Drought, Infrastructure and Conflict Risk in Sub-Saharan Africa

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Eidesstattliche Erklärung / Declaration on oath

Hiermit erkläre ich an Eides statt, dass ich die vorliegende Dissertation selbst verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe.

I hereby declare, on oath, that I have written the present dissertation by my own and have not used other than the acknowledged resources and aids.

Berlin, den 31.01.2018

Adrien Detges

List of research articles

This thesis is based on the following research articles, which are referred to in the text by their Roman numerals:

I. Detges, A. (2014). Close-up on renewable resources and armed conflict. The spatial logic of pastoralist violence in northern Kenya. *Political Geography*, *42*, 57–65. https://doi.org/10.1016/j.polgeo.2014.06.003

II. Detges, A. (2017). Droughts, state-citizen relations and support for political violence in Sub-Saharan Africa: A micro-level analysis. *Political Geography*, *61*, 88–98. https://doi.org/10.1016/j.polgeo.2017.07.005

III. Detges, A. (2016). Local conditions of drought-related violence in sub-Saharan Africa: The role of road and water infrastructures. *Journal of Peace Research*, *53*(5), 696–710. https://doi.org/10.1177/0022343316651922

Contents

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Summary of findings

Recent years have seen a surge in the number of scientific studies, reports and newspaper articles portraying possible connections between climate variability and violent conflict. As sudden changes in temperature and precipitation are expected to become more frequent in certain areas due to climate change, researchers and decision-makers alike have become increasingly worried about the security implications of extreme events such as droughts and floods. Concerns are that such events could undermine people's livelihoods, exacerbate social tensions and eventually contribute to political instability and violence, with crises in Syria, Darfur and the Western Sahel being frequently mentioned as examples.

Yet, despite the vocal nature of those linking climate variability and violent conflict risk and the plausibility of some of their arguments, the empirical connection between the two phenomena is far from evident. Overall, we observe that violence is a far less common reaction to climatic shocks than peaceful adaptation or just silent suffering. Where it emerges, the relationship between climate variability and violent conflict is complex and contingent on further conflict-enabling societal conditions. Systematic knowledge about these conditions and the way in which they shape climate-conflict dynamics remains currently limited, which restricts our ability to understand climate-conflict linkages and assess potential climate-security risks.

The present dissertation addresses this gap. Particular emphasis is placed on road and water infrastructures and on the way in which they influence the relationship between drought and conflict risk in Sub-Saharan Africa. Extreme precipitation shortfalls and their disastrous consequences for rain-fed agriculture and pastoralism are frequently discussed in the literature as possible threats to the peace and stability of African states. At the same time, there are reasons to believe that key infrastructures, such as roads and water delivery systems, would mediate the relationship between drought and conflict risk: a) they facilitate the delivery of humanitarian aid, give access to alternative sources of water and thereby reduce the vulnerability of drought-affected rural communities b) they signal the government's commitment to protect its constituents from climatic hazards and thereby help maintaining more harmonious relations between drought-stricken communities and public authorities c) they create particular strategic opportunities and constraints for armed groups and thereby influence military planning and action. Yet, little systematic research has been conducted hitherto on an explicit connection between drought, infrastructures and conflict risk in Sub-Saharan Africa.

The present dissertation addresses this lacuna both theoretically and empirically. From a theoretical perspective, it identifies possible mechanisms linking drought, infrastructures and conflict risk. Particular emphasis is placed on identifying motivations and opportunities for violence under conditions of climatic stress and on understanding how these are influenced by the presence or absence of relevant infrastructure. The empirical implications of this work are tested in three research articles that shed light on different facets of the supposed relationship between drought, infrastructures and conflict risk. The first analysis emphasises the strategic role of road and water infrastructures and the way in which they can provide incentives or disincentives for violence in a drought-prone environment. The second analysis is concerned with the possible influence of infrastructures on political attitudes and support for political violence among drought-stricken people, while the third analysis emphasises issues of distributional justice in the provision of essential infrastructures and how those are likely to affect conflict risk in times of drought.

