an armed conflict. Another study also found State institutions as key factors to de-escalate conflict.[20]

B. Climate change versus climate variability[21]

Most statistical studies of contemporary societies that aim to explore the links between climate change and conflict use proxies of anomalies and short changes in weather. These are often related to climate variability and interannual variations rather than long-term changes in the climate. No study on climate change and conflict focuses exclusively on parts or the whole of the Arab region. The relevance of studies on weather anomalies for understanding the effects of climate change rest on the assumption that we can transfer knowledge about deviations from a climate in which the situation ultimately returns to normal conditions. This is not exactly what a change in climate is, which implies permanent shifts as opposed to climate variability which involves relatively short-term shocks. Several studies analyse climatic change in the pre-industrial era covering centuries of warfare stretching as far back as the year 0 AD in China or the medieval period in Europe. This strand of literature consistently finds shifts in long-term climate averages to increase conflict risk, arguably due to the limited coping capacity of societies.[22] Four studies test the

17 Maystadt, J.-F., M. Calderone and L. You, 2015. Local warming and violent conflict in North and South Sudan. *Journal of Economic Geography*, vol. 15, Issue 3, pp. 649-671. Available at https://doi.org/10.1093/jeg/lbu033.

18 Ide, T. and others, 2020. Pathways to water conflict during drought in the MENA region. *Journal of Peace Research*, 0022343320910777, vol. 58, Issue 3. Available at https://doi.org/10.1177/0022343320910777.

19 Döring, S., 2020b. From Bullets to Boreholes: A Disaggregated Analysis of Domestic Water Cooperation in Drought-prone Regions. *Global Environmental Change*, vol. 65, 102147. Available at https://doi.org/10.1016/j.gloenvcha.2020.102147.

20 Tubi, A. and E. Feitelson, 2016. Drought and cooperation in a conflict prone area: Bedouin herders and Jewish farmers in Israel's northern Negev, 1957-1963. *Political Geography*, vol. 51, pp. 30-42. Available at https://doi.org/10.1016/j.polgeo.2015.11.009.

21 Matthews, J. B. R. (ed.)., 2018. Glossary. In *Global Warming of 1.5°C*. IPCC. Available at https://www.ipcc.ch/report/sr15/glossary/. Definitions as in Matthews, 2018, have been employed in this report (see glossary for a full description).

22 Burke, M., S. M. Hsiang and E. Miguel, 2015. Climate and Conflict. *Annual Review of Economics*, vol. 7, Issue 1, pp. 577-617. Available at https://doi.org/10.1146/annurev-economics-080614-115430.

latter for the contemporary world. One study compared the permanent shift in the long rains in Kenya and Ethiopia occurring after 1998,[23] which found that areas experiencing stronger decreases in the long rains saw moderate upticks in most measures of violence for the period 1999-2014,[24] but it contributed little to predicting conflict. A study of the African continent comparing the period 2003-2017 with 1988-2002 found shifts in average temperature levels, but not precipitation to increase conflict risk, but this was mainly for areas that already witnessed conflict during 1988-2002.[25] Changes in average temperature and precipitation have some effects on predicting conflict. Another study of Africa and the Middle East failed to detect a general relationship between long-term warming and conflict.[26] Studying the African continent, Breckner and Sunde[27] found that an increase in extreme warm months over time increased the incidence of violent events.[28] Areas with more warming also saw more conflict, but controlling for increases in extreme warm months, the effect of temperature changes was very small and no longer significant. The nascent literature on shifts in climate, therefore, detects some conflict-increasing effects, but results vary. The phenomenon studied most intensively – changes in average temperature – increased conflict risk in two of three studies.

C. Accounting for contextual factors

To account for contextual effects and conditions, numerous studies model indirect mechanisms instead of direct uniform effects, particularly economic contraction. Although there might be specificities for the Arab region, due to the limited number of dedicated publications on the region, this section builds on the general literature. It should, therefore, be unsurprising that there is more support for studies modeling indirect mechanisms instead of direct uniform effects, particularly economic contraction. While Koubi reports mixed results for studies using precipitation as an instrument for economic activity, in concordance with Theisen, focusing on the effect of climatic hazards on agricultural production or food prices reportedly mostly finds an effect on various types of conflicts, but the effect is for ongoing conflicts and not the risk of an outbreak.[29] A meta-analysis finds land scarcity to increase conflict risk whereas less freshwater decreases it. Climatic hazards increase the effect of cropland deficiency on conflict indicating an interplay between resources and climatic hazards.[30] The effect of multiple bad harvest years captures how coping capacity is stressed by frequent hazards or by compound climate risks. When accounting for compound and repeated effects, the studies find a positive effect of climate on conflict risk. Furthermore, as

23 Van Weezel, S., 2019. On climate and conflict: Precipitation decline and communal conflict in Ethiopia and Kenya. *Journal of Peace Research*, vol. 56, Issue 4, pp. 514-528. Available at https://doi.org/10.1177/0022343319826409.

24 Contrary to other forms of violence, violence against civilians decreased as a function of decreasing long rains.

25 Van Weezel, S., 2020. Local warming and violent armed conflict in Africa. *World Development*, vol. 126, 104708. Available at https://doi.org/10.1016/j.worlddev.2019.104708.

26 Helman and Zaitchik, 2020.

27 Breckner, M. and U. Sunde (2019). Temperature extremes, global warming, and armed conflict: new insights from high resolution data. *World Development*, vol. 123, 104624. Available at https://doi.org/10.1016/j.worlddev.2019.104624.

28 The effect is considerably larger than from a parallel analysis of the anomalously warm weather.

29 Koubi, 2019; Theisen, 2017.

30 Vesco, P. and others, 2020. Natural resources and conflict: A meta-analysis of the empirical literature. *Ecological Economics*, vol. 172, 106633. Available at https://doi.org/10.1016/j.ecolecon.2020.106633.

conflict increases vulnerability and decreases coping capacity, there might be a vicious cycle induced by conflict and climatic hazards. Indicative of this, the sole study testing whether droughts prolong civil wars has found support for this hypothesis.[31] Generally, a robust and general link between climate hazards and the outbreak of civil conflict is wanting, but two recent studies have detected a conditional and unconditional effect of agricultural drought and temperature, respectively.[32] One reason for less robust effects on outbreak can be the role of context-specific factors in triggering new conflicts, but once a rebellion has taken root, much of the collective action problem is overcome and a hazard's effect may constitute a more salient factor than under non-violent pre-conflict conditions.

D. Migration

Globally, few single-country studies test whether weather-induced migration increases the risk of violence, with even fewer covering the Arab region or parts of it; research has found this link in India, Kenya and the Syrian Arab Republic.[33] Only a few multi-country studies exist due to sparse and patchy data on internal migration. One study utilized the displacement floods created and found this to affect the incidence but not the onset of civil conflicts.[34] Two other studies found drought and temperature, respectively, to increase conflict which, in turn, increased the number of asylum seekers. The first finds the effect contained to the period 2011-15 and particularly for Western Asia.[35] The latter finds asylum seekers to decrease the impact of climate hazards on conflict in sending countries, and the conflict risk in receiving countries not to increase, pointing to emigration as adaptation reducing the effect of hazards on conflict risk.[36]

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31 Keels, E., 2019. Praying for Rain? Water Scarcity and the Duration and Outcomes of Civil Wars. *Defence and Peace Economics*, vol. 30, Issue 1, pp. 27-45. Available at https://doi.org/10.1080/10242694.2017.1320184; Koren, O., B. E. Bagozzi and T. Benson, 2021. Food and water insecurity as causes of social unrest: Evidence from geolocated twitter data. *Journal of Peace Research*, vol. 58, Issue 1. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320975091; Von Uexkull, N., 2014. Linkages between climate variability, vulnerability and armed conflict in sub-Saharan Africa. A review. In Bob, U. and S. Bronkhorst (eds.), *Conflict-Sensitive Adapation to Climate Change in Africa*, pp. 161-176. Berliner Wissenschafts-Verlag; Von Uexkull, N. and others, 2016. Civil conflict sensitivity to growing-season drought. *Proceedings of the National Academy of Sciences*, vol. 113, Issue 44, pp. 12391-12396. Available at https://doi.org/10.1073/pnas.1607542113.

32 Buhaug, H. and others, 2021. A Conditional Model of Local Income Shock and Civil Conflict. *The Journal of Politics*, vol. 83, Issue 1, pp. 354-366. Available at https://doi.org/10.1086/709671 (Buhaug and others find no unconditional effect of agricultural droughts on the risk of ethnic civil wars breaking out in developing countries, but for groups that have recently lost political power, droughts have an effect. The contribution for correctly predicting onsets was small); Koubi, 2019; Schultz, K. A. and J. S. Mankin, 2019. Is Temperature Exogenous? The Impact of Civil Conflict on the Instrumental Climate Record in Sub-Saharan Africa. *American Journal of Political Science*, vol. 63, Issue 4, pp. 723-739. Available at https://doi.org/10.1111/ajps.12425; Theisen, 2017.

33 Ash, K. and N. Obradovich, 2020. Climatic Stress, Internal Migration, and Syrian Civil War Onset. *Journal of Conflict Resolution*, vol. 64, Issue 1, pp. 3-31. Available at https://doi.org/10.1177/0022002719864140; Bhavnani, R. R. and H. Lacina, 2015. The Effects of Weather-Induced Migration on Sons of the Soil Riots in India. *World Politics*, vol. 67, Issue 4, pp. 760-794. Cambridge Core. Available at https://doi.org/10.1017/S0043887115000222; Linke, A. M, and others, 2018. The consequences of relocating in response to drought: human mobility and conflict in contemporary Kenya. *Environmental Research Letters*, vol. 13, Issue 9, 094014. Available at https://doi.org/10.1088/1748-9326/aad8cc. See also box 2 on the Syrian case.

34 Ghimire, R., S. Ferreira and J. H. Dorfman, J. H., 2015. Flood-Induced Displacement and Civil Conflict. *World Development*, vol. 66 (Supplement C), pp. 614-628. Available at https://doi.org/10.1016/j.worlddev.2014.09.021.

35 Abel, G. J. and others, 2019. Climate, conflict and forced migration. *Global Environmental Change*, vol. 54, pp. 239-249. Available at https://doi.org/10.1016/j.gloenvcha.2018.12.003.

36 Bosetti, V., C. Cattaneo and G. Peri, 2020. Should they stay or should they go? Climate migrants and local conflicts. *Journal of Economic Geography*, lbaa002. Available at https://doi.org/10.1093/jeg/lbaa002.

Box 1. The case of Darfur

Darfur represents a case where linkages to climate change have been debated. While a link between climatic hazards and conflict had been suggested, satellite data show that from the mid-1980s until the escalation of the Darfur conflict in 2003, precipitation and vegetation cover increased, challenging the notion that overpopulation, overgrazing and drought caused irreversible desertification which, in turn, increased conflict risk.[a] This must be balanced against the following arguments, namely, that (i) three conflicts were entangled into each other where the most local one was clearly partly driven by the drought in the mid-1980s when precipitation reached its nadir and provided fertile ground for exploitation by political entrepreneurs later on; (ii) the motivation of combatants might be influenced by increased resource stress in some regions and improved resources in others; and (iii) long-term environmental change might have triggered a market collapse reducing synergies between farmers and pastoralists.[b]

[a] Brown, I., 2010. Assessing eco-scarcity as a cause of the outbreak of conflict in Darfur: a remote sensing approach. International Journal of Remote Sensing, vol. 31, Issue 10, pp. 2513-2520. Available at http://dx.doi.org/10.1080/01431161003674592; Mamdani, M., 2007. The Politics of Naming: Genocide, Civil War, Insurgency. London Review of Books, vol. 29, Issue 5. Available at https://www.lrb.co.uk/the-paper/v29/n05/mahmood-mamdani/the-politics-of-naming-genocide-civil-war-insurgency; Kevane, M. and L. Gray, 2008. Darfur: rainfall and conflict. Environmental Research Letters, vol. 3, Issue 3, 034006. Available at https://iopscience.iop.org/article/10.1088/1748-9326/3/3/034006/meta. Recent research on environmental trends in the Sahel has questioned the assumption of widespread land degradation and desertification in the region. For a discussion, see the special issue on the greening of the Sahel in the Journal of Arid Environments 2005, vol .63. For a comprehensive problematization of the debate on the trends and concept of desertification which facilitates comparison across regions, see the edited volume by Behnke & Mortimore 2016; Selby, J. and C. Hoffmann, 2014. Beyond scarcity: Rethinking water, climate change and conflict in the Sudans. Global Environmental Change, vol. 29, pp. 360-370. Available at https://doi.org/10.1016/j.gloenvcha.2014.01.008.

[b] Bromwich, B., 2018. Power, contested institutions and land: repoliticising analysis of natural resources and conflict in Darfur. Journal of Eastern African Studies, vol. 12, Issue 1, pp. 1-21. Available at https://doi.org/10.1080/17531055.2017.1403782; De Juan, A., 2015. Long-term environmental change and geographical patterns of violence in Darfur, 2003-2005. Political Geography, vol. 45, pp. 22-33. Available at https://doi.org/10.1016/j.polgeo.2014.09.001; Olsson, O., 2016. Climate Change and Market Collapse: A Model Applied to Darfur. Games, vol. 7, Issue 1, p.9. Available at https://doi.org/10.3390/g7010009.

Box 2. The Syrian case

The demonstrations preceding the Syrian civil war have been argued to be in part the result of climate change, but the steps in the suggested causal chain are contested.[a] First, while several studies argue that climate change made a multi-year drought more likely, this is contested by some.[b] Second, agricultural policies and overuse of water, and the push for agricultural expansion into marginal lands are acknowledged by all studies[c] to increase vulnerability and drought, but its relative importance in causing the agricultural slump during 2007-2009 varies considerably, with several seeing this component as far more important than the meteorological drought. Third, while there have been arguments about a wholesale agricultural collapse in the north-eastern part of the Syrian Arab Republic, satellite-derived data show clear signs of recovery after the worst meteorological drought.[d] Fourth, while not a collapse as such, there was a major production downturn that could have increased outmigration considerably to urban and peri-urban areas.[e]

Although there is agreement on the likely increase in outmigration, good data on migration numbers do not exist, and a lively debate on the scale of migration is not settled with critics also pointing to considerable pre-drought migration.[f]

Fifth, the argument that this migration overwhelmed the labour market and social services in the receiving areas is contested. Critics[g] argue that migrants mostly went to the countryside looking for agricultural work and that

the cities before 2007 did not provide enough jobs. Sixth, the argument that some of the cities and surrounding rural areas that saw the heaviest in-migration were also the locus of the initial demonstrations in 2011 is nuanced in that there is little evidence that the migrants themselves were the target of grievances or active in the demonstrations, but that the handling of the agricultural crisis and the predicament of the migrants helped fuel existing grievances against the authorities. While there is considerable debate, experts suggest that the role of climate change was limited to helping ignite peaceful demonstrations, but not escalation.[h] A major problem with the debate over the suggested links above, except for the meteorological drought, is the lack of quality data.

While the role of drought in triggering the Syrian conflict is debated, studies investigating the ongoing conflict have found the following: (i) drought increases some forms of conflict intensity, arguably over agricultural resources; (ii) agriculture has become more vulnerable to drought during the conflict, potentially constituting a vicious cycle between ongoing conflict and vulnerability to climate hazards whereby these two factors reinforce each other,[i] and (iii) agriculture is a crucial source of funds and food.[j]

[a] See separate brief for a fuller discussion of the potential role of climate change prior to and during the conflict.

[b] Selby, J. and others, 2017. Climate change and the Syrian civil war revisited. *Political Geography*, vol. 60, pp. 232-244. Available at https://doi.org/10.1016/j.polgeo.2017.05.007.

[c] Châtel, F. D., 2014. The Role of Drought and Climate Change in the Syrian Uprising: Untangling the Triggers of the Revolution. *Middle Eastern Studies*, vol. 50, Issue 4, pp. 521-535. Available at https://doi.org/10.1080/00263206.2013.850076; Eklund, L. and others, n. d. *Understanding climate-conflict relationships requires shifting from meteorological to agricultural drought indicators* (under review); Feitelson, E. and A. Tubi, 2017. A main driver or an intermediate variable? Climate change, water and security in the Middle East. *Global Environmental Change*, vol. 44, pp. 39-48. Available at https://doi.org/10.1016/j.gloenvcha.2017.03.001; Fröhlich, C. J., 2016. Climate migrants as protestors? Dispelling misconceptions about global environmental change in pre-revolutionary Syria. *Contemporary Levant*, vol. 1, Issue 1, pp. 38-50. Available at https://doi.org/10.1080/20581831.2016.1149355; Gleick, P. H., 2014. Water, Drought, Climate Change, and Conflict in Syria. *Weather, Climate, and Society*, vol. 6, Issue 3, pp. 331-340. Available at https://doi.org/10.1175/WCAS-D-13-00059.1; Ide, T., 2018a. Climate War in the Middle East? Drought, the Syrian Civil War and the State of Climate-Conflict Research. *Current Climate Change Reports*, vol. 4, Issue 4, pp. 347-354. Available at https://doi.org/10.1007/s40641-018-0115-0; Kelley, C. P. and others, 2015. Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, No. 112, vol. 11, pp. 3241-3246. Available at https://doi.org/10.1073/pnas.1421533112; Selby, J. and others, 2017. Climate change and the Syrian civil war revisited: A rejoinder. *Political Geography*, vol. 60, pp. 253–255. Available at https://doi.org/10.1016/j.polgeo.2017.08.001**;** Selby, J., 2019. Climate change and the Syrian civil war, Part II: The Jazira's agrarian crisis. *Geoforum*, vol. 101,
pp. 260-274. Available at https://doi.org/10.1016/j.geoforum.2018.06.010; Werrell, C. E., F. Femia and T. Sternberg, 2015. Did We See It Coming?: State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt. *SAIS Review of International Affairs*, vol. 35, Issue 1, pp. 29-46. Available at https://doi.org/10.1353/sais.2015.0002.

[d] Eklund and others, under review.

[e] Eklund, L. and others, 2017. How conflict affects land use: agricultural activity in areas seized by the Islamic State. *Environmental Research Letters*, vol. 12, Issue 5, 054004. Available at https://doi.org/10.1088/1748-9326/aa673a.

[f] Fröhlich, 2016.

[g] Selby and others, 2017.

[h] Châtel, 2014; Eklund and others, under review; Feitelson and Tubi, 2017; Gleick, 2014; Kelley and others, 2015; Selby and others, 2017; Werrell, Femia and Sternberg, 2015.

[i] Buhaug, H. and N. von Uexkull, 2021. Vicious circles: Violence, vulnerability, and climate change. *Annual Review of Environment and Resources*, vol. 46 (in press).

[j] Eklund and others, 2017; Eklund and others, under review; Jaafar, H. H. and E. Woertz, 2016. Agriculture as a funding source of ISIS: A GIS and remote sensing analysis. *Food Policy*, vol. 64, pp. 14-25. Available at https://doi.org/10.1016/j.foodpol.2016.09.002; Linke, A. M. and B. Ruether, 2021. Weather, wheat and war: Security implications of climate variability for conflict in Syria. *Journal of Peace Research*, vol. 58, Issue 1. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320973070.