Collectively, the results of the dissertation show that infrastructures make a difference when it comes to the conflict-exacerbating potential of droughts in Sub-Saharan Africa. Roads and water infrastructures are found to play a key strategic role in armed contests over climate-sensitive natural resources in Kenya's drought-prone North. Here, major roads act as a constraint to livestock raiding and communal clashes over grazing land by allowing police and security forces to quickly intervene in local disputes, while deep wells are key assets in territorial conflicts and are also a privileged spot for livestock raiding (Article I). Similarly, I find that structurally neglected administrative regions in Sub-Saharan Africa with poor overall access to improved water sources and paved roads are more likely to experience violent conflicts following drought (Article III).

These results corroborate previous arguments that climate variability per se is unlikely to augment the risk of violence, unless it interacts with other issues, such as low levels of economic development, high dependence on rain-fed agriculture, ineffective institutions and major social inequalities. They also show that climate-conflict linkages in African countries are shaped by factors and decisions at the discretion of national elites and international donors, and thereby encourage climate-conflict analyst to emphasise not only the 'natural' but also the social, economic and political dimensions of the climate-security nexus.

The results of the dissertation also give some indication as to the mechanisms connecting drought, infrastructures and conflict risk in Sub-Saharan Africa. Article I supports an *opportunity* narrative, whereby violent actors seeking access to climate-sensitive natural resources act rationally according to situational opportunities and constraints for violence. Seen through this lens, infrastructures matter for climate-conflict connections if they determine the feasibility and likely benefits of military actions, given the means and goals of local armed groups. The results of the dissertation also support a *grievance* narrative that connects climate variability and conflict risk. Together, Article II and III suggest that the drought-conflict-infrastructure nexus in Africa can be understood through the lens of popular dissatisfaction with biased development policies and unequal access to essential services; in particular if lack of access results in an impediment to cope with extreme weather events among disadvantaged people.

Then again, the results of the dissertation vary greatly depending on the spatial scale and the indicators of conflict risk used in the analysis, as well as depending on the type of infrastructure that is considered. It also remains unclear how far they can be generalised to explain possible linkages between climate variability and conflict risk outside Africa. Caution is thus warranted when assessing their external validity.

The dissertation concludes with a set of recommendations about how to build upon its findings and advance climate conflict research. The dissertation echoes the demands of other researchers in calling for a further conceptualisation and specification of the causal mechanisms underlying observed pattern of concordance between climate variability and conflict risk. In particular, it encourages researchers to delve deeper into the economic and political motivations of people affected by climatic extremes and into the environmental conditions that influence their behaviour. This implies further involvement with situational opportunities and constraints created by factors such as terrain, distance, infrastructure and relative military capacity, but also with the structural conditions that facilitate political radicalisation and the emergence of violent attitudes. Closely related to this point, the dissertation also calls for a further specification

of the spatial and temporal aspects of possible connections between climate variability and violent conflict, and of how these relate to third factors, such as poor economic development, incoherent policies or social inequalities.

As part of its conclusion, the dissertation also discusses possible policy implications. While my findings strongly suggest that infrastructural development can serve as entry point for curbing drought-related security risks in African countries, they also highlight the diversity and complexity of ways in which infrastructures moderate possible connections between drought and conflict risk. A cautious, context-sensitive approach to infrastructural development is thus needed, in order to avoid negative externalities and harness its peace-building potential.

Zusammenfassung der Ergebnisse

Immer mehr wissenschaftliche Studien machen auf einen möglichen Zusammenhang zwischen Klimavariabilität und gewaltsamen Konflikten aufmerksam. Infolge der globalen Erderwärmung ist vielerorts mit größeren Schwankungen in Temperaturen und Niederschlägen zu rechnen, was zu extremen Ereignissen wie Dürren und Überschwemmungen führen kann. Eine wesentliche Sorge