E. Inter-State relations and transboundary water management

There is a relatively broad consensus in the global literature that transboundary water cooperation is far more common than militarized disputes. Research suggests that the use of violence over water is extremely rare in inter-State relations.[37] Such relations are strengthened by trade networks and cooperation, even if outside the water sector.[38] For instance, increased trade in virtual water decreases the likelihood of conflict. For border disputes, a relatively common inter-State conflict, borders along surface water are less likely to be contested.[39] Even the common assumption that asymmetries through upstream-downstream relations produce conflict has not been shown to predict violent conflict in statistical analyses. In short, there is no support for inter-State wars over water.[40]

This is even true when considering water disputes as part of territorial issues more generally; compared to other land issues, freshwater disputes more often result in some form of conflict management.[41] Democratic institutions, either domestic or regional, are also key factors in preventing conflicts as they often follow conflict resolution norms or make hydrological data available to involved parties.[42] Increasing cross-border cooperation over water is conducive to more peaceful inter-State relations in general.[43] Wars between countries have become rare, and there are few historic

37 Bernauer, T. and T. Böhmelt, 2014. Basins at Risk: Predicting International River Basin Conflict and Cooperation. *Global Environmental Politics*, vol. 14, Issue 4, pp. 116-138. Available at https://doi.org/10.1162/GLEP_a_00260; Brochmann, M. and N. P. Gleditsch, 2012. Shared rivers and conflict – A reconsideration. *Political Geography*, vol. 31, Issue 8, pp. 519-527. Available at https://doi.org/10.1016/j.polgeo.2012.11.001.

38 Beck, L. and others, 2014. Implications of hydro-political dependency for international water cooperation and conflict: Insights from new data. *Political Geography*, vol. 42, pp. 23-33. Available at https://doi.org/10.1016/j.polgeo.2014.05.004.

39 Furlong, K., N. P. Gleditsch and H. Hegre, 2006. Geographic Opportunity and Neomalthusian Willingness: Boundaries, Shared Rivers, and Conflict. *International Interactions*, vol. 32, Issue 1, pp. 79-108. Available at https://doi.org/10.1080/03050620600596421; Goemans, H. E. and K. A. Schultz, 2017. The Politics of Territorial Claims: A Geospatial Approach Applied to Africa. *International Organization*, vol. 71, Issue 1, pp. 31-64. Available at https://doi.org/10.1017/S0020818316000254.

40 Brochmann, M. and P. R. Hensel, 2009. Peaceful Management of International River Claims. *International Negotiation*, vol. 14, Issue 2, pp. 393-418. Available at https://doi.org/10.1163/157180609X432879; De Angelis, E. and others, 2017. Virtual water trade and bilateral conflicts. *Advances in Water Resources*, vol. 110, 549-561-549-561. Available at https://doi.org/10.1016/j.advwatres.2017.04.002; Devlin, C. and C. S. Hendrix, 2014. Trends and triggers redux: Climate change, rainfall, and interstate conflict. *Political Geography*, vol. 43, pp. 27-39. Available at https://doi.org/10.1016/j.polgeo.2014.07.001.

41 Owsiak, A. P. and S. M. Mitchell, 2019. Conflict Management in Land, River, and Maritime Claims. *Political Science Research and Methods*, vol. 7, Issue 1, p. 43. Available at http://dx.doi.org/10.1017/psrm.2016.56.

42 Karreth, J. and J. Tir, 2018. International agreement design and the moderating role of domestic bureaucratic quality: The case of freshwater cooperation. *Journal of Peace Research*, vol. 55, Issue 4, pp. 460-475. Available at https://doi.org/10.1177/0022343317749271; Tir, J. and D. M. Stinnett, 2012. Weathering climate change: Can institutions mitigate international water conflict? *Journal of Peace Research*, vol. 49, Issue 1, pp. 211-225. Available at https://doi.org/10.1177/0022343311427066.

43 Ovodenko, A., 2016. Regional Water Cooperation: Creating Incentives for Integrated Management. *Journal of Conflict Resolution*, vol. 60, Issue 6, pp. 1071-1098. Available at https://doi.org/10.1177/0022002714553109; Zeitoun, M. and N. Mirumachi, 2008. Transboundary water interaction I: reconsidering conflict and cooperation. *International Environmental Agreements: Politics, Law and Economics*, vol. 8, Issue 4, p. 297. Available at https://doi.org/10.1007/s10784-008-9083-5.

instances of inter-State violence over water.[44] Disputes over rivers are far more likely to lead to treaties on water allocation or other regulating institutions.[45] A significant share of inter-State water agreements has been made possible through the support of credible third parties, such as other Governments or regional organizations. Such actors can create credible commitments and reduce frictions through mediation or the establishment of transboundary river mechanisms. Particularly third-party actors or other treaty enforcement mechanisms (for instance, binding thresholds of quantity or quality of water) can promote bilateral or regional peace. Regional water cooperation is also beneficial for knowledge sharing (for instance, on irrigation methods or maintenance) and provides potential collaboration beyond the water sector.[46] Even with inter-State disputes over water access remaining non-violent, bilateral relationships do not necessarily remain stable and collaborative at all times. Inter-State relations over water can be complex, with some countries cooperating over one issue whilst engaging in violent conflict over another.[47]

Box 3. The effect of war on water security

War affects water resources in multiple ways. Water provision is perhaps the most essential factor for humanitarian responses during civil wars. Water is required daily through individual needs (nutrition, sanitation, hygiene, and others) and within several work sectors, especially agriculture. In several Arab States, the water sector continues to suffer from long-term destruction of the infrastructure as a result of past wars or ongoing armed conflicts which further impede safe access to water for vulnerable populations. Thus, linking water scarcity and conflict concerns not only coping with climate change, but also addressing the consequences of war.

Armed conflict can be a key driver of water scarcity. For example, a significant amount of internal displacement during the Yemeni civil war may not be directly caused by fighting, but is to a large extent due to damages to critical water, sanitation and hygiene infrastructure.[a] Fighting can also explain changes in land usage, especially for uses requiring water resources.[b] For instance, the Food and Agriculture Organization (FAO) estimated that in Iraq, areas with increased fighting lost more than 75 per cent of their grain production, largely due to lost irrigation. Water resources were also targeted by armed groups. For example, the so-called Islamic State of Iraq

44 Bernauer, T. and others, 2012. Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset. *International Interactions*, vol. 38, Issue 4, pp. 529-545. Available at https://doi.org/10.1080/03050629.2012.697428.

45 Dinar, S. and others, 2015. Climate change, conflict, and cooperation: Global analysis of the effectiveness of international river treaties in addressing water variability. *Political Geography*, vol. 45, pp. 55-66. Available at https://doi.org/10.1016/j.polgeo.2014.08.003; Giordano, M. and others, 2014. A review of the evolution and state of transboundary freshwater treaties. *International Environmental Agreements: Politics, Law and Economics*, vol. 14, Issue 3, pp. 245-264. Available at https://doi.org/10.1007/s10784-013-9211-8; Mitchell, S. M. and N. A. Zawahri, 2015. The effectiveness of treaty design in addressing water disputes. *Journal of Peace Research*, vol. 52, Issue 2, pp. 187-200. Available at https://doi.org/10.1177/0022343314559623.

46 Ide, T., 2018b. Does environmental peacemaking between states work? Insights on cooperative environmental agreements and reconciliation in international rivalries. *Journal of Peace Research*, vol. 55, Issue 3, pp. 351-365. Available at https://doi.org/10.1177/0022343317750216.

47 Saidi, M. and A. Hefny, 2018. Institutional arrangements for beneficial regional cooperation on water, energy and food priority issues in the Eastern Nile Basin. *Journal of Hydrology*, vol. 562, pp. 821-831. Available at https://doi.org/10.1016/j.jhydrol.2018.05.009; Ide, T. and A. Detges, 2018. International Water Cooperation and Environmental Peacemaking. *Global Environmental Politics*, vol. 18, Issue 4, pp. 63-84. Available at https://doi.org/10.1162/glep_a_00478; Ide, T. and A. Detges, 2018. International Water Cooperation and Environmental Peacemaking. *Global Environmental Politics*, vol. 18, Issue 4, pp. 63-84. Available at https://doi.org/10.1162/glep_a_00478; Yoffe, S., A. T. Wolf and M. Giordano, 2003. Conflict and Cooperation Over International Freshwater Resources: Indicators of Basins at Risr1. *JAWRA Journal of the American Water Resources Association*, vol. 39, Issue 5, pp. 1109-1126. Available at https://doi.org/10.1111/j.1752-1688.2003.tb03696.x.

and the Levant (ISIL) has engaged in the looting and destruction of water pipes, pumps, channels, and wells.[c] Deteriorated irrigation infrastructure may furthermore create long-term water scarcity issues. This is the case when normally irrigated fields are abandoned and thereby exposed to desertification. Lasting damage can also occur through unregulated water abstraction.[d]

War affects water resources even far away from combat. This includes declining water quality and quantity through lack of fuel for groundwater pumping, damaged water pipes or dysfunctional wastewater treatment, among others. Driven by continuous fighting, the recent cholera outbreak in Yemen has been the worst such epidemic in modern history.[e] Ongoing combat also significantly hampers vaccination programmes which can have long-term health consequences for local populations.[f] Such events then contribute to or even drive internal displacement or migration out of the country.

Although rebuilding essential water services is a priority once fighting ceases, the consequences of destroyed water resources can be felt decades after. In fact, improving water access for the general population is a key driver for sustainable development.[g] For instance, access to clean water decreases early childhood mortality and waterborne infectious diseases.[h] Apart from preventing illness, improving water access significantly improves living conditions even for those who already have a safe source of water. For example, access to piped household water has been shown to strengthen social integration and mental health in Morocco.[i]

[a] International Committee of the Red Cross (ICRC), 2015. *Bled dry. How war in the Middle East is bringing the region's water supplies to breaking point. An ICRC report.* Available at https://www.icrc.org/en/download/file/5508/full_report-water-middle-east-icrc.pdf.

[b] Baumann, M. and T. Kuemmerle, 2016. The impacts of warfare and armed conflict on land systems. *Journal of Land Use Science*, vol. 11, Issue 6, pp. 672-688. Available at https://doi.org/10.1080/1747423X.2016.1241317.

[c] FAO (2017). Iraq: Agriculture damage and loss needs assessment. Rome. Available at https://www.fao.org/3/i7810e/i7810e.pdf.

[d] United Nations Educational, Scientific and Cultural Organization (UNESCO) World Water Assessment Programme, 2019. *World Water Development Report 2019: Leaving No One Behind.* UNESCO. Available at https://unesdoc.unesco.org/ark:/48223/pf0000367306; Zeitoun, M. and M. Talhami, 2016. The impact of explosive weapons on urban services: Direct and reverberating effects across space and time. *International Review of the Red Cross*, vol. 98, Issue 901, pp. 53-70. Available at https://doi.org/10.1017/S1816383117000157.

[e] Camacho, A. and others, 2018. Cholera epidemic in Yemen, 2016-18: an analysis of surveillance data. *The Lancet Global Health*, vol. 6, Issue 6, pp. e680-e690. Available at https://doi.org/10.1016/S2214-109X(18)30230-4.

[f] Ngo, N. V. and others, 2020. Armed conflict, a neglected determinant of childhood vaccination: some children are left behind. *Human Vaccines & Immunotherapeutics*, vol. 16, Issue 6, pp. 1454-1463. Available at https://doi.org/10.1080/21645515.2019.1688043.

[g] Fewtrell, L. and others, 2005. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, vol. 5, Issue 1, pp. 42-52. Available at https://doi.org/10.1016/S1473-3099(04)01253-8; Gates, S. and others, 2012. Development Consequences of Armed Conflict. *World Development*, vol. 40, Issue 9, pp. 1713-1722. Available at https://doi.org/10.1016/j.worlddev.2012.04.031.

[h] Duflo, E. and others, 2015. *Toilets Can Work: Short and Medium Run Health Impacts of Addressing Complementarities and Externalities in Water and Sanitation* (No. w21521; p. w21521). National Bureau of Economic Research. Available at https://doi.org/10.3386/w21521.

[i] Devoto, F. and others, 2012. Happiness on Tap: Piped Water Adoption in Urban Morocco. *American Economic Journal: Economic Policy*, vol. 4, Issue 4, pp. 68-99. Available at https://doi.org/10.1257/pol.4.4.68.

For the Arab region, far fewer studies at the inter-State level exists. A comprehensive analysis of global hydrobasins classified no basins in the Arab region as at very high risk, but much of it is still categorized as at risk through exacerbating factors linked to declining water reserves and high-water variability.[48] Comparing results across other related studies,[49] Euphrates-Tigris and the Juba-Shabelle are the basins most at risk in the region. The majority of qualitative case studies are in line with these general trends and provide more nuance to understanding country relations over water issues. For instance, conflict of interest and diplomatic crises can persist even with otherwise low threat levels.[50]

F. Food insecurity and civil conflict

While the literature on food and conflict tends to centre around lower-level forms of conflict in terms of organization and battle-related deaths (for instance, various forms of unrest such as demonstrations and riots), there has also been an increasing number of quantitative studies, covering various parts of the world, looking at the effect of food insecurity and the outbreak of intra-State conflict in recent years. For example, research has shown that increasing international and domestic food prices are positively correlated with an increase in the incidence of demonstrations, riots and civil conflict.[51] In addition, studies that focus on metric measures for food insecurity, such as child stunting or undernutrition as a cause of armed conflict, find that food insecurity is linked with the onset of conflict.[52] Studies also suggest that it matters whether the increase in a commodity price occurs in the labour-intensive agricultural sector or the less labour-intensive natural resource sector. For example, Dube and Vargas find that, for Colombia, higher wages in the agricultural sector can reduce opportunity costs to join a conflict, whereas increasing divisible income from the natural resource sector can increase conflict potential by offering greater pay-offs from resource exploitation. They find this effect looking at armed civil conflict, including one-sided violence and sabotage.[53] In terms of conflict dynamics, increased access to food resources increases the opportunity for rebel groups to engage and continue fighting, whereas decreasing food availability increases the risk that rebel groups will engage in conflict over food resources. Also, the time horizon seems to have an effect on the probability of employing violent means. Rebel groups with a short time horizon tend to engage in violent means against the civilian population to immediately extract and obtain food in the short run while groups with a longer time horizon choose cooptation as the preferred strategy based on the benefits of future

48 Bernauer and Böhmelt, 2014.

49 De Stefano, L. and others, 2017. Assessment of transboundary river basins for potential hydro-political tensions. *Global Environmental Change*, vol. 45, pp. 35-46. Available at https://doi.org/10.1016/j.gloenvcha.2017.04.008.

50 Swain, A., 2004. *Managing Water Conflict*. Routledge; Wolf, A. T., S. B. Yoffe and M. Giordano, 2003. International waters: identifying basins at risk. *Water Policy*, vol. 5, Issue 1, pp. 29-60. Available at https://doi.org/10.2166/wp.2003.0002; Yoffe, S. and others, 2004. Geography of international water conflict and cooperation: Data sets and applications. *Water Resources Research*, vol. 40, Issue 5. Available at https://doi.org/10.1029/2003WR002530; Zeitoun and Mirumachi, 2008.

51 Arezki, R. and M. Brueckner, 2014. Effects of International Food Price Shocks on Political Institutions in Low-Income Countries: Evidence from an International Food Net-Export Price Index. *World Development*, vol. 61, pp. 142-153. Available at https://doi.org/10.1016/j.worlddev.2014.04.009.

52 Koren, O. and B. E. Bagozzi, 2016. From global to local, food insecurity is associated with contemporary armed conflicts. *Food Security*, vol. 8, Issue 5, pp. 999-1010. Available at https://doi.org/10.1007/s12571-016-0610-x.

53 Dube, O. and J. F. Vargas, 2013. Commodity Price Shocks and Civil Conflict: Evidence from Colombia. *The Review of Economic Studies*, vol. 80, Issue 4, pp. 1384-1421. Available at https://doi.org/10.1093/restud/rdt009.

interaction with the local population.[54] The linkages between food insecurity and conflict are complex and endogenous. There is, however, an emerging agreement that food insecurity, especially in the form of increasing food prices, is related to various forms of conflict.[55]

Box 4. The effect of war on food security

Food insecurity is both a cause and consequence of conflict, contributing to a conflict trap that can be difficult to escape. During the Arab Spring, one of the main slogans in Egypt was 'bread, freedom and social justice', a telling order of the importance of food. The Arab region presents multiple examples of how food insecurity is linked to instability, particularly in the form of bread uprisings.[a] People living in countries affected by armed conflict are more likely to be affected by food insecurity and undernourishment; a situation often aggravated by forced migration and displacement. Indeed, almost all of today's major food crises are in countries experiencing endemic conflict, such as Iraq, the Sudan and Yemen.[b] The World Food Programme (WFP) spends more than 80 per cent of its operational budget in conflict zones.[c] Conflict impacts food security directly by forcing people to leave their livelihoods and destroying crops and agricultural yields; and indirectly, through reduced economic activity, disrupting food distribution, health services, and basic sanitation, which reduces people's income and ability to access food.

Several examples in the region show how these processes are interlinked. The current war in Yemen has led to large-scale suffering, hunger and malnutrition at extreme levels with 45 per cent of deaths being children under five.[d] Yemen is now the world's largest emergency response programme of WFP.[e] There are concerns that warring parties may have violated Yemenis' right to food and engaged in aid theft.[f] Climate-related shocks further reduce food security with locust threatening food production and flash floods having severe impacts in affected areas. Another example is the conflict in the Syrian Arab Republic, where large-scale fighting, economic stagnation, forced migration, and displacement have pushed millions into food insecurity, reaching an all-time high with around 60 per cent of the population having been food insecure at the end of 2020.[g]

With the negative impacts of conflict on livelihoods, it is recognized that protracted armed conflict affects population's resilience and levels of nutrition. As seen in the Gaza strip, conflict can hinder the capacity of the population to diversify sources of income, thereby making it increasingly difficult to cope with conflict-induced shocks.

[a] For example in Egypt (1977), Morocco and Tunisia (1984), the Sudan (1985), Algeria and Jordan (1988), Lebanon (1989), and across the Middle East during 2007-2008 (Sadiki, L., 2000. Popular Uprisings and Arab Democratization. International Journal of Middle East Studies, vol. 32, Issue 1, pp. 71-95. Available at https://www.cambridge.org/core/journals/international-journal-of-middle-east-studies/article/abs/popular-uprisings-and-arab-democratization/D278E9DBEB3F2072BEE7D8389EFEE837).

[b] Food Security Information Network (FSIN), 2020. *Global Report on Food Crises 2020.* Available at https://www.fsinplatform.org/sites/default/files/resources/files/GRFC_2020_ONLINE_200420.pdf.

[c] World Food Programme (WFP), 2019. Fact sheet: Hunger & conflict. Available at https://reliefweb.int/report/world/wfp-fact-sheet-hunger-conflict-june-2019.

54 Koren, O. and B. E. Bagozzi, 2017. Living off the land: The connection between cropland, food security, and violence against civilians. *Journal of Peace Research*, vol. 54, Issue 3, pp. 351-364. Available at https://doi.org/10.1177/0022343316684543.

55 Maystadt, J.-F., J.-F Trinh Tan and C. Breisinger, 2014. Does food security matter for transition in Arab countries? *Food Policy*, vol. 46, pp. 106-115. Available at https://doi.org/10.1016/j.foodpol.2014.01.005; Pinstrup-Andersen, P. and S. Shimokawa, 2008. Do poverty and poor health and nutrition increase the risk of armed conflict onset? *Food Policy*, vol. 33, Issue 6, pp. 513-520. Available at https://doi.org/10.1016/j.foodpol.2008.05.003; Raleigh, C., H. J. Choi and D. Kniveton, 2015. The devil is in the details: An investigation of the relationships between conflict, food price and climate across Africa. *Global Environmental Change*, vol. 32, pp. 187-199. Available at https://doi.org/10.1016/j.gloenvcha.2015.03.005.

[d] World Bank, 2017. Yemen: Immediate Priorities for Post-Conflict Recovery of the Health Sector. Input to the Yemen Policy Note no. 4 on Inclusive Services Delivery. World Bank. Available at https://documents1.worldbank.org/curated/en/349331508408515508/pdf/120530-WP-P159636-PUBLIC-Yemen-Health-Policy-Note-Input-to-PN-RA-edits.pdf.

[e] WFP, 2021. Yemen Emergency. Available at https://www.wfp.org/emergencies/yemen-emergency.

[f] United Nations Security Council, 2021. Final report of the Panel of Experts on Yemen (S/2021/79). Available at https://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/S_2021_79.pdf.

[g] WFP and Mercy Corps, 2021. Whole of Syria Food Security Sector: Situation Report. Second quarter. Available at https://fscluster.org/sites/default/files/documents/wos_fss_sitrep_2_january_to_june_2021_final.pdf.

There are several studies on the potential relationship between climate hazards and political instability in different manifestations in the Arab region. While food prices are strongly affected by non-climatic factors, there is a non-negligible effect of weather anomalies on them as well. A study on this issue covering the Middle East during 2007-2008 found that riots were triggered by rising food prices, but that the unrest was underpinned by factors such as economic inequality and repression.[56] Droughts in wheat-growing regions in China during 2011 are strongly correlated with increased global wheat prices as the country mitigated production shortfalls by buying wheat on the international market. This arguably helped fuel civil unrest in Egypt as bread prices tripled.[57] Additionally, simultaneous droughts in the Middle East during 2010 led to depressing yields in Arab States, driving global prices of wheat up by 40 per cent in late 2010.[58] This amplified existing grievances against Governments and escalated grievances in countries whose fiscal space was limited, preventing them from cushioning poorer citizens from price hikes. Relatedly, another study finds global food price hikes to worsen food security, in turn increasing risk of civil conflict in the Arab region more than poverty, inequality or governance does, making the region stand out from the rest of the world.[59]

G. Gaps, limitations and summary

Based on the literature both covering the whole world and the Arab region, there is considerable space for improvement. One widely acknowledged limitation in the statistical literature is that climate-conflict theories are very elaborated yet difficult to operationalize. This can be an important source of conflicting findings and preventing tailored interventions.[60] Climate-conflict studies sometimes use the same mechanisms to explain quite different types of conflict, namely, civil war, interethnic violence, massacres of civilians, demonstrations, and even robbery and domestic violence. Since certain sub-forms of

56 Bush, R., 2010. Food Riots: Poverty, Power and Protest. *Journal of Agrarian Change*, vol. 10, Issue 1, pp. 119-129. Available at https://doi.org/10.1111/j.1471-0366.2009.00253.x.

57 Sternberg, T., 2012. Chinese drought, bread and the Arab Spring. *Applied Geography*, vol. 34, pp. 519-524. Available at https://doi.org/10.1016/j.apgeog.2012.02.004.

58 Soffiantini, 2020.

59 Maystadt, J.-F., J.-F Trinh Tan and C. Breisinger, 2014.

60 For similar arguments, see Koubi, 2019; Sakaguchi, Varughese and Auld, 2017; Von Uexkull, N. and H. Buhaug, 2021. Security implications of climate change: A decade of scientific progress. *Journal of Peace Research*, vol. 58, Issue 1, pp. 3-17. Available at https://doi.org/10.1177/0022343320984210.

violence have been found to have different causal mechanisms, this can be a risky strategy. Divergent findings are also affected by the specific statistical method, control variables, operationalization of causal variables, and data sources used.[61] Another shortcoming is correlating short-term changes in weather patterns, such as droughts, with conflict, making the strong assumption that this has substantively similar impacts as changes in average climate conditions. Although this has been criticized, most scholars see merit to it, but with caveats.[62] The lower consensus in findings of studies on the contemporary world compared to studies on climatic changes for past societies might be that the former does not model climate change, but rather inter-annual variation. Despite these shortcomings, in contexts with high agricultural dependence, poverty and marginalization, there is agreement on a linkage between the effect of hazards and conflict. Table 1 summarizes the main findings from the global literature, and table 2 summarizes the concomitant results for the literature specific to the Arab region.

Table 1. Summary of the most important findings from the general literature

- Precipitation has a mixed relationship to conflict.
- Temperature has a stronger effect on smaller conflicts.
- The onset of civil conflicts is less related to climate hazards than ongoing conflicts/events;
- Iterative or cumulative hazards increase conflict risk.
- Studies accounting for vulnerable socioeconomic or political factors find more effects of climate anomalies on conflict risk.
- Few studies find general effects of migration on conflict risk.
- Changes in climate increased risk consistently in pastoral societies.
- Studies that conduct sub-analyses of particularly vulnerable contexts or model mechanisms tend to find more of an effect of climate anomalies on conflict risk.

Source: Compiled by authors.

61 For an illustration of this, see O'Loughlin, J., A. M. Linke and F. D. W. Witmer, 2014. Modeling and data choices sway conclusions about climate-conflict links. *Proceedings of the National Academy of Sciences*, vol. 111, Issue 6, pp. 2054-2055. Available at https://doi.org/10.1073/pnas.1323417111. For the same argument but with far-reaching conclusions, see Selby, J., 2014. Positivist Climate Conflict Research: A Critique. *Geopolitics*, vol. 19, Issue 4, pp. 829-856. Available at https://doi.org/10.1080/14650045.2014.964865; Vesco and others, 2020.

62 Dell, M., B. F. Jones and B. A. Olken, 2014. What Do We Learn from the Weather? The New Climate-Economy Literature. *Journal of Economic Literature*, vol. 52, Issue 3, pp. 740-798. Available at https://doi.org/10.1257/jel.52.3.740; Koubi, 2019; Roche, K. R. and others, 2020. Climate change and the opportunity cost of conflict. *Proceedings of the National Academy of Sciences*, vol. 117, Issue 4, p. 1935. Available at https://doi.org/10.1073/pnas.1914829117; Selby, 2014. See also subheading 'General climate risk' of the current report.

Table 2. Summary of findings from the literature on the Arab region

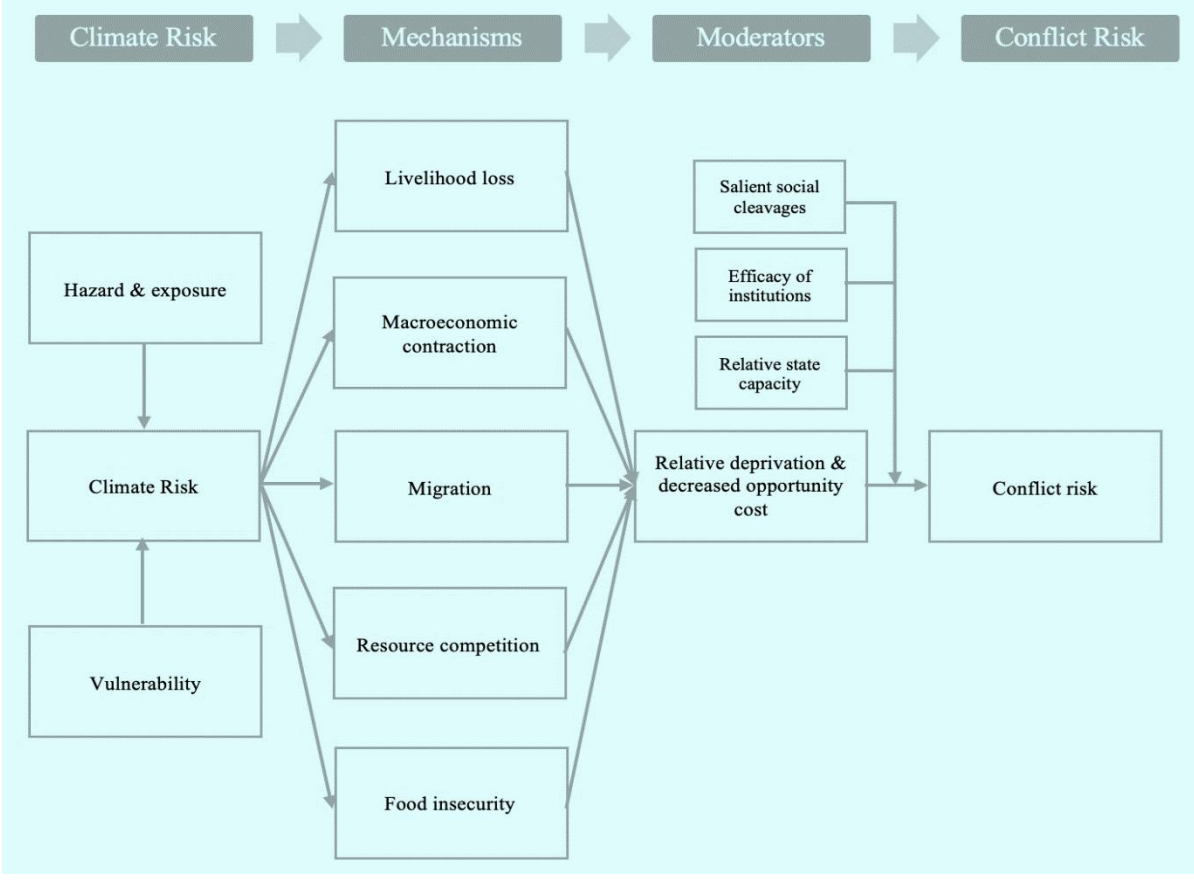
- Findings on temperature anomalies are mixed.
- Majority of studies find less precipitation to increase risk.
- Studies of particularly vulnerable areas find a higher effect of temperature.
- Higher food prices are associated with unrest.
- Water scarcity can trigger both cooperative and low-intensity violence events.

Source: Compiled by authors.

2. Conceptual framework

Drawing on the literature on the subject, it is hard to argue a direct causal link between climate change and armed conflict. However, climate change can indirectly increase the risk of conflict by exacerbating factors that can, in a complex interplay, lead to conflict. Since climatic conditions rarely affect conflict risk directly, the suggested framework considers climate-driven risks that plausibly increase the likelihood, severity or duration of violence via intermediate mechanisms, whose salience is affected by moderators. Figure 1 depicts a simplified conceptual framework of how climate risks may translate into conflict risks and which mechanisms and moderators are involved in this process. For simplicity, the way the different mechanisms and moderators interact with one another is not depicted in the figure. Likewise, possible feedback loops between the mechanisms and moderators are left out.

Figure 1. Plausible linkages between general climate risk and conflict risk



Source: Compiled by authors.

A. Climate risk

Consistent with the definitions by the Intergovernmental Panel on Climate Change (IPCC), climate-related risks are understood as the product of three interdependent determinants, namely, hazard, exposure and vulnerability. Risk is interpreted broadly to cover any potential adverse consequence where something of value is at stake and the outcome is uncertain.[63] Climate risk is assumed to be the type of climate-driven negative impacts and human responses that affect conflict risk.

The first determinant of climate risk, namely, **hazard**, refers to the potential occurrence of climate-related physical events or trends with negative consequences. The following two main categories of hazards are considered: (i) gradual and durable changes, such as long-term warming, drying and sea-level rise, usually observed at decadal scales; and (ii) short-term changes, including droughts or extreme weather events, observed at inter-annual or shorter temporal scales that revert to pre-shock properties. The second determinant of climate risk is **exposure** to hazards, largely shaped by demographic factors, such as population size and settlement patterns, but also by changes in these, through population growth, urbanization and migration. For instance, coastal populations are more exposed to groundwater depletion through seawater intrusion. Socioeconomic factors further exacerbate exposure, for instance, low-income households are often pushed to settle in exposed areas such as river deltas or other floodplains.[64] This disproportionately affects populations displaced by war who are already exposed to multiple hazards. An example are flash flooding events in camps of internally displaced people (IDPs) in many parts of Somalia.[65]

Vulnerability captures the propensity to be adversely affected by a hazard. It may be explored at different social scales, from the individual and household levels to society at large. For instance, women, men, girls, and boys are affected differently by climate change and disasters.[66] Social norms, gender roles and gender-based discrimination make women and girls more vulnerable to climate change and disaster [67] Low economic development and high economic inequality are commonly seen as key drivers of vulnerability as financial strains are associated with poor housing quality and public

63 Cardona, O.-D. and others, 2012. Determinants of Risk: Exposure and Vulnerability. In Christopher B. Field and others (eds.). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (pp. 65-108). Cambridge University Press. Available at https://doi.org/10.1017/CBO9781139177245.005. For a more detailed description of risk, see the IPCC glossary in Matthews, 2018; and Oppenheimer, M. and others (eds.), 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 1039-1099). Cambridge University Press.

64 Garschagen, M. and P. Romero-Lankao, 2015. Exploring the relationships between urbanization trends and climate change vulnerability. *Climatic Change*, vol. 133, Issue 1, pp. 37-52. Available at https://doi.org/10.1007/s10584-013-0812-6.

65 United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2019. Somalia Flash Update No. 2: Humanitarian impact of flooding. Available at https://reliefweb.int/report/somalia/ocha-somalia-flash-update-2-humanitarian-impact-flooding-28-october-2019-enso.

66 The General Recommendation No. 37 of the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) acknowledges that women and girls are more vulnerable to climate change and disaster due to gender-based inequalities (Convention on the Elimination of Discrimination against Women (CEDAW), 2018. General Recommendation No. 37 on the Gender-related dimension of disaster risk reduction in the context of climate change (CEDAW/C/GC/37). Available at https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolno=CEDAW/C/GC/37&Lang=en).

67 Neumayer, E. and T. Plümper, 2007. The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981-2002. *Annals of the Association of American Geographers*, vol. 97, Issue 3, pp. 551-566. Available at https://doi.org/10.1111/j.1467-8306.2007.00563.x.

goods delivery, further limiting the scope of coping strategies and increasing sensitivity or susceptibility to harm. This can be further compounded by intersectional identities and needs of people in any given society. People living in poverty and those forcibly relocated lose more of their wealth to hazards than the better-off, and tend to receive less post-disaster assistance from their social network and through insurance schemes.[68]

Key factors that define vulnerability are coping and adaptive capacity. Coping capacity relates to the ability of people, institutions, organizations, and systems to address, manage and overcome the negative impacts of a certain hazard and build resilience. It is divided into several categories including institutional capacity that measures the effective management of resources as well as governance that evaluates the quality of public services, political pressure, quality of policy design and implementation, and corruption. It is represented by the extent to which infrastructure such as communication (electricity, Internet and literacy levels), physical infrastructure such as technology and urban planning, and health care is prepared for climatic changes.[69]

B. Moving from climate risk to conflict risk

For climatic risks to increase conflict risk, several mechanisms are suggested. In order to maintain simplicity and to align with the mainstream argument in the literature, particularly contested mechanisms are left out. Thus, while there is solid psychological evidence that extreme heat increases aggressive emotions,[70] it remains a contested argument whether this translates into increased risk of collective violence. Mechanisms that are likely to be context-specific are not investigated either. For instance, studies on intergroup violence in East Africa find sometimes dry conditions, sometimes wet conditions and sometimes both to increase conflict risk.[71] These divergent findings are explained by cattle raiding patterns varying according to the strategies of different pastoral groups. Since cattle raiding, as a violent yet culturally accepted institution, does not exist outside pastoral areas of East Africa and a functional equivalent is difficult to envision, it is therefore not discussed further here. Finally, mechanisms that are underresearched such as conflicts over fisheries,[72] or that have to do with geopolitical considerations[73] that lend themselves less to general testing and prediction

68 Hallegatte, S. and others, 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. The World Bank. Available at https://doi.org/10.1596/978-1-4648-0673-5.

69 ESCWA and FAO, 2017. Arab Horizon 2030: Prospects for Enhancing Food Security in the Arab Region: Technical Summary (p. 41). Available at https://archive.unescwa.org/sites/www.unescwa.org/files/uploads/arab-horizon-2030-prospects-enhancing-food-security-summary-english.pdf.

70 Miles-Novelo, A. and C. A. Anderson, 2019. Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression. *Current Climate Change Reports*, vol. 5, Issue 1, pp. 36-46. Available at https://doi.org/10.1007/s40641-019-00121-2; Raleigh, C., A. Linke and J. O'Loughlin, 2014. Extreme temperatures and violence. *Nature Climate Change*, vol. 4, Issue 2, pp. 76-77. Available at https://www.nature.com/articles/nclimate2101?page=1.

71 Ember, C. R. and others, 2014. Rain and Raids Revisited: Disaggregating Ethnic Group Livestock Raiding in the Ethiopian-Kenyan Border Region. *Civil Wars*, vol. 16, Issue 3, pp. 300-327. Available at https://doi.org/10.1080/13698249.2014.966430; Schilling, J., 2012. *On Rains, Raids and Relations: A Multimethod Approach to Climate Change, Vulnerability, Adaptation and Violent Conflict in Northern Africa and Kenya.* Hamburg University. Available at https://d-nb.info/1024772357/34; Theisen, 2012; Witsenburg and Adano, 2009.

72 Hendrix, C. S. and S. M. Glaser, 2011. Civil conflict and world fisheries, 1952-2004. *Journal of Peace Research*, vol. 48, Issue 4, pp. 481-495. Available at https://doi.org/10.1177/0022343311399129; Mendenhall, E. and others, 2020. Climate change increases the risk of fisheries conflict. *Marine Policy*, Issue 117, 103954. Available at https://doi.org/10.1016/j.marpol.2020.103954.

73 Koubi, 2019.

are not included, without denying their potential importance. While a full empirical test of the causal mechanisms discussed below is yet to be conducted, there is considerable agreement on the plausibility of each of them. It is also important to remark that the exact pathways from climate change, via water scarcity and food security, to violence are still not fully understood.

The proposed links are non-deterministic and do not necessarily reflect the sole causes for violent behaviour. While violence is the visible outcome at a group level, the underlying processes cannot be conceptualized through one level of analysis; instead, they oscillate between the regional, national, subnational, community, and individual levels. The salience of mechanisms in increasing conflict risk is affected by moderating factors that are generic for explaining civil violence. These can broadly be thought of as factors that affect the rationality of using violent or non-violent means that affect the feasibility of organizing anti-State violence.

1. Mechanisms

Climate change is generally expected to have negative consequences in terms of **livelihood loss and deprivation**, particularly for countries where the performance of economic sectors is closely linked with climatic conditions. First, livelihood loss and falling incomes reduce the opportunity costs of criminal behaviour, including participating in collective violence.[74] When legal wage-earning opportunities drop, inevitably income does too, increasing the relative attractiveness of rebel groups and other illegal activities. This argument has received criticism for neither considering the inherent political motivation of insurgents[75] nor the ability of rebel leaders to provide selective incentives to would-be insurgents in a situation of general economic contraction. Nevertheless, the argument that individual-level poverty increases conflict risk remains influential. Second, worsening socioeconomic situations generally increase frustration and thereby the inclination to support anti-regime activity.[76] While few dispute the relevance of both relative deprivation and individual-level opportunity cost in understanding violence, it is empirically difficult to separate them, and they often operate in tandem. More fundamentally, however, both arguments are at the individual level but used to explain collective phenomena. Thus, while absolute and relative deprivation is ubiquitous, armed conflict is not.[77] Therefore, constraints need to be considered that must be overcome for individual factors to be translated into collective violence.

Macroeconomic contraction is arguably among the most important correlates of domestic armed conflict and one that is very

74 Collier, P. and A. Hoeffler, 2004. Greed and grievance in civil war. *Oxford Economic Papers*, vol. 56, Issue 4, pp. 563-595. Available at https://doi.org/10.1093/oep/gpf064; Grossman, H. I., 1991. A general equilibrium model of insurrections. *The American Economic Review*, vol. 81, Issue 4, pp. 912-921. Available at https://www.jstor.org/stable/2006650.

75 Fearon, J. D., 2008. Economic development, insurgency, and civil war. In *Institutions and Economic Performance*. Harvard University Press.

76 Gurr, T. R., 1970. *Why men rebel*. Princeton University Press; Koos, C., 2018. Which Grievances Make People Support Violence against the State? Survey Evidence from the Niger Delta. *International Interactions*, vol. 44, Issue 3, pp. 437-462. Available at https://doi.org/10.1080/03050629.2017.1369411.

77 Fearon, J. D. and D. D. Laitin, 2003. Ethnicity, Insurgency, and Civil War. *The American Political Science Review*, vol. 97, Issue 1, pp. 75-90. Available at https://doi.org/10.2307/3118222; Lichbach, M. I., 1998. *The rebel's dilemma*. University of Michigan Press.

likely a consequence of climate change.[78] First, countries negatively affected economically[79] by climate change are more exposed to elite competition over dwindelling economic resources, possibly also pitting social groups against each other.[80] Second, historical studies have shown that periods with prolonged inflation and/or gaps between expectations and realities in the labour market for social elites see more instability.[81] Third, and related to the moderator capacity of the State discussed below, economic contraction can reduce the fiscal base of States, diminishing their capacity to deter, detect and prevent insurgencies. Economic downturns can, therefore,[82] erode popular support for political elites. Beyond acting as a trigger for social unrest, macroeconomic contraction exacerbates climate risks, in the long run, by eroding society's adaptive capacity.[83] Therefore, the impact of macroeconomic contraction, caused by climate change, is evident in the short and long term.

Migration motivated by livelihood decline, unmet expectations or resource competition is not uncommon. Factors affecting habitability, such as sea-level rise and, in the case of parts of the Arab region, extremely high maximum temperatures, can create motives for outmigration. Adaptation to such conditions is sometimes possible, but if it is unfeasible, then outmigration is the most likely coping mechanism. However, the negative changes that affect the motivation to move also affect the ability to relocate, creating two countervailing mechanisms with unknown net effects. A recent review found that anomalous weather, typically occurring within the timespan of a year, had quite heterogeneous effects on outmigration.[84] Slow-onset hazards (droughts) were more likely to induce relocation than rapid-onset shocks (floods). Hazards were more pronounced drivers of long-distance domestic moves, and less so for short-distance yet domestic or international migration. The severity of the shock and the vulnerability of the household interact to affect the propensity to move. Consequently, vulnerable households were less likely to move in the short term as a response to a single-year drought, but more likely in the long term, when facing compound hazards or permanent shifts in climate, as the persistence of unfavourable conditions increases motives for emigrating.[85]

Climate-related migration is argued to increase conflict risk in receiving areas in several ways.

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78 Dell, Jones and Olken, 2014; Gillingham, K. and others, 2018. Modeling Uncertainty in Integrated Assessment of Climate Change: A Multimodel Comparison. *Journal of the Association of Environmental and Resource Economists*, vol. 5, Issue 4, pp. 791-826. Available at https://doi.org/10.1086/698910; Nordhaus, W. D., 2006. Geography and macroeconomics: New data and new findings. *Proceedings of the National Academy of Sciences of the United States of America*, vol. 103, Issue 10, pp. 3510-3517. Available at https://doi.org/10.1073/pnas.0509842103.

79 Homer-Dixon, T. F., 1999. *Environment, Scarcity, and Violence*. Princeton University Press.

80 Bohlken, A. T. and E. J. Sergenti, 2010. Economic growth and ethnic violence: An empirical investigation of Hindu-Muslim riots in India. *Journal of Peace Research*, vol. 47, Issue 5, pp. 589-600. Available at https://doi.org/10.1177/0022343310373032.

81 Goldstone, J. A., 1991. *Revolution and rebellion in the early modern world*. University of California Press.

82 Keen, S., 2020. The appallingly bad neoclassical economics of climate change. *Economics and Climate Emergency*, vol. 18, Issue 7, pp. 1149-1177. Available at https://doi.org/10.1080/14747731.2020.1807856.

83 Carleton, T. A. and S. M. Hsiang, 2016. Social and economic impacts of climate. *Science*, vol. 353, No. 6304. Available at https://doi.org/10.1126/science.aad9837; Hallegatte, S. and J. Rozenberg, 2017. Climate change through a poverty lens. *Nature Climate Change*, vol. 7, Issue 4, pp. 250-256. Available at https://doi.org/10.1038/nclimate3253.

84 Kaczan, D. J. and J. Orgill-Meyer, 2020. The impact of climate change on migration: a synthesis of recent empirical insights. *Climatic Change*, vol. 158, Issues 3-4, pp. 281-300. Available at https://doi.org/10.1007/s10584-019-02560-0.

85 Ibid.

First, contestation between hosts and newcomers over scarce resources can turn violent,[86] for example, in places hosting refugees where there is a loss of vegetation due to an increase in farmland.[87] Second, host communities may feel threatened by the influx of newcomers and changes in the ethnic settlement pattern, causing a demographic security dilemma.[88] Third, immigration may solidify tensions over existing fault lines, for instance, between herders and farmers.[89] Fourth, people seeking relocation may be particularly vulnerable to attack from hostile actors and, thereby, increase violence as more 'easy targets' become available.[90] The extent to which climate-driven migration increases conflict risk depends on the local political structure in the receiving area, particularly whether elites have an interest in conflict or not.[91]

In sum, more gradual and persistent climate hazards seem to play a larger role in the propensity to migrate permanently than sudden-onset hazards such as floods. Moreover, those displaced by sudden-onset hazards are less likely to compete in the labour market of the receiving area and are likely to be seen by host communities as having no option. One study covering five developing countries[92] finds that those migrating due to long-term changes have more conflictual (not necessarily violent) attitudes than those relocating due to more sudden hazards. Sudden-onset hazards not only send fewer migrants but the migrants that relocate are also less likely to increase conflict risk.[93] Even though migration is one of the most frequently suggested mechanisms linking climate risk with conflict, regarding the potential for different climate hazards to spur violent conflict, cross-country evidence is too sparse to say anything of certainty at the current stage. What is quite clear is that migration is an adaptation option and should not be seen as uniformly negative.

Climate risks can increase **competition over resources**. This can either occur in areas with acute scarcity, or when those affected by climate hazards decide to relocate and find themselves in conflict with the host community. While some scholars see competition over scarce resources as among the root causes of conflict,[94] it is unlikely to be violent, at least in the initial stages.[95] Even in areas with very little State presence, there is little evidence of conflicts that are triggered solely by resource scarcity.[96] Conflicts over renewable resources made scarcer by climatic risks have a larger

86 Koubi, V. and others, 2018. The Determinants of Environmental Migrants' Conflict Perception. *International Organization*, vol. 72, Issue 4, pp. 905-936. Available at https://doi.org/10.1017/S0020818318000231.

87 Maystadt, J.-F. and others, 2020. Vegetation changes attributable to refugees in Africa coincide with agricultural deforestation. *Environmental Research Letters*, vol. 15, Issue 4, 044008. Available at https://doi.org/10.1088/1748-9326/ab6d7c.

88 Koubi and others, 2018.

89 Reuveny, R., 2007. Climate change-induced migration and violent conflict. *Political Geography*, vol. 26, Issue 6, pp. 656-673. Available at https://doi.org/10.1016/j.polgeo.2007.05.001.

90 Linke and others, 2018.

91 Bohlken and Sergenti, 2010; Boone, C., 2014. *Property and political order: land rights and the structure of conflict in Africa*. Cambridge University Press.

92 These countries are Cambodia, Nicaragua, Peru, Uganda, and Vietnam.

93 Koubi, 2019, p. 354.

94 Gat, A., 2009. So Why Do People Fight? Evolutionary Theory and the Causes of War. *European Journal of International Relations*, vol. 15, Issue 4, pp. 571-599. Available at https://doi.org/10.1177/1354066109344661.

95 Smidt, M. and O. M. Theisen, 2018. Climate Change and Conflict: Agriculture, Migration and Institutions. In *Crisis and Conflict in Agriculture* (pp. 40-52). CABI International.

96 Reuveny, 2007.

potential for escalation if the situation coincides with larger fault lines in society or if the institutions regulating ownership, access and dispute settlement are politicized.[97]

Water scarcity is influenced by many factors and at several levels. Water governance, therefore, deals with dispute resolution at different levels, from subnational to national or from basin-wide to global issues. At the global level, climate change, contradicting water conventions, and weak technology transfer are among the main challenges to clean freshwater availability, while migration and shared water resources between countries are the major challenges at the regional level.[98] Nationally, policies that do not consider equality are of concern. In this regard, integrated water resource management takes a particular role in determining the vulnerability to hazards because it represents a policy instrument at the intersection of climate vulnerability and exposure.[99]

Municipal, federal or other State administrations, along with regional institutions, are important factors that mitigate the problems relating to both water scarcity and intergroup disputes. Where State presence is weak, mitigation will also be hampered. Some groups may receive limited help by the State due to geographic remoteness or political reasons. In both cases, negligence delegitimizes the Government. Moreover, State capacity is also undermined and legitimacy eroded when well-intended Government actions are insufficient. The effects of water scarcity can be mitigated by informal or formal institutions. These can be shaped by a community and through State policies. Yet, the tools that help communities adapt to scarcity are limited and do not always provide enough remedy.[100]

Broadly understood, **food security** relates to the nutritional status and well-being of the individual and the potential threats to this status. FAO defines food security as a situation where '[…] all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life'.[101] Therefore, food insecurity exists when there is a lack of sufficient physical, social or economic access to food. The definition encompasses four dimensions of food insecurity, namely: food availability (the degree of satisfactory quantities through either domestic production or imports), food access (the ability for individuals to acquire a sufficient amount of food), utilization (the presence of appropriate facilities to prepare food), and stability (the degree of economic or climatic shocks).[102] There is a large variation in the level and type of food insecurity both within and across regions, and food insecurity is about more than just how much people have to eat. Some households can be faced with the threat of food insecurity but are not immediately experiencing hunger, and others can be in a

97 Boone, C., 2017. Sons of the Soil Conflict in Africa: Institutional Determinants of Ethnic Conflict Over Land. *World Development*, Issue 96, pp. 276-293. Available at https://doi.org/10.1016/j.worlddev.2017.03.012; Smidt and Theisen, 2018.

98 Rahaman, M. M. and O. Varis, 2005. Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice and Policy*, vol. 1, Issue 1, pp. 15-21. Available at https://doi.org/10.1080/15487733.2005.11907961.

99 Ibid.

100 Ostrom, E., 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press; Ostrom, E., 2002. Common-pool resources and institutions. In *Handbook of Agricultural Economics* (pp. 1315-1339). Elsevier.

101 FAO, 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action. World Food Summit, Rome, 13-17 November.

102 FAO (2006). Food security. FAO Policy Brief, Issue 2. Available at http://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.

desperate situation, with the former of these two being harder to detect.[103]

While there is agreement in the literature that food insecurity is associated with unrest, it is neither a necessary nor sufficient condition for unrest.[104] Although weather-driven fluctuations in local food production play an important role for food security, for many regions, including the Arab States, being net importers of food, global food prices (partly affected by weather), a State's food policies, including price subsidies and the vulnerability of the population to food price shocks, shape the vulnerability to food insecurity. The following four factors are central in gauging a population's vulnerability to global food price increases: (i) the purchasing power of the population, in particular, the share of income spent on food for the poorest sections; (ii) a Government's ability and willingness to buffer its population against increasing food prices through subsidies, among others; (iii) the extent to which the country is a net food importer, particularly the import status for commodities; and (iv) the extent to which the country is a net importer of agricultural goods.[105]

When food insecurity occurs, its effect on social instability does not play out in a vacuum but is heavily impacted by factors such as low economic development, limited social safety nets, unemployment, demographic pressures, and political grievances. It is, therefore, often seen as an additional burden and thereby contributes to the outbreak of social unrest. Thus, food riots tend to concern a broad range of socioeconomic issues, where increasing food prices is the last straw that leads to unrest.[106] Whether such unrest materializes in the type of organized violence under scrutiny here, is again shaped by the moderators discussed below.

2. Moderators

The mechanisms suggested can go some distance in explaining individual-level violence and clashes between groups. The literature has underscored that, by themselves, they are insufficient to explain the risk of collective violence, in particular rebel-state violence.[107] Thus, contextual moderators heavily shape the effect the mechanisms have on conflict risk; for operational purposes, three key moderators are suggested. They are treated as exogenous to climate risk due to sparse evidence in support of strong linkages.

The existence of **salient social cleavages** is an important variable when explaining how

103 FAO and others, 2020. *The State of Food Security and Nutrition in the World 2020*. Rome: Food and Agriculture Organization of the United Nations. Available at http://www.fao.org/publications/sofi/2020/en/; Maxwell, D., R. Caldwell and M. Langworthy, 2008. Measuring food insecurity: Can an indicator based on localized coping behaviors be used to compare across contexts? *Food Policy*, vol. 33, Issue 6, pp. 533-540. Available at https://doi.org/10.1016/j.foodpol.2008.02.004; Saint Ville, A. and others, 2019. Food security and the Food Insecurity Experience Scale (FIES): ensuring progress by 2030. *Food Security*, vol. 11, Issue 3, pp. 483-491. Available at https://doi.org/10.1007/s12571-019-00936-9; Webb, P. and others, 2006. Measuring Household Food Insecurity: Why It's So Important and Yet So Difficult to Do. *The Journal of Nutrition*, vol. 136, Issue 5, pp. 1404S-1408S. Available at https://doi.org/10.1093/jn/136.5.1404S.

104 Rudolfsen, I., 2020. Food Insecurity and Domestic Instability: A Review of the Literature. *Terrorism and Political Violence*, vol. 32, Issue 5, pp. 921-948. Available at https://doi.org/10.1080/09546553.2017.1418334.

105 ESCWA and FAO, 2017.

106 Heslin, A., 2021. Riots and resources: How food access affects collective violence. *Journal of Peace Research*, vol. 58, Issue 2, pp. 199-214. Available at https://doi.org/10.1177/0022343319898227; Maystadt, Trinh Tan and Breisinger, 2014; Rudolfsen, I., 2021. Food price increase and urban unrest: The role of societal organizations. *Journal of Peace Research*, vol. 58, Issue 2, pp. 215-230. Available at https://doi.org/10.1177/0022343319899705.

107 Kahl, C. H., 2006. *States, Scarcity, and Civil Strife in the Developing World*. Princeton University Press; McAdam, D., S. Tarrow and C. Tilly, 2001. *Dynamics of Contention*. Cambridge University Press.

individual-level factors increase the risk of collective violence. Individuals have little rational self-interest in rebelling against the State when faced with injustice or deprivation as they would reap the benefits of a successful rebellion whether participating or not, but participating means risking their lives.[108] Thus, in order to recruit and retain soldiers, the rebel leadership needs to overcome freeriding by providing some kind of selective benefits for participation. In such a situation, pre-existing groups that require less selective benefits are more likely to succeed. Such groups often also contain social networks that can be utilized to facilitate underground activity such as organizing a rebellion. Any social cleavage can be used for organizing collective action; in the context analysed, and particularly for violent conflict, communal characteristics stand out.[109] Thus, nascent rebel groups building on communal platforms are more successful in creating viable rebel movements compared to those less rooted in distinct social identity groups.[110]

Additionally, research on the motivation of combatants points to identification with a collective goal on behalf of a group as crucial, rather than to egoistic aims. The salience of intergroup cleavages is enhanced if they intersect with socioeconomic inequalities in producing horizontal inequalities.[111] Hazards tend to affect disadvantaged groups more due to their higher vulnerability to general climate risk, and thereby also revealing governmental discrimination of certain groups. All else being equal, shared grievances within an identity group, both material and political, provide members with a common lens through which to view their grievances and a shared political cause. A shared experience of misery within a group coinciding with a lack of political influence increases the appeal of resorting to contentious actions as conventional political channels are closed. Consequently, the likelihood that climate hazards escalate to the level of civil violence increases if it coincides with strong intergroup cleavages.[112]

Efficacy of political institutions and the political opportunity structure also determine the potential for shared grievances to increase the risk of conflict. Although for different reasons, both highly open and highly closed regimes are experiencing less conflict.[113] Regarding regime openness, the extent to which disgruntled citizens perceive effective non-violent channels for addressing one's grievances is of importance. One's external political efficacy, defined as 'the belief that one

108 Gates, S., 2002. Recruitment and Allegiance: The Microfoundations of Rebellion. *Journal of Conflict Resolution*, vol. 46, Issue 1, pp. 111-130. Available at https://doi.org/10.1177/0022002702046001007; Olson, M., 1965. *The Logic of Collective Action. Public Goods and the Theory of Groups*. Cambridge University Press.

109 Buhaug, H., L.-E. Cederman and K. S. Gleditsch, 2014. Square Pegs in Round Holes: Inequalities, Grievances, and Civil War. *International Studies Quarterly*, vol. 58, Issue 2, pp. 418-431. Available at https://doi.org/10.1111/isqu.12068; Denny, E. K. and B. F. Walter, 2014. Ethnicity and civil war. *Journal of Peace Research*, vol. 51, Issue 2, pp. 199-212. Available at https://doi.org/10.1177/0022343313512853.

110 Lewis, J. I., 2017. How Does Ethnic Rebellion Start? *Comparative Political Studies*, vol. 50, Issue 10, pp. 1420-1450. Available at https://doi.org/10.1177/0010414016672235.

111 Østby, G., 2008. Polarization, Horizontal Inequalities and Violent Civil Conflict. *Journal of Peace Research*, vol. 45, Issue 2, pp. 143-162. Available at https://doi.org/10.1177/0022343307087169; Stewart, F., 2008. *Horizontal Inequalities and Conflict. Understanding Group Violence in Multi-ethnic Societies.* Palgrave Macmillan.

112 Buhaug and others, 2021; Theisen, O. M., H. Holtermann and H. Buhaug, 2011. Climate Wars? Assessing the Claim That Drought Breeds Conflict. *International Security*, vol. 36, Issue 3, pp. 79-106. Available at https://doi.org/10.1162/ISEC_a_00065; Von Uexkull and others, 2016.

113 Hegre, H., 2014. Democracy and armed conflict. *Journal of Peace Research*, vol. 51, Issue 2, pp. 159-172. Available at https://doi.org/10.1177/0022343313512852.

has some real measure of influence on policy decisions by expressing one's positions publicly',[114] affects whether or not grievances will be addressed via institutionalized channels, with the latter comprising both violent and non-violent measures. Macrostructures that affect external efficacy fall along the following two dimensions: the openness of the regime and the ability of the regime to implement policies. First, in an open regime, the utility of armed rebellion to push one's agenda is less rational than working to change policies through institutionalized channels, resulting in highly democratic countries rarely suffering from civil conflict.[115] Second, political regimes can be relatively open, yet the efficiency of the State in implementing policies can be low, which reduces the efficacy of the political regime. In addition, citizens' trust in the institutional channels to bring change is dependent on the bureaucratic quality and administrative capacity of a State.[116] Relatedly, the political opportunity structure, during transition periods, may put countries at more risk of experiencing violence due to the volatility, strategies and interests of key actors.[117]

Closed regimes represent a quite different way in which the political opportunity structure reduces the risk of rebellion. Here, grievances giving rise to conflict are less likely, at least in the short run, as most organized political activity is repressed, with armed rebellions being nipped in the bud.[118] However, in the longer run, participatory political governance structures are significantly more durable than autocracies.[119] Thus, having more episodes of instability, in the long run, makes closed regimes more vulnerable to civil conflict.

State capacity is the last moderator that determines the amount of opportunities for organizing large-scale anti-State violence. It falls along two dimensions, namely, State capacity in the projection of force and suppression of potential rebels, and existing conflict-specific capital facilitating rebel organization. The ability of the State to detect and crush nascent insurgencies is an important factor in explaining which countries suffer civil conflict and which do not.[120] The geographic location of civil wars within countries as a State's force projection capacity is not constant over space.[121] Typically, the closer to major political or military centres, the less challenging the terrain, the better the military infrastructure, the higher the projective force of the State is. Moreover, there is some empirical overlap between the political efficacy of a regime and its ability to project force[122] as the bureaucratic capacity of the State apparatus

114 Sulitzeanu-Kenan, R. and E. Halperin, 2013. Making a Difference: Political Efficacy and Policy Preference Construction. *British Journal of Political Science*, vol. 43, Issue 2, pp. 295-322. Available at https://doi.org/10.1017/S0007123412000324, p. 295.

115 Gleditsch, K. and A. Ruggeri, 2010. Political opportunity structures, democracy, and civil war. *Journal of Peace Research*, vol. 47, Issue 3, pp. 299-310. Available at https://doi.org/10.1177/0022343310362293.

116 Hendrix, C. S., 2010. Measuring state capacity: Theoretical and empirical implications for the study of civil conflict. *Journal of Peace Research*, vol. 47, Issue 3, pp. 273-285. Available at https://doi.org/10.1177/0022343310361838.

117 Hegre and others, 2001.

118 Hegre, 2014.

119 Gates, S. and others, 2006. Institutional Inconsistency and Political Instability: Polity Duration, 1800-2000. *American Journal of Political Science*, vol. 50, Issue 4, pp. 893-908. Available at https://doi.org/10.1111/j.1540-5907.2006.00222.x.

120 Fearon and Laitin, 2003; Hendrix, 2010.

121 Buhaug, H., 2010. Dude, Where's My Conflict? *Conflict Management and Peace Science*, vol. 27, Issue 2, pp. 107-128. Available at https://doi.org/10.1177/0738894209343974.

122 Buhaug, H. and S. Gates, 2002. The Geography of Civil War. *Journal of Peace Research*, vol. 39, Issue 4, pp. 417-433. Available at https://doi.org/10.1177/0022343302039004003.

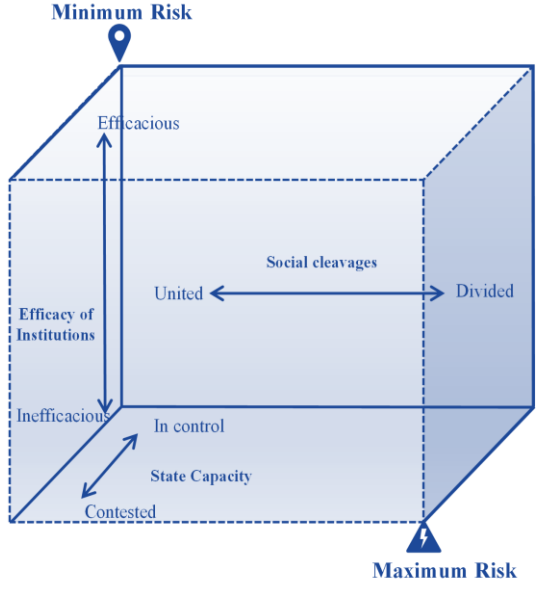
affects its ability to deter and detect nascent rebellion.[123] Indicative of this, some studies find climatic hazards only to increase conflict risk in weak States.[124]

Since power is a relational concept, the projective force of the State should be judged relative to the conflict-specific capital of potential rebels.[125] The total effect of the conflict-specific capital on the rebel side is, therefore, relative to the projective power of the State. Thus, a Government with weak projective capacity may be able to quell poorly organized and weakly armed insurgents but may fail to do so facing opponents with more conflict-specific capital that a stronger State would be able to stop.

C. Summary of argument

Beyond individual-level mechanisms, the three moderating factors discussed above are central in understanding conflict risk. They are crucial in understanding how they facilitate or prevent the mechanisms to find an organizational and violent form that can result in civil conflict. Figure 2 shows how these moderators can reinforce or weaken each other. Several studies have pointed out that a combination of salient ethnic division lines and political institutions of low efficacy strongly shape whether environmental risks are likely to generate civil conflict.[126] In the absence of strong identity divides, a platform for organizing rebellion is not as readily available. If there are effective institutions and high communal salience, the formation of communal-based parties to address grievances is a more likely outcome. Thus, whether ancient and deep or recently constructed, the socioeconomic and political status of identity groups is central in understanding conflict risk.[127] While the existing literature has, to a lesser extent, theorized and tested the potentially mutually reinforcing effects of relative State capacity and political efficacy or identity cleavages on civil conflict, such effects should not be ruled out.

Figure 2. Moderators and conflict risk



Source: Authors.

123 Hendrix, 2010.

124 Omelicheva, M. Y., 2011. Natural Disasters: Triggers of Political Instability? *International Interactions*, vol. 37, Issue 4, pp. 441-465. Available at https://doi.org/10.1080/03050629.2011.622653.

125 Conflict-specific capital, broadly defined, concerns factors such as the accessibility of weapons, safe havens (often in neighbouring countries), close-knit social networks, and other factors that increase the fighting capacity of potential rebels vis-à-vis the State. For an elaboration, see Blattman, C. and E. Miguel, 2010. Civil War. *Journal of Economic Literature*, vol. 48, Issue 1, pp. 3-57. Available at https://doi.org/10.2307/40651577.

126 Buhaug and others,. 2021; Kahl, 2006; Theisen, Holtermann and Buhaug, 2011.

127 Chandra, K., 2006. What is Ethnic Identity and does it matter? *Annual Review of Political Science*, vol. 9, Issue 1, pp. 397-424. Available at https://doi.org/10.1146/annurev.polisci.9.062404.170715.

The framework presented above illustrates how climate risk can engender several mechanisms that, in turn, produce a fertile environment for unrest at the individual level, but these factors on their own are unlikely to produce organized violence. The likelihood of the intermediate mechanisms to increase conflict risk substantially increases in the presence of highly salient identity groups, political institutions of low efficacy and a State where the capacity to detect and quell rebellion is low.

3. Conclusions and recommendations

This report has provided a conceptual framework with the aim to improve the collective capacity of the Arab States to address the negative impacts of climate change on peace and security. The framework suggests that climate change can indirectly exacerbate factors that may consequently lead to conflict. Given the particularities of the Arab region, water scarcity and food security are particularly relevant. To theorize the transition from climate risks to conflict risks, it is necessary to understand how the different mechanisms and moderators interact. This relationship is complex and, in most cases, context-specific, making the prediction of conflict, based exclusively on climatic indicators, problematic.

The Arab region is very heterogeneous when it comes to wealth and socioeconomic outcomes, with some countries among the poorest and some among the richest in the world by gross domestic product per capita. Within this complexity, the role of agriculture emerges as a key sector in the Arab region to analyse how climate risk may translate into conflict risk. The agricultural sector is most at risk from climate change, however, and so are States in the Arab region that increasingly rely on the import of foodstuff and are, therefore, increasingly exposed to global price shocks. These two dimensions can be used to classify countries into three clusters related to the type of climate risks which they are most subjected to. The first type of countries (A) are those in which a large portion of the population relies on agriculture for their income. The other countries in the region are importers of main foodstuff. Import-dependent countries can be divided into two categories, namely, (B) those who have the fiscal capacity to import and subsidize food at even higher costs, thus cushioning their citizens against price hikes, and (C) those who struggle with this. For all three types of countries, important subnational variations are possible, particularly between large cities and food-producing areas. Future climate impacts point to increasing difficulties facing agriculture in several countries in the region,[128] and, therefore, more countries are likely to increasingly rely on food imports, implying that some countries will move from category A into B or, more likely, C. While countries in category A are most likely to experience agriculturally-related conflict dynamics that could be based in primarily rural areas, countries in category B are generally less vulnerable to the kind of climate risks deemed most relevant for conflict. While countries in category C are less likely to suffer conflict related to agricultural production than countries in category A, to some extent, countries in category C may experience food riots related to increased prices. The latter type of conflict, often starting with peaceful protests, might be qualitatively different from rural-based insurgencies that are more likely in countries of type A.

The section below provides suggestions to advance conflict-forecasting efforts based on climatic variables. The suggestions are organized according to the following three different criteria: first, recommendations that are plausible but, for different reasons,

128 ESCWA, 2017. *Arab Climate Change Assessment Report* (E/ESCWA/SDPD/2017/RICCAR/Report). Available at https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report.

premature for forecasting; second, recommendations for possible venues of research that are outside the scope of this report; and third, suggestions that are both plausible and possible to undertake forecasting in the current project.

A. Plausible but premature recommendations

Migration driven by climate hazards is one of the most frequently suggested mechanisms linking climate change to conflict and is central in the most prominent cases in the literature. The suggested mechanisms occur primarily within countries. While the relationship in itself deserves high priority for research, the lack of clear definitions and comprehensive high-quality datasets at a subnational scale on domestic migration over time prevents a forecasting modeling of this mechanism.

1. Climate change

Among the studies aiming to assess the impact of going from one type of climate to another on conflict risk in contemporary societies which have been reviewed, no study, to date, follows the convention of the IPCC of comparing two 30-year periods. This would entail comparing the average precipitation, temperature and wind –or its variability– over one 30-year period with another. To date, while climate data for this exists, conflict databases of satisfactory quality, resolution and coverage go back to 1989 and not 1961, which would be the minimum required, thus precluding this possibility. Only four studies[129] have analysed the impact of differences in climate parameters between periods of sufficient length to approximate climate change and not anomalous weather that eventually reverted to normality. Of these studies, the ability to predict violence based on climate parameters, compared to others, varies from minuscule to improving predictions to some extent, but are still inferior to economic and political predictors.[130] Acknowledging this, the section with possible options within the current framework provides approximations analysing the effect of climate change on shorter time scales. Climate change as such should be a high priority for research.

2. Low-probability high-impact crises

Although the main aim of this report is to provide a framework for understanding general links between climate change and conflict dynamics, there is some concern that climate change may in very specific circumstances create major crises that, although being of low probability, would have a high impact, inter-State conflict over rivers being the most commonly suggested scenario in the Arab region. Conflict over the Euphrates and Tigris rivers is deemed less likely due to the current political context between the riparian countries. The Nile has, on several occasions, been argued to be at risk in the popular discourse and media; however, more nuanced analyses are less pessimistic, pointing to divergent interests among the downstream States of the Sudan and Egypt.[131]

129 Breckner and Sunde, 2019; Helman and Zaitchik, 2020;Vvan Weezel, 2019.

130 Van Weezel 2019; Van Weezel, 2020.

131 Tvedt, T., 2021. *The Nile: History's Greatest River*. Bloomsbury Publishing.

B. Recommendations for future research

1. Sudden onset hazards

While floods may increase conflict risk and represent the type of disaster that currently accounts for the highest economic losses in several Arab States,[132] systematically modeling the effect of floods on conflict risk is outside the scope of this project for two reasons. First, the literature on floods and conflict, in general, is in its infancy with only a handful of studies published.[133] Second, assessing flood risk for the Arab region would imply modeling at the river basin, wadi catchment areas and at other geographic units, which is a task beyond the boundaries of this project.

2. Extreme temperatures

While a connection between extreme heat and conflict has been suggested and several studies find a correlation, the mechanism behind this finding is less clear. One possible mechanism that has only been briefly analysed is the effect of excessively high temperatures during the growing season, in particular during anthesis, which harms crop productivity,[134] or when temperatures approach an absolute threshold, severely disrupting the growth of food plants.[135] Thus, this constitutes a different and complementary effect of temperature on agricultural production that affects soil moisture. Since the Arab region already experiences growing-season temperatures that are close to being harmful to crop growth, this potential effect should be investigated in future studies as the most certain and strongest future development in the region is an increase in very hot days.

3. Improved measures of water scarcity

As a water-stressed region, and increasingly so with climate change, further improvements in measures of water scarcity for the Arab region could pay off with a better understanding of climate-conflict linkages. Pollution of both surface and below-surface water endangers the safe use of these resources. In addition, seawater intrusion becomes more common, especially for aquifers close to urbanized coastal zones. Furthermore, it is crucial to collect more fine-grained and reliable data for cross-country comparisons with subnational data. For instance, evaluating future hydroelectric capacity requires more than modeling seasonal runoff, as extreme conditions mask averages. Making processed data products from satellite imagery available is one way of tackling such problems. Although research has demonstrated that effects from micro-level water conservation can be measured through freely available remote sensing products, to achieve a more holistic picture of water scarcity, reliable

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132 ESCWA, 2017.

133 ESCWA, 2017; Ghimire, Ferreira and Dorfman, 2015; Ghimire, R. and S. Ferreira, 2016. Floods and armed conflict. *Environment and Development Economics*, vol. 21, Issue 1, pp. 23-52. Available at https://doi.org/10.1017/S1355770X15000157; Ide, T., A. Kristensen and H. Bartusevičus, 2021. First comes the river, then comes the conflict? A qualitative comparative analysis of flood-related political unrest. *Journal of Peace Research*, vol. 58, Issue 1, pp. 83-97. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320966783.

134 Luo, Q. (2011). Temperature thresholds and crop production: a review. *Climatic Change*, vol. 109, Issue 3, pp. 583-598. Available at https://doi.org/10.1007/s10584-011-0028-6.

135 Caruso, R., I. Petrarca and R. Ricciuti, 2016. Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research*, vol. 53, Issue 1, pp. 66-83. Available at https://doi.org/10.1177/0022343315616061.

information is needed on local watershed status, water use and water budgets.[136] Moreover, disaggregated data for changes in water extent, pollution or runoff should also be utilized in order to have a more fine-tuned measure of actual water availability.

4. The outbreak of new civil wars

On the relative importance of socioeconomic and political factors for the outbreak of new civil wars, few statistical studies have discerned a robust effect of weather shocks on the outbreak of civil conflict.[137] There is stronger support that certain forms of adverse environmental shocks systematically affect the dynamics of ongoing conflicts. This is also the case for high-profile environment-conflict cases such as Darfur and the Syrian Arab Republic. Thus, predictions are arguably better suited to capture the likelihood of conflict intensification compared to genuine new outbreaks of civil conflict.[138] Climate mitigation and adaptation measures can have security implications in terms of outbreak and conflict dynamics, but this requires a separate analysis.

5. Separate models for different types of conflicts

The preceding paragraph shows that climate risk may have different effects on different types of conflicts, in that agricultural droughts may increase the risk of rural rebel-Government violence, whereas food price increases are more likely to trigger demonstrations and urban unrest. Non-State and one-sided violence are other forms of violence that, although often closely connected to civil conflicts, can harbour dynamics that are different from the latter. For example, studies on intergroup violence sometimes find abnormal increases in rainfall, or abnormal decreases in rainfall, and sometimes both, leading to an increased risk of conflict. Likewise, a few, yet a minority, studies on one-sided violence, have found it to be negatively related to drought conditions. This indicates that there could be either important regional differences in how climate parameters affect conflict and/or differences in how different types of violence are affected by climate risk.

C. Possible recommendations within the current framework

1. Agricultural mechanisms

The literature has started to converge on the prospect of climate hazards increasing conflict dynamics when they harm agricultural activities in agriculturally-dependent or vulnerable regions. Aligned with this, some operationalizations of hazard and vulnerability that could help in forecasting conflict in the Arab region are suggested hereunder.

(a) Design

First, there are substantial subnational variations in where hazards strike, the number of exposed people and their vulnerability in total

136 Ali, D. A., K. Deininger and D. Monchuk, 2020. Using satellite imagery to assess impacts of soil and water conservation measures: Evidence from Ethiopia's Tana-Beles watershed. *Ecological Economics*, Issue 169, 106512. Available at https://doi.org/10.1016/j.ecolecon.2019.106512; Garrick, D. E. and others, 2017. Valuing water for sustainable development. *Science*, Issue 358 (6366), pp. 1003-1005. Available at https://doi.org/10.1126/science.aao4942; Zhang, X. and others, 2018. Impacts of climate change, policy and Water-Energy-Food nexus on hydropower development. *Renewable Energy*, Issue 116, pp. 827-834. Available at https://doi.org/10.1016/j.renene.2017.10.030.

137 Buhaug and von Uexkull, 2021.

138 Brown, 2010; De Juan, 2015; C. Kelley, C. and others, 2017. Commentary on the Syria case: Climate as a contributing factor. *Political Geography*, vol. 60, pp. 245-247. Available at https://doi.org/10.1016/j.polgeo.2017.06.013; Kelley and others, 2015; Koubi, 2019; Selby and Hoffmann, 2014; Theisen, 2017.

indicating climate risk. This is also the case for moderators affecting the likelihood that climate risk translates into collective violence, such as the salience of subregional identities, the political status and influence of subnational regions. Therefore, geographically disaggregated data allowing to capture the local dependence on agriculture as well as a host of factors that are generic for explaining conflict should be used. Moreover, since the relationship between the constituent elements of climate risk is inherently multiplicative, and since the effect of moderators in affecting how climate risk translates into conflict risk is also multiplicative, a modeling strategy that accounts for this should be preferred over an additive model. In this regard, a random-forest algorithm is preferable over a standard regression setup as it allows for very complex combinations of variables without demanding too much data. In this respect, it is particularly useful for analysing and forecasting the climate-conflict nexus where mechanisms have long been theorized to be multiplicative.

No matter how severe, a hazard hitting uninhabited areas will not have many negative social consequences. In order to account for this, subnational data on population density is vital in order to capture exposure, but also the propensity for conflict, to some extent, is a probability function of the number of persons living in an area.

(b) Agricultural drought

Concerning the operationalization of hazards that are harmful to agriculture, drought is arguably a crucial concept to capture. First, it should account for both the effects of temperature and precipitation, as water evaporation and transpiration are generally high in the Arab region. Second, it should capture soil moisture during the growing season and not conditions outside it. Thus, the Standardized Precipitation Evapotranspiration Index (SPEI), which allows for the above considerations, is an appropriate measure.[139] In addition, for forecasting purposes where reverse causality (conflict reducing crops) is less of a concern, data on harvest quantity should be utilized. One drawback of these measures for monthly predictions is that the mechanism depends on the growing season as such, so it is less suited to account for sudden shifts in that each year has one to three growing seasons, whereas the forecasting model accounts for all twelve months. A lesser concern is the fact that the data on main crops hitherto have only accounted for the main crop and its main harvest, excluding the possibility to account for multiple harvests in one year. This is most relevant for irrigated areas; however, a measure such as SPEI to capture mainly rain-based agricultural drought should be less affected by this concern.

(c) Iterative droughts

Iterative droughts reflect the idea that, while one bad year might be overcome, several consecutive poor harvests put a much stronger strain on the system and should also be investigated. Capturing iterative droughts could be done using measures similar to those for single-year droughts; for example, by counting the consecutive number of years with growing-season droughts exceeding the historic median of the area or by analysing the average of SPEI for a period spanning several years, but shorter than the period required for analysing modal shifts (for instance, the last four to five years).

139 Beguería, S. and others, 2014. Standardized precipitation evapotranspiration index (SPEI) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. *International Journal of Climatology*, vol. 35, Issue 10, pp. 3001-3023. Available at https://doi.org/10.1002/joc.3887.

(d) Climate change

If an area has not experienced severe droughts in the past but is starting to experience them, it is less likely that it has adapted to drought conditions and will therefore be more vulnerable. This is what changes to average climate conditions could look like. They should be feasible to capture, although it is not necessarily always feasible to compare 30-year periods as the standard definition would require. Several ways of exploring this are possible. First, one could measure average drought conditions over the last ten years and then measure the current year's deviation from it. The logic behind this would be that, if a current drought is outside what it has normally been the last ten years, then agricultural systems are less likely to have adapted to it. Even closer to capturing change in climate, one could first define a 30-year baseline period of which the coefficient of variation of the growing-season soil humidity is captured. This will reflect the normal variation in the pre-period and should then be compared with the current year's anomaly to assess whether it is a break from or within the bounds of the past climate.

(e) Vulnerability

In order to capture vulnerability to drought, several factors should be accounted for. First, agricultural production irrigation versus rain-fed agriculture should be distinguished from each other, with more irrigation generally meaning less vulnerability to drought in the short run. Second, the agricultural dependence of the population should be captured. While data of sufficient quality and coverage on agricultural dependence do not exist at the subnational level for the Arab region as a whole, data at the national level yield useful information, as they also capture information on institutional and governance factors, as well as trade – factors that are all primarily at the national level. Finally, the level of economic development should be accounted for, as people with lower income are often found to be both more vulnerable to hazards and have lower coping and adaptive capacity. Good and direct measures capturing wealth and alternatives for livelihood diversification satisfactorily are difficult to come by, but temporal variations in night-light emissions reflect wealth to some extent, except in very rich and very poor areas.

2. Water

The Arab region is already water-stressed, and the outlook is gloomy. Population growth and climate change are estimated to increase water scarcity in the region exponentially.[140] Therefore, the impact of climate change in the Arab region will be significantly determined by the availability of water. At its core, water scarcity implies that the attainable water sources cannot cover what is required for average use. This presupposes a persisting discrepancy between existing supply and expressed demand. The notion of needs being perceived or expressed is important because scarcities are not merely about physical limitation, but also about subjective restraints evident through existing norms and practices. The consumers' attitude and their efficient use of the amounts of water they can access at the household level and the efficient use of water for agriculture play a huge role in water scarcity. Thus, water scarcity is also directly associated with the degree of efficient resource management, including addressing issues such as salination, pollution or infrastructure maintenance.[141] These varying

140 UN Water. (2019). Leaving no one behind. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000367306.

141 Woodhouse, P. and M. Muller, 2017. Water Governance—A Historical Perspective on Current Debates. World Development, vol. 92, pp. 225-241. Available at https://www.researchgate.net/publication/312103637_Water_Governance-An_Historical_Perspective_on_Current_Debates.

norms around water are coupled with different purposes of water use. For instance, communities that use groundwater only for sanitation and nutritional purposes might be less susceptible to shortages than communities that use groundwater to irrigate their crops. Thus, extreme water scarcity worsens the conditions for those engaged in agriculture or farming. Above all, severe water stress impairs living conditions and poses a serious threat to all forms of subsistence by diminishing access to nutrition and sanitation.[142]

The ViEWS project has found that predictors of violence, related to water, performed relatively well in forecasting conflict, particularly measures for drought conditions. Currently, the ViEWS project includes data on water scarcity based on data availability and its temporal and geographic coverage. The results suggest that, in countries with efficient water management systems, the risk of armed conflict, in general, is lower than in countries with inefficient water management systems. To improve the granularity and quality of future predictions, additional water indicators could be considered to account for factors related to the role of institutions, variation of virtual water supply and the aggregate adaptive capacity at the country level.

3. Food

Ongoing research has seen a shift from focusing on food insecurity in terms of availability to focus more on access to food.[143] Thus, the indicators should focus on food insecurity in terms of inadequate food access. Food insecurity is about poverty and vulnerability rather than agricultural productivity, where consumption rather than production is emphasized. This is because access is most closely related to the concept of well-being for the individual or household, focusing on the food choices available. Therefore, this paper seeks to measure food insecurity in terms of the ability to obtain food from the marketplace or other sources, or inadequate food access. In order to capture the potential effect of food security on conflict, one should ideally have measures that capture both food access over time and sudden shocks[144] to account for both chronic levels of insecurity and the mechanisms related to price hikes. This would capture sudden shocks to food insecurity levels, whereas categories such as undernourishment would capture a broader understanding of food access. Data availability for food indicators is patchy, and, in contrast to meteorological data, which is often sourced from satellite imagery, it often requires a minimum of a working State or other infrastructure to collect data. For conflict-affected countries, such data can be hard to come by. Feasibility and availability concerns, therefore, weigh heavily on the selection of data, but data on food insecurity, prices and different indicators by FAO used for hunger reporting are among the most promising data sources to assess the food-conflict relationship.[145]

For the potential effect of food prices, a geographically disaggregated design probably would add less to a nation-level model

142 UNESCO, 2015. The United Nations World Water Development Report 2015: Water for a Sustainable World. Available at https://www.unwater.org/publications/world-water-development-report-2015/.

143 Based on the seminal work of Amartya Sen. See, for instance, Sen, A., 1981. *Poverty and famines: an essay on entitlement and deprivation*. Oxford University Press.

144 Data from FAO and WFP, for instance.

145 Barrett, C. B. and E. C. Lentz, 2010. *Food Insecurity*. Oxford Research Encyclopedia of International Studies. Available at https://doi.org/10.1093/acrefore/9780190846626.013.438; Hendriks, S., 2016. The Food Security Continuum: The Impact on Health, Growth, and Well-Being. In *Food Security and Child Malnutrition* (chapter 1, pp. 1-24). Available at https://doi.org/10.1201/9781315365749-2.

compared to the mechanisms capturing food production shocks and water scarcity. Food prices for main cities within the same country are likely to be relatively similar in most Arab States due to high import rates. Moreover, and related thereto, the way national Governments are able and choose to cushion food consumers against price hikes is a central factor in determining whether unrest will follow global food price hikes or not. Government price policies also tend to reduce price differentials between urban areas. For this reason, geographically disaggregated analyses of food prices may have little extra to add to analyses conducted at the national level. Moreover, food price hikes are arguably more likely to affect riots and demonstrations directly and less so armed conflicts. Thus, it is hard to predict the nature and strength of the association between food prices and the risk of armed conflict.

4. Moderators

The conceptual model shows that livelihood loss, resource competition, migration, and other social processes (mechanisms) spurred by climate risk are more likely to increase conflict risk when occurring in certain contexts that should be accounted for. First, social cleavages that are politically salient should be considered. While linguistic, sectarian or other cultural traits have been frequently used, much research shows that, measurement issues aside, cultural distance is of secondary importance to the sociopolitical salience of social groups. In this regard, only accounting for salient groups in a subnational area and avoiding politically irrelevant factors is desirable. The second moderating dimension, namely the efficacy of political institutions, should also be captured as it accounts for how rational it is for disgruntled elements to take up arms or to try peaceful channels. Fortunately, the Geographic Ethnic Power Relations dataset[146] combines data on the subnational location of politically relevant groups with their political status in the national arena. While other local measures of the efficacy of local political institutions or the local quality of the central State exist, these are mainly limited to certain regions or States. At the national level, measures of political openness, voice or accountability should also be considered, since political opportunity structures do not only follow group-based or subnational patterns. The third moderator, relative State capacity, can, in a forecasting model, be reasonably proxied by previous violent conflict in the same or adjacent areas. However, this mainly captures the territorial control part of relative State capacity. More precise measures such as distance to capital and borders, military bases and the size and location of rebel forces could also improve the validity of the measure. For State strength in terms of fiscal capacity, this is primarily a measure at the national level and could be integrated alongside other variables at the national level.

146 Vogt, M. and others, 2015. Integrating Data on Ethnicity, Geography, and Conflict: The Ethnic Power Relations Data Set Family. *Journal of Conflict Resolution*, vol. 59, Issue 7. Available at https://doi.org/10.1177/0022002715591215.

Bibliography

Abbs, L. (2019). The hunger games: Food prices, ethnic cleavages and nonviolent unrest in Africa. *Journal of Peace Research*, vol. 57, pp. 281-296. Available at https://journals.sagepub.com/doi/10.1177/0022343319866487.

Abel, G. J. and others (2019). Climate, conflict and forced migration. *Global Environmental Change*, vol. 54, pp. 239-249. Available at https://doi.org/10.1016/j.gloenvcha.2018.12.003.

Aidt, T. and G. Leon (2016). The Democratic Window of Opportunity: Evidence from Riots in Sub-Saharan Africa. *Journal of Conflict Resolution*, vol. 60, Issue 4, pp. 694-717. Available at https://journals.sagepub.com/doi/10.1177/0022002714564014.

Ali, D. A., K. Deininger and D. Monchuk (2020). Using satellite imagery to assess impacts of soil and water conservation measures: Evidence from Ethiopia's Tana-Beles watershed. *Ecological Economics*, Issue 169, 106512. Available at https://doi.org/10.1016/j.ecolecon.2019.106512.

Al-Saidi, M. and A. Hefny (2018). Institutional arrangements for beneficial regional cooperation on water, energy and food priority issues in the Eastern Nile Basin. *Journal of Hydrology*, vol. 562, pp. 821-831. Available at https://doi.org/10.1016/j.jhydrol.2018.05.009.

Arezki, R. and M. Brueckner (2014). Effects of International Food Price Shocks on Political Institutions in Low-Income Countries: Evidence from an International Food Net-Export Price Index. *World Development*, vol. 61, pp. 142-153. Available at https://doi.org/10.1016/j.worlddev.2014.04.009.

Ash, K. and N. Obradovich (2020). Climatic Stress, Internal Migration, and Syrian Civil War Onset. *Journal of Conflict Resolution*, vol. 64, Issue 1, pp. 3-31. Available at https://doi.org/10.1177/0022002719864140.

Barrett, C. B. and E. C. Lentz (2010). *Food Insecurity*. Oxford Research Encyclopedia of International Studies. Available at https://doi.org/10.1093/acrefore/9780190846626.013.438.

Baumann, M. and T. Kuemmerle (2016). The impacts of warfare and armed conflict on land systems. *Journal of Land Use Science*, vol. 11, Issue 6, pp. 672-688. Available at https://doi.org/10.1080/1747423X.2016.1241317.

Beck, L. and others (2014). Implications of hydro-political dependency for international water cooperation and conflict: Insights from new data. *Political Geography*, vol. 42, pp. 23-33. Available at https://doi.org/10.1016/j.polgeo.2014.05.004.

Beguería, S. and others (2014). Standardized precipitation evapotranspiration index (SPEI) revisited: parameter fitting, evapotranspiration models, tools, datasets and drought monitoring. *International Journal of Climatology*, vol. 35, Issue 10, pp. 3001-3023. Available at https://doi.org/10.1002/joc.3887.

Benjaminsen, T. A. and others (2012). Does climate change drive land-use conflicts in the Sahel? *Journal of Peace Research*, vol. 49, Issue 1, pp. 97-111. Available at https://doi.org/10.1177/0022343311427343.

Bernauer, T. and others (2012). Water-Related Intrastate Conflict and Cooperation (WARICC): A New Event Dataset. *International Interactions*, vol. 38, Issue 4, pp. 529-545. Available at https://doi.org/10.1080/03050629.2012.697428.

Bernauer, T. and T. Böhmelt (2014). Basins at Risk: Predicting International River Basin Conflict and Cooperation. *Global Environmental Politics*, vol. 14, Issue 4, pp. 116-138. Available at https://doi.org/10.1162/GLEP_a_00260.

Bhavnani, R. R. and H. Lacina (2015). The Effects of Weather-Induced Migration on Sons of the Soil Riots in India. *World Politics*, vol. 67, Issue 4, pp. 760-794. Cambridge Core. Available at https://doi.org/10.1017/S0043887115000222.

Blattman, C. and E. Miguel (2010). Civil War. *Journal of Economic Literature*, vol. 48, Issue 1, pp. 3-57. Available at https://doi.org/10.2307/40651577.

Bohlken, A. T. and E. J. Sergenti (2010). Economic growth and ethnic violence: An empirical investigation of Hindu-Muslim riots in India. *Journal of Peace Research*, vol. 47, Issue 5, pp. 589-600. Available at https://doi.org/10.1177/0022343310373032.

Boone, C. (2014). Property and political order: land rights and the structure of conflict in Africa. Cambridge University Press.

_____ (2017). Sons of the Soil Conflict in Africa: Institutional Determinants of Ethnic Conflict Over Land. *World Development*, Issue 96, pp. 276-293. Available at https://doi.org/10.1016/j.worlddev.2017.03.012.

Bosetti, V., C. Cattaneo and G. Peri (2020). Should they stay or should they go? Climate migrants and local conflicts. *Journal of Economic Geography*, lbaa002. Available at https://doi.org/10.1093/jeg/lbaa002.

Breckner, M. and U. Sunde (2019). Temperature extremes, global warming, and armed conflict: new insights from high resolution data. *World Development*, vol. 123, 104624. Available at https://doi.org/10.1016/j.worlddev.2019.104624.

Brochmann, M. and P. R. Hensel (2009). Peaceful Management of International River Claims. *International Negotiation*, vol. 14, Issue 2, pp. 393-418. Available at https://doi.org/10.1163/157180609X432879.

Brochmann, M. and N. P. Gleditsch (2012). Shared rivers and conflict – A reconsideration. *Political Geography*, vol. 31, Issue 8, pp. 519-527. Available at https://doi.org/10.1016/j.polgeo.2012.11.001.

Bromwich, B. (2018). Power, contested institutions and land: repoliticising analysis of natural resources and conflict in Darfur. *Journal of Eastern African Studies*, vol. 12, Issue 1, pp. 1-21. Available at https://doi.org/10.1080/17531055.2017.1403782.

Brown, I. (2010). Assessing eco-scarcity as a cause of the outbreak of conflict in Darfur: a remote sensing approach. *International Journal of Remote Sensing*, vol. 31, Issue 10, pp. 2513-2520. Available at http://dx.doi.org/10.1080/01431161003674592.

Brückner, M. and A. Ciccone (2011). Rain and the Democratic Window of Opportunity. *Econometrica*, vol. 79, Issue 3, pp. 923-947. Available at https://doi.org/10.3982/ECTA8183.

Buhaug, H. (2010). Dude, Where's My Conflict? *Conflict Management and Peace Science*, vol. 27, Issue 2, pp. 107-128. Available at https://doi.org/10.1177/0738894209343974.

Buhaug, H. and S. Gates (2002). The Geography of Civil War. *Journal of Peace Research*, vol. 39, Issue 4, pp. 417-433. Available at https://doi.org/10.1177/0022343302039004003.

Buhaug, H., L.-E. Cederman and K. S. Gleditsch (2014). Square Pegs in Round Holes: Inequalities, Grievances, and Civil War. *International Studies Quarterly*, vol. 58, Issue 2, pp. 418-431. Available at https://doi.org/10.1111/isqu.12068.

Buhaug, H. and others (2021). A Conditional Model of Local Income Shock and Civil Conflict. *The Journal of Politics*, vol. 83, Issue 1, pp. 354-366. Available at https://doi.org/10.1086/709671.

Buhaug, H. and N. von Uexkull (2021). Vicious circles: Violence, vulnerability, and climate change. *Annual Review of Environment and Resources*, vol. 46 (in press).

Burke, M., S. M. Hsiang and E. Miguel (2015). Climate and Conflict. *Annual Review of Economics*, vol. 7, Issue 1, pp. 577-617. Available at https://doi.org/10.1146/annurev-economics-080614-115430.

Bush, R. (2010). Food Riots: Poverty, Power and Protest. *Journal of Agrarian Change*, vol. 10, Issue 1, pp. 119-129. Available at https://doi.org/10.1111/j.1471-0366.2009.00253.x.

Camacho, A. and others (2018). Cholera epidemic in Yemen, 2016-18: an analysis of surveillance data. *The Lancet Global Health*, vol. 6, Issue 6, pp. e680-e690. Available at https://doi.org/10.1016/S2214-109X(18)30230-4.

Cardona, O.-D. and others (2012). Determinants of Risk: Exposure and Vulnerability. In Christopher B. Field and others (eds.). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (pp. 65-108). Cambridge University Press. Available at https://doi.org/10.1017/CBO9781139177245.005.

Carleton, T. A. and S. M. Hsiang (2016). Social and economic impacts of climate. *Science*, vol. 353, No. 6304. Available at https://doi.org/10.1126/science.aad9837.

Caruso, R., I. Petrarca and R. Ricciuti (2016). Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research*, vol. 53, Issue 1, pp. 66-83. Available at https://doi.org/10.1177/0022343315616061.

Chandra, K. (2006). What is Ethnic Identity and does it matter? *Annual Review of Political Science*, vol. 9, Issue 1, pp. 39-424. Available at https://doi.org/10.1146/annurev.polisci.9.062404.170715.

Châtel, F. D. (2014). The Role of Drought and Climate Change in the Syrian Uprising: Untangling the Triggers of the Revolution. *Middle Eastern Studies*, vol. 50, Issue 4, pp. 521-535. Available at https://doi.org/10.1080/00263206.2013.850076.

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

Convention on the Elimination of Discrimination against Women (CEDAW) (2018). General Recommendation No. 37 on the Gender-related dimension of disaster risk reduction in the context of climate change (CEDAW/C/GC/37). Available at https://tbinternet.ohchr.org/_layouts/15/treatybodyexternal/Download.aspx?symbolno=CEDAW/C/GC/37&Lang=en.

Daoudy, M. (2020). *The Origins of the Syrian Conflict: Climate Change and Human Security*. Cambridge University Press.

De Angelis, E. and others (2017). Virtual water trade and bilateral conflicts. *Advances in Water Resources*, vol. 110, 549-561-549-561. Available at https://doi.org/10.1016/j.advwatres.2017.04.002.

De Juan, A. (2015). Long-term environmental change and geographical patterns of violence in Darfur, 2003-2005. *Political Geography*, vol. 45, pp. 22-33. Available at https://doi.org/10.1016/j.polgeo.2014.09.001.

De Stefano, L. and others (2017). Assessment of transboundary river basins for potential hydro-political tensions. *Global Environmental Change*, vol. 45, pp. 35-46. Available at https://doi.org/10.1016/j.gloenvcha.2017.04.008.

De Waal, A. and J. Flint (2008). *Darfur: A Short History of a Long War*. Zed Books.

Dell, M., B. F. Jones and B. A. Olken (2014). What Do We Learn from the Weather? The New Climate-Economy Literature. *Journal of Economic Literature*, vol. 52, Issue 3, pp. 740-798. Available at https://doi.org/10.1257/jel.52.3.740.

Denny, E. K. and B. F. Walter (2014). Ethnicity and civil war. *Journal of Peace Research*, vol. 51, Issue 2, pp. 199-212. Available at https://doi.org/10.1177/0022343313512853.

Devlin, C. and C. S. Hendrix (2014). Trends and triggers redux: Climate change, rainfall, and interstate conflict. *Political Geography*, vol. 43, pp. 27-39. Available at https://doi.org/10.1016/j.polgeo.2014.07.001.

Devoto, F. and others (2012). Happiness on Tap: Piped Water Adoption in Urban Morocco. *American Economic Journal: Economic Policy*, vol. 4, Issue 4, pp. 68-99. Available at https://doi.org/10.1257/pol.4.4.68.

Dinar, S. and others (2015). Climate change, conflict, and cooperation: Global analysis of the effectiveness of international river treaties in addressing water variability. *Political Geography*, vol. 45, pp. 55-66. Available at https://doi.org/10.1016/j.polgeo.2014.08.003.

Döring, S. (2020a). Come rain, or come wells: How access to groundwater affects communal violence. *Political Geography*, vol. 76, 102073. Available at https://doi.org/10.1016/j.polgeo.2019.102073.

_____ (2020b). From Bullets to Boreholes: A Disaggregated Analysis of Domestic Water Cooperation in Drought-prone Regions. *Global Environmental Change*, vol. 65, 102147. Available at https://doi.org/10.1016/j.gloenvcha.2020.102147.

Dube, O. and J. F. Vargas (2013). Commodity Price Shocks and Civil Conflict: Evidence from Colombia. *The Review of Economic Studies*, vol. 80, Issue 4, pp. 1384-1421. Available at https://doi.org/10.1093/restud/rdt009.

Duflo, E. and others (2015). *Toilets Can Work: Short and Medium Run Health Impacts of Addressing Complementarities and Externalities in Water and Sanitation* (No. w21521; p. w21521). National Bureau of Economic Research. Available at https://doi.org/10.3386/w21521.

Eklund, L. and others (n.d.). Understanding climate-conflict relationships requires shifting from meteorological to agricultural drought indicators (under review).

Eklund, L. and others (2017). How conflict affects land use: agricultural activity in areas seized by the Islamic State. *Environmental Research Letters*, vol. 12, Issue 5, 054004. Available at https://doi.org/10.1088/1748-9326/aa673a.

Ember, C. R. and others (2014). Rain and Raids Revisited: Disaggregating Ethnic Group Livestock Raiding in the Ethiopian-Kenyan Border Region. *Civil Wars*, vol. 16, Issue 3, pp. 300-327. Available at https://doi.org/10.1080/13698249.2014.966430.

Economic and Social Commission for Western Asia (ESCWA) (2017). *Arab Climate Change Assessment Report* (E/ESCWA/SDPD/2017/RICCAR/Report). Available at https://www.unescwa.org/publications/riccar-arab-climate-change-assessment-report.

ESCWA and Food and Agriculture Organization (FAO) (2017). Arab Horizon 2030: Prospects for Enhancing Food Security in the Arab Region: Technical Summary (p. 41). Available at https://archive.unescwa.org/sites/www.unescwa.org/files/uploads/arab-horizon-2030-prospects-enhancing-food-security-summary-english.pdf.

Food and Agriculture Organization (FAO) (1996). Rome Declaration on World Food Security and World Food Summit Plan of Action. World Food Summit, Rome, 13-17 November.

_____ (2006). Food security. FAO Policy Brief, Issue 2. Available at http://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf.

_____ (2017). Iraq: Agriculture damage and loss needs assessment. Rome. Available at https://www.fao.org/3/i7810e/i7810e.pdf.

FAO and others (2020). *The State of Food Security and Nutrition in the World 2020*. Rome: Food and Agriculture Organization of the United Nations. Available at http://www.fao.org/publications/sofi/2020/en/.

Fearon, J. D. (2008). Economic development, insurgency, and civil war. In *Institutions and Economic Performance*. Harvard University Press.

Fearon, J. D. and D. D. Laitin (2003). Ethnicity, Insurgency, and Civil War. *The American Political Science Review*, vol. 97, Issue 1, pp. 75-90. Available at https://doi.org/10.2307/3118222.

Feitelson, E. and A. Tubi (2017). A main driver or an intermediate variable? Climate change, water and security in the Middle East. *Global Environmental Change*, vol. 44, pp. 39-48. Available at https://doi.org/10.1016/j.gloenvcha.2017.03.001.

Fewtrell, L. and others (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, vol. 5, Issue 1, pp. 42-52. Available at https://doi.org/10.1016/S1473-3099(04)01253-8.

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

Fröhlich, C. J. (2016). Climate migrants as protestors? Dispelling misconceptions about global environmental change in pre-revolutionary Syria. *Contemporary Levant*, vol. 1, Issue 1, pp. 38-50. Available at https://doi.org/10.1080/20581831.2016.1149355.

Food Security Information Network (FSIN) (2020). *Global Report on Food Crises 2020*. Available at https://www.fsinplatform.org/sites/default/files/resources/files/GRFC_2020_ONLINE_200420.pdf.

Furlong, K., N. P. Gleditsch and H. Hegre (2006). Geographic Opportunity and Neomalthusian Willingness: Boundaries, Shared Rivers, and Conflict. *International Interactions*, vol. 32, Issue 1, pp. 79-108. Available at https://doi.org/10.1080/03050620600596421.

Garrick, D. E. and others (2017). Valuing water for sustainable development. *Science*, Issue 358 (6366), pp. 1003-1005. Available at https://doi.org/10.1126/science.aao4942.

Garschagen, M. and P. Romero-Lankao (2015). Exploring the relationships between urbanization trends and climate change vulnerability. *Climatic Change*, vol. 133, Issue 1, pp. 37-52. Available at https://doi.org/10.1007/s10584-013-0812-6.

Gat, A. (2009). So Why Do People Fight? Evolutionary Theory and the Causes of War. *European Journal of International Relations*, vol. 15, Issue 4, pp. 571-599. Available at https://doi.org/10.1177/1354066109344661.

Gates, S. (2002). Recruitment and Allegiance: The Microfoundations of Rebellion. *Journal of Conflict Resolution*, vol. 46, Issue 1, pp. 111-130. Available at https://doi.org/10.1177/0022002702046001007.

Gates, S. and others (2006). Institutional Inconsistency and Political Instability: Polity Duration, 1800-2000. *American Journal of Political Science*, vol. 50, Issue 4, pp. 893-908. Available at https://doi.org/10.1111/j.1540-5907.2006.00222.x.

Gates, S. and others (2012). Development Consequences of Armed Conflict. *World Development*, vol. 40, Issue 9, pp. 1713-1722. Available at https://doi.org/10.1016/j.worlddev.2012.04.031.

Ghimire, R., S. Ferreira and J. H. Dorfman, J. H. (2015). Flood-Induced Displacement and Civil Conflict. *World Development*, vol. 66 (Supplement C), pp. 614-628. Available at https://doi.org/10.1016/j.worlddev.2014.09.021.

Ghimire, R. and S. Ferreira (2016). Floods and armed conflict. *Environment and Development Economics*, vol. 21, Issue 1, pp. 23-52. Available at https://doi.org/10.1017/S1355770X15000157.

Gillingham, K. and others (2018). Modeling Uncertainty in Integrated Assessment of Climate Change: A Multimodel Comparison. *Journal of the Association of Environmental and Resource Economists*, vol. 5, Issue 4, pp. 791-826. Available at https://doi.org/10.1086/698910.

Giordano, M. and others (2014). A review of the evolution and state of transboundary freshwater treaties. *International Environmental Agreements: Politics, Law and Economics*, vol. 14, Issue 3, pp. 245-264. Available at https://doi.org/10.1007/s10784-013-9211-8.

Gleditsch, K. and A. Ruggeri (2010). Political opportunity structures, democracy, and civil war. *Journal of Peace Research*, vol. 47, Issue 3, pp. 299-310. Available at https://doi.org/10.1177/0022343310362293.

Gleick, P. H. (2014). Water, Drought, Climate Change, and Conflict in Syria. *Weather, Climate, and Society*, vol. 6, Issue 3, pp. 331-340. Available at https://doi.org/10.1175/WCAS-D-13-00059.1.

Goemans, H. E. and K. A. Schultz (2017). The Politics of Territorial Claims: A Geospatial Approach Applied to Africa. *International Organization*, vol. 71, Issue 1, pp. 31-64. Available at https://doi.org/10.1017/S0020818316000254.

Goldstone, J. A. (1991). *Revolution and rebellion in the early modern world*. University of California Press.

Grossman, H. I. (1991). A general equilibrium model of insurrections. *The American Economic Review*, vol. 81, Issue 4, pp. 912-921. Available at https://www.jstor.org/stable/2006650.

Gurr, T. R. (1970). *Why men rebel*. Princeton University Press.

Hallegatte, S. and others (2016). *Shock Waves: Managing the Impacts of Climate Change on Poverty*. The World Bank. Available at https://doi.org/10.1596/978-1-4648-0673-5.

Hallegatte, S. and J. Rozenberg (2017). Climate change through a poverty lens. *Nature Climate Change*, vol. 7, Issue 4, pp. 250-256. Available at https://doi.org/10.1038/nclimate3253.

Harari, M. and E. La Ferrara (2018). Conflict, Climate, and Cells: A Disaggregated Analysis. *The Review of Economics and Statistics*, vol. 100, Issue 4, pp. 594-608. Available at https://doi.org/10.1162/rest_a_00730.

Hegre, H. (2014). Democracy and armed conflict. *Journal of Peace Research*, vol. 51, Issue 2, pp. 159-172. Available at https://doi.org/10.1177/0022343313512852.

Hegre, H. and others (2001). Toward a Democratic Civil Peace? Democracy, Political Change, and Civil War, 1816-1992. *American Political Science Review*, vol. 95, Issue 1, pp. 33-48. Available at https://doi.org/10.1017/S0003055401000119.

Hegre, H. and others (2019). ViEWS: A political violence early-warning system. *Journal of Peace Research*, vol. 56, Issue 2, pp. 155-174. Available at https://doi.org/10.1177/0022343319823860.

Hegre, H. and others (2021). ViEWS2020: Revising and evaluating the ViEWS political Violence Early-Warning System. *Journal of Peace Research*, vol. 58, Issue 3, pp. 599-611. Available at https://doi.org/10.1177/0022343320962157.

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

Helman, D., B. F. Zaitchik and C. Funk (2020). Climate has contrasting direct and indirect effects on armed conflicts. *Environmental Research Letters*, vol. 15, Issue 10, 104017. Available at https://doi.org/10.1088/1748-9326/aba97d.

Hendriks, S. (2016). The Food Security Continuum: The Impact on Health, Growth, and Well-Being. In *Food Security and Child Malnutrition* (chapter 1, pp. 1-24). Available at https://doi.org/10.1201/9781315365749-2.

Hendrix, C. S. (2010). Measuring state capacity: Theoretical and empirical implications for the study of civil conflict. *Journal of Peace Research*, vol. 47, Issue 3, pp. 273-285. Available at https://doi.org/10.1177/0022343310361838.

Hendrix, C. S. and S. M. Glaser (2011). Civil conflict and world fisheries, 1952-2004. *Journal of Peace Research*, vol. 48, Issue 4, pp. 481-495. Available at https://doi.org/10.1177/0022343311399129.

Heslin, A. (2021). Riots and resources: How food access affects collective violence. *Journal of Peace Research*, vol. 58, Issue 2, pp. 199-214. Available at https://doi.org/10.1177/0022343319898227.

Homer-Dixon, T. F. (1999). *Environment, Scarcity, and Violence*. Princeton University Press.

International Committee of the Red Cross (ICRC) (2015). *Bled dry. How war in the Middle East is bringing the region's water supplies to breaking point. An ICRC report.* Available at https://www.icrc.org/en/download/file/5508/full_report-water-middle-east-icrc.pdf.

Ide, T. (2018a). Climate War in the Middle East? Drought, the Syrian Civil War and the State of Climate-Conflict Research. *Current Climate Change Reports*, vol. 4, Issue 4, pp. 347-354. Available at https://doi.org/10.1007/s40641-018-0115-0.

_____ (2018b). Does environmental peacemaking between states work? Insights on cooperative environmental Ide, T. and A. Detges (2018). International Water Cooperation and Environmental Peacemaking. *Global Environmental Politics*, vol. 18, Issue 4, pp. 63-84. Available at https://doi.org/10.1162/glep_a_00478.

agreements and reconciliation in international rivalries. *Journal of Peace Research*, vol. 55, Issue 3, pp. 351-365. Available at https://doi.org/10.1177/0022343317750216.

Ide, T. and A. Detges (2018). International Water Cooperation and Environmental Peacemaking. *Global Environmental Politics*, vol. 18, Issue 4, pp. 63-84. Available at https://doi.org/10.1162/glep_a_00478.

Ide, T. and others (2020). Pathways to water conflict during drought in the MENA region. *Journal of Peace Research*, 0022343320910777, vol. 58, Issue 3. Available at https://doi.org/10.1177/0022343320910777.

Ide, T., A. Kristensen and H. Bartusevičus (2021). First comes the river, then comes the conflict? A qualitative comparative analysis of flood-related political unrest. *Journal of Peace Research*, vol. 58, Issue 1, pp. 83-97. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320966783.

Jaafar, H. H. and E. Woertz (2016). Agriculture as a funding source of ISIS: A GIS and remote sensing analysis. *Food Policy*, vol. 64, pp. 14-25. Available at https://doi.org/10.1016/j.foodpol.2016.09.002.

Kaczan, D. J. and J. Orgill-Meyer (2020). The impact of climate change on migration: a synthesis of recent empirical insights. *Climatic Change*, vol. 158, Issues 3-4, pp. 281-300. Available at https://doi.org/10.1007/s10584-019-02560-0.

Kahl, C. H. (2006). *States, Scarcity, and Civil Strife in the Developing World*. Princeton University Press.

Karreth, J. and J. Tir (2018). International agreement design and the moderating role of domestic bureaucratic quality: The case of freshwater cooperation. *Journal of Peace Research*, vol. 55, Issue 4, pp. 460-475. Available at https://doi.org/10.1177/0022343317749271.

Keels, E. (2019). Praying for Rain? Water Scarcity and the Duration and Outcomes of Civil Wars. *Defence and Peace Economics*, vol. 30, Issue 1, pp. 27-45. Available at https://doi.org/10.1080/10242694.2017.1320184.

Keen, S. (2020). The appallingly bad neoclassical economics of climate change. *Economics and Climate Emergency*, vol. 18, Issue 7, pp. 1149-1177. Available at https://doi.org/10.1080/14747731.2020.1807856.

Kelley, C. and others (2015). Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences*, No. 112, vol. 11, pp. 3241-3246. Available at https://doi.org/10.1073/pnas.1421533112.

Kelley, C. and others (2017). Commentary on the Syria case: Climate as a contributing factor. *Political Geography*, vol. 60, pp. 245-247. Available at https://doi.org/10.1016/j.polgeo.2017.06.013.

Koos, C. (2018). Which Grievances Make People Support Violence against the State? Survey Evidence from the Niger Delta. *International Interactions*, vol. 44, Issue 3, pp. 437-462. Available at https://doi.org/10.1080/03050629.2017.1369411.

Koren, O. and B. E. Bagozzi (2016). From global to local, food insecurity is associated with contemporary armed conflicts. *Food Security*, vol. 8, Issue 5, pp. 999-1010. Available at https://doi.org/10.1007/s12571-016-0610-x.

Koren, O. and B. E. Bagozzi (2017). Living off the land: The connection between cropland, food security, and violence against civilians. *Journal of Peace Research*, vol. 54, Issue 3, pp. 351-364. Available at https://doi.org/10.1177/0022343316684543.

Koren, O., B. E. Bagozzi and T. Benson (2021). Food and water insecurity as causes of social unrest: Evidence from geolocated twitter data. *Journal of Peace Research*, vol. 58, Issue 1. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320975091.

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

Koubi, V. and others (2018). The Determinants of Environmental Migrants' Conflict Perception. *International Organization*, vol. 72, Issue 4, pp. 905-936. Available at https://doi.org/10.1017/S0020818318000231.

Landis, S. T. and others (2017). Fording differences? Conditions mitigating water insecurity in the Niger River Basin. *Political Geography*, vol. 56, pp. 77-90. Available at https://doi.org/10.1016/j.polgeo.2016.10.002.

Lewis, J. I. (2017). How Does Ethnic Rebellion Start? *Comparative Political Studies*, vol. 50, Issue 10, pp. 1420-1450. Available at https://doi.org/10.1177/0010414016672235.

Lichbach, M. I. (1998). *The rebel's dilemma*. University of Michigan Press.

Linke, A. M. and others (2015). Rainfall variability and violence in rural Kenya: Investigating the effects of drought and the role of local institutions with survey data. *Global Environmental Change*, vol. 34, pp. 35-47. Available at https://doi.org/10.1016/j.gloenvcha.2015.04.007.

Linke, A. M. and others (2018). The consequences of relocating in response to drought: human mobility and conflict in contemporary Kenya. *Environmental Research Letters*, vol. 13, Issue 9, 094014. Available at https://doi.org/10.1088/1748-9326/aad8cc.

Linke, A. M. and B. Ruether (2021). Weather, wheat and war: Security implications of climate variability for conflict in Syria. *Journal of Peace Research*, vol. 58, Issue 1. Available at https://journals.sagepub.com/doi/full/10.1177/0022343320973070.

Luo, Q. (2011). Temperature thresholds and crop production: a review. *Climatic Change*, vol. 109, Issue 3, pp. 583-598. Available at https://doi.org/10.1007/s10584-011-0028-6.

Mack, E. A. and others (2021). Conflict and its relationship to climate variability in Sub-Saharan Africa. *Science of The Total Environment*, vol. 775, 145646. Available at https://doi.org/10.1016/j.scitotenv.2021.145646.

Mamdani, M. (2007). The Politics of Naming: Genocide, Civil War, Insurgency. *London Review of Books*, vol. 29, Issue 5. Available at https://www.lrb.co.uk/the-paper/v29/n05/mahmood-mamdani/the-politics-of-naming-genocide-civil-war-insurgency.

Matthews, J. B. R. (ed.). (2018). Glossary. In *Global Warming of 1.5°C*. IPCC. Available at https://www.ipcc.ch/report/sr15/glossary/.

Maxwell, D., R. Caldwell and M. Langworthy (2008). Measuring food insecurity: Can an indicator based on localized coping behaviors be used to compare across contexts? *Food Policy*, vol. 33, Issue 6, pp. 533-540. Available at https://doi.org/10.1016/j.foodpol.2008.02.004.

Maystadt, J.-F. and O. Ecker (2014). Extreme Weather and Civil War: Does Drought Fuel Conflict in Somalia through Livestock Price Shocks? *American Journal of Agricultural Economics*, vol. 96, Issue 4, pp. 1157-1182. Available at https://doi.org/10.1093/ajae/aau010.

Maystadt, J.-F., M. Calderone and L. You (2015). Local warming and violent conflict in North and South Sudan. *Journal of Economic Geography*, vol. 15, Issue 3, pp. 649-671. Available at https://doi.org/10.1093/jeg/lbu033.

Maystadt, J.-F. and others (2020). Vegetation changes attributable to refugees in Africa coincide with agricultural deforestation. *Environmental Research Letters*, vol. 15, Issue 4, 044008. Available at https://doi.org/10.1088/1748-9326/ab6d7c.

Maystadt, J.-F., J.-F Trinh Tan and C. Breisinger (2014). Does food security matter for transition in Arab countries? *Food Policy*, vol. 46, pp. 106-115. Available at https://doi.org/10.1016/j.foodpol.2014.01.005.

McAdam, D., S. Tarrow and C. Tilly (2001). *Dynamics of Contention*. Cambridge University Press.

Mendenhall, E. and others (2020). Climate change increases the risk of fisheries conflict. *Marine Policy*, Issue 117, 103954. Available at https://doi.org/10.1016/j.marpol.2020.103954.

Kevane, M. and L. Gray (2008). Darfur: rainfall and conflict. *Environmental Research Letters*, vol. 3, Issue 3, 034006. Available at https://iopscience.iop.org/article/10.1088/1748-9326/3/3/034006/meta.

Miles-Novelo, A. and C. A. Anderson (2019). Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression. *Current Climate Change Reports*, vol. 5, Issue 1, pp. 36-46. Available at https://doi.org/10.1007/s40641-019-00121-2.

Mitchell, S. M. and N. A. Zawahri (2015). The effectiveness of treaty design in addressing water disputes. *Journal of Peace Research*, vol. 52, Issue 2, pp. 187-200. Available at https://doi.org/10.1177/0022343314559623.

Neumayer, E. and T. Plümper (2007). The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981-2002. *Annals of the Association of American Geographers*, vol. 97, Issue 3, pp. 551-566. Available at https://doi.org/10.1111/j.1467-8306.2007.00563.x.

Ngo, N. V. and others (2020). Armed conflict, a neglected determinant of childhood vaccination: some children are left behind. *Human Vaccines & Immunotherapeutics*, vol. 16, Issue 6, pp. 1454-1463. Available at https://doi.org/10.1080/21645515.2019.1688043.

Nordhaus, W. D. (2006). Geography and macroeconomics: New data and new findings. *Proceedings of the National Academy of Sciences of the United States of America*, vol. 103, Issue 10, pp. 3510-3517. Available at https://doi.org/10.1073/pnas.0509842103.

Nordkvelle, J., S. A. Rustad and M. Salmivalli (2017). Identifying the effect of climate variability on communal conflict through randomization. *Climatic Change*, vol. 141, Issue 4, pp. 627-639. Available at https://doi.org/10.1007/s10584-017-1914-3.

O'Loughlin, J., A. M. Linke and F. D. W. Witmer (2014). Modeling and data choices sway conclusions about climate-conflict links. *Proceedings of the National Academy of Sciences*, vol. 111, Issue 6, pp. 2054-2055. Available at https://doi.org/10.1073/pnas.1323417111.

Olson, M. (1965). *The Logic of Collective Action. Public Goods and the Theory of Groups*. Cambridge University Press.

Olsson, O. (2016). Climate Change and Market Collapse: A Model Applied to Darfur. *Games*, vol. 7, Issue 1, p. 9. Available at https://doi.org/10.3390/g7010009.

Omelicheva, M. Y. (2011). Natural Disasters: Triggers of Political Instability? *International Interactions*, vol. 37, Issue 4, pp. 441-465. Available at https://doi.org/10.1080/03050629.2011.622653.

Oppenheimer, M. and others (eds.) (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 1039-1099). Cambridge University Press.

Østby, G. (2008). Polarization, Horizontal Inequalities and Violent Civil Conflict. *Journal of Peace Research*, vol. 45, Issue 2, pp. 143-162. Available at https://doi.org/10.1177/0022343307087169.

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.

Ostrom, E. (2002). Common-pool resources and institutions. In *Handbook of Agricultural Economics* (pp. 1315-1339). Elsevier.

Ovodenko, A. (2016). Regional Water Cooperation: Creating Incentives for Integrated Management. *Journal of Conflict Resolution*, vol. 60, Issue 6, pp. 1071-1098. Available at https://doi.org/10.1177/0022002714553109.

Owsiak, A. P. and S. M. Mitchell (2019). Conflict Management in Land, River, and Maritime Claims. *Political Science Research and Methods*, vol. 7, Issue 1, p. 43. Available at http://dx.doi.org/10.1017/psrm.2016.56.

Pettersson, T. and M. Öberg (2020). Organized violence, 1989-2019. *Journal of Peace Research*, vol. 57, Issue 4, pp. 597-613. Available at https://doi.org/10.1177/0022343320934986.

Pinstrup-Andersen, P. and S. Shimokawa (2008). Do poverty and poor health and nutrition increase the risk of armed conflict onset? *Food Policy*, vol. 33, Issue 6, pp. 513-520. Available at https://doi.org/10.1016/j.foodpol.2008.05.003.

Rahaman, M. M. and O. Varis (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice and Policy*, vol. 1, Issue 1, pp. 15-21. Available at https://doi.org/10.1080/15487733.2005.11907961.

Raleigh, C. and D. Kniveton (2012). Come rain or shine: An analysis of conflict and climate variability in East Africa. *Journal of Peace Research*, vol. 49, Issue 1, pp. 51-64. Available at https://doi.org/10.1177/0022343311427754.

Raleigh, C., A. Linke and J. O'Loughlin (2014). Extreme temperatures and violence. *Nature Climate Change*, vol. 4, Issue 2, pp. 76-77. Available at https://www.nature.com/articles/nclimate2101?page=1.

Raleigh, C., H. J. Choi and D. Kniveton (2015). The devil is in the details: An investigation of the relationships between conflict, food price and climate across Africa. *Global Environmental Change*, vol. 32, pp. 187-199. Available at https://doi.org/10.1016/j.gloenvcha.2015.03.005.

Reuveny, R. (2007). Climate change-induced migration and violent conflict. *Political Geography*, vol. 26, Issue 6, pp. 656-673. Available at https://doi.org/10.1016/j.polgeo.2007.05.001.

Roche, K. R. and others (2020). Climate change and the opportunity cost of conflict. *Proceedings of the National Academy of Sciences*, vol. 117, Issue 4, p. 1935. Available at https://doi.org/10.1073/pnas.1914829117.

Rudolfsen, I. (2020). Food Insecurity and Domestic Instability: A Review of the Literature. *Terrorism and Political Violence*, vol. 32, Issue 5, pp. 921-948. Available at https://doi.org/10.1080/09546553.2017.1418334.

_____ (2021). Food price increase and urban unrest: The role of societal organizations. *Journal of Peace Research*, vol. 58, Issue 2, pp. 215-230. Available at https://doi.org/10.1177/0022343319899705.

Sadiki, L. (2000). Popular Uprisings and Arab Democratization. International Journal of Middle East Studies, vol. 32, Issue 1, pp. 71–95. Available at https://www.cambridge.org/core/journals/international-journal-of-middle-east-studies/article/abs/popular-uprisings-and-arab-democratization/D278E9DBEB3F2072BEE7D8389EFEE837.

Saint Ville, A. and others (2019). Food security and the Food Insecurity Experience Scale (FIES): ensuring progress by 2030. *Food Security*, vol. 11, Issue 3, pp. 483-491. Available at https://doi.org/10.1007/s12571-019-00936-9.

Sakaguchi, K., A. Varughese and G. Auld (2017). Climate Wars? A Systematic Review of Empirical Analyses on the Links between Climate Change and Violent Conflict. *International Studies Review*, vol. 19, Issue 4, pp. 622-645. Available at https://doi.org/10.1093/isr/vix022.

Schilling, J. (2012). *On Rains, Raids and Relations: A Multimethod Approach to Climate Change, Vulnerability, Adaptation and Violent Conflict in Northern Africa and Kenya.* Hamburg University. Available at https://d-nb.info/1024772357/34.

Schultz, K. A. and J. S. Mankin (2019). Is Temperature Exogenous? The Impact of Civil Conflict on the Instrumental Climate Record in Sub-Saharan Africa. *American Journal of Political Science*, vol. 63, Issue 4, pp. 723-739. Available at https://doi.org/10.1111/ajps.12425.

Selby, J. (2014). Positivist Climate Conflict Research: A Critique. *Geopolitics*, vol. 19, Issue 4, pp. 829-856. Available at https://doi.org/10.1080/14650045.2014.964865.

_____ (2019). Climate change and the Syrian civil war, Part II: The Jazira's agrarian crisis. *Geoforum*, vol. 101, pp. 260-274. Available at https://doi.org/10.1016/j.geoforum.2018.06.010.

Selby, J. and others (2017). Climate change and the Syrian civil war revisited: A rejoinder. *Political Geography*, vol. 60, pp. 253-255. Available at https://doi.org/10.1016/j.polgeo.2017.08.001

Selby, J. and C. Hoffmann (2014). Beyond scarcity: Rethinking water, climate change and conflict in the Sudans. *Global Environmental Change*, vol. 29, pp. 360-370. Available at https://doi.org/10.1016/j.gloenvcha.2014.01.008.

Sen, A. (1981). *Poverty and famines: an essay on entitlement and deprivation*. Oxford University Press.

Smidt, M. and O. M. Theisen (2018). Climate Change and Conflict: Agriculture, Migration and Institutions. In *Crisis and Conflict in Agriculture* (pp. 40-52). CABI International.

Soffiantini, G. (2020). Food insecurity and political instability during the Arab Spring. *Global Food Security*, vol. 26, 100400. Available at https://doi.org/10.1016/j.gfs.2020.100400.

Sofuoğu, E. and A. Ay (2020). The relationship between climate change and political instability: the case of MENA countries (1985:01-2016:12). *Environmental Science and Pollution Research*, vol. 27, Issue 12, pp. 14033-14043. Available at https://doi.org/10.1007/s11356-020-07937-8.

Sternberg, T. (2012). Chinese drought, bread and the Arab Spring. *Applied Geography*, vol. 34, pp. 519-524. Available at https://doi.org/10.1016/j.apgeog.2012.02.004.

Stewart, F. (2008). *Horizontal Inequalities and Conflict. Understanding Group Violence in Multi-ethnic Societies*. Palgrave Macmillan.

Sulitzeanu-Kenan, R. and E. Halperin (2013). Making a Difference: Political Efficacy and Policy Preference Construction. *British Journal of Political Science*, vol. 43, Issue 2, pp. 295-322. Available at https://doi.org/10.1017/S0007123412000324.

Swain, A. (2004). *Managing Water Conflict*. Routledge.

Theisen, O. M. (2012). Climate clashes? Weather variability, land pressure, and organized violence in Kenya, 1989-2004. *Journal of Peace Research*, vol. 49, Issue 1, pp. 81-96. Available at https://doi.org/10.1177/0022343311425842.

_____ (2017). Climate Change and Violence: Insights from Political Science. *Current Climate Change Reports*, vol. 3, Issue 4, pp. 210-221. Available at https://doi.org/10.1007/s40641-017-0079-5.

Theisen, O. M., H. Holtermann and H. Buhaug (2011). Climate Wars? Assessing the Claim That Drought Breeds Conflict. *International Security*, vol. 36, Issue 3, pp. 79-106. Available at https://doi.org/10.1162/ISEC_a_00065.

Tir, J. and D. M. Stinnett (2012). Weathering climate change: Can institutions mitigate international water conflict? *Journal of Peace Research*, vol. 49, Issue 1, pp. 211-225. Available at https://doi.org/10.1177/0022343311427066.

Tubi, A. and E. Feitelson (2016). Drought and cooperation in a conflict prone area: Bedouin herders and Jewish farmers in Israel's northern Negev, 1957-1963. *Political Geography*, vol. 51, pp. 30-42. Available at https://doi.org/10.1016/j.polgeo.2015.11.009.

Tvedt, T. (2021). *The Nile: History's Greatest River*. Bloomsbury Publishing.

United Nations (2018). Security Council Resolution 2429 (S/RES/2429), July 13. Available at https://undocs.org/en/S/RES/2429(2018).

_____ (2019). Security Council Resolution 2461 (S/RES/2461), March 27. Available at https://undocs.org/S/RES/2461(2019).

United Nations Educational, Scientific and Cultural Organization (UNESCO) World Water Assessment Programme (2019). *World Water Development Report 2019: Leaving No One Behind*. UNESCO. Available at https://unesdoc.unesco.org/ark:/48223/pf0000367306.

UNESCO, 2015. The United Nations World Water Development Report 2015: Water for a Sustainable World. Available at https://www.unwater.org/publications/world-water-development-report-2015/.

United Nations Office for the Coordination of Humanitarian Affairs (OCHA) (2019). Somalia Flash Update No. 2: Humanitarian impact of flooding. Available at https://reliefweb.int/report/somalia/ocha-somalia-flash-update-2-humanitarian-impact-flooding-28-october-2019-enso.

United Nations Security Council (2021). Final report of the Panel of Experts on Yemen (S/2021/79). Available at https://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/S_2021_79.pdf.

Van Weezel, S. (2019). On climate and conflict: Precipitation decline and communal conflict in Ethiopia and Kenya. *Journal of Peace Research*, vol. 56, Issue 4, pp. 514-528. Available at https://doi.org/10.1177/0022343319826409.

_____ (2020). Local warming and violent armed conflict in Africa. *World Development*, vol. 126, 104708. Available at https://doi.org/10.1016/j.worlddev.2019.104708.

Vesco, P. and others (2020). Natural resources and conflict: A meta-analysis of the empirical literature. *Ecological Economics*, vol. 172, 106633. Available at https://doi.org/10.1016/j.ecolecon.2020.106633.

Vogt, M. and others (2015). Integrating Data on Ethnicity, Geography, and Conflict: The Ethnic Power Relations Data Set Family. *Journal of Conflict Resolution*, vol. 59, Issue 7. Available at https://doi.org/10.1177/0022002715591215.

Von Uexkull, N. (2014). Linkages between climate variability, vulnerability and armed conflict in sub-Saharan Africa. A review. In Bob, U. and S. Bronkhorst (eds.), *Conflict-Sensitive Adapation to Climate Change in Africa*, pp. 161-176. Berliner Wissenschafts-Verlag.

Von Uexkull, N. and others (2016). Civil conflict sensitivity to growing-season drought. *Proceedings of the National Academy of Sciences*, vol. 113, Issue 44, pp. 12391-12396. Available at https://doi.org/10.1073/pnas.1607542113.

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

Webb, P. and others (2006). Measuring Household Food Insecurity: Why It's So Important and Yet So Difficult to Do. *The Journal of Nutrition*, vol. 136, Issue 5, pp. 1404S-1408S. Available at https://doi.org/10.1093/jn/136.5.1404S.

Werrell, C. E., F. Femia and T. Sternberg (2015). Did We See It Coming?: State Fragility, Climate Vulnerability, and the Uprisings in Syria and Egypt. *SAIS Review of International Affairs*, vol. 35, Issue 1, pp. 29-46. Available at https://doi.org/10.1353/sais.2015.0002.

World Food Programme (WFP) (2019). Fact sheet: Hunger & conflict. Available at https://reliefweb.int/report/world/wfp-fact-sheet-hunger-conflict-june-2019.

_____ (2021). Yemen Emergency. Available at https://www.wfp.org/emergencies/yemen-emergency.

WFP and Mercy Corps (2021). Whole of Syria Food Security Sector: Situation Report. Second quarter. Available at https://fscluster.org/sites/default/files/documents/wos_fss_sitrep_2_january_to_june_2021_final.pdf.

Witsenburg, K. M. and W. R. Adano (2009). Of Rain and Raids: Violent Livestock Raiding in Northern Kenya. *Civil Wars*, vol. 11, Issue 4, pp. 514-538. Available at https://doi.org/10.1080/13698240903403915.

Wolf, A. T., S. B. Yoffe and M. Giordano (2003). International waters: identifying basins at risk. *Water Policy*, vol. 5, Issue 1, pp. 29-60. Available at https://doi.org/10.2166/wp.2003.0002.

Woodhouse, P. and M. Muller (2017). Water Governance—A Historical Perspective on Current Debates. *World Development*, vol. 92, pp. 225-241. Available at https://www.researchgate.net/publication/312103637_Water_Governance-An_Historical_Perspective_on_Current_Debates.

World Bank (2017). Yemen: Immediate Priorities for Post-Conflict Recovery of the Health Sector. Input to the Yemen Policy Note no. 4 on Inclusive Services Delivery. World Bank. Available at https://documents1.worldbank.org/curated/en/349331508408515508/pdf/120530-WP-P159636-PUBLIC-Yemen-Health-Policy-Note-Input-to-PN-RA-edits.pdf.

Yoffe, S., A. T. Wolf and M. Giordano (2003). Conflict and Cooperation Over International Freshwater Resources: Indicators of Basins at Risr1. *JAWRA Journal of the American Water Resources Association*, vol. 39, Issue 5, pp. 1109-1126. Available at https://doi.org/10.1111/j.1752-1688.2003.tb03696.x.

Yoffe, S. and others (2004). Geography of international water conflict and cooperation: Data sets and applications. *Water Resources Research*, vol. 40, Issue 5. Available at https://doi.org/10.1029/2003WR002530.

Zeitoun, M. and N. Mirumachi (2008). Transboundary water interaction I: reconsidering conflict and cooperation. *International Environmental Agreements: Politics, Law and Economics*, vol. 8, Issue 4, p. 297. Available at https://doi.org/10.1007/s10784-008-9083-5.

Zeitoun, M. and M. Talhami (2016). The impact of explosive weapons on urban services: Direct and reverberating effects across space and time. *International Review of the Red Cross*, vol. 98, Issue 901, pp. 53-70. Available at https://doi.org/10.1017/S1816383117000157.

Zhang, X. and others (2018). Impacts of climate change, policy and Water-Energy-Food nexus on hydropower development. *Renewable Energy*, Issue 116, pp. 827-834. Available at https://doi.org/10.1016/j.renene.2017.10.030.

The Arab States are affected by a wide range of environmental challenges exacerbated by current and projected impacts of climate change, including, among others, depletion of scarce natural resources such as water and arable land, increasing pollution levels, and the growing number and magnitude of extreme weather events. At the same time, the Arab region has been a hotspot for conflicts during the last decades. This highlights the need among policymakers and practitioners of conflict prevention and peacebuilding to better understand how climate change might contribute to current or future dynamics of conflict. This report provides a conceptual framework for analysts and policymakers in the region that shows how the loss of livelihood, economic contraction, resource competition, migration, poor governance, and other social processes (mechanisms) spurred by climate risk are more likely to increase conflict risk when occurring in certain contexts.

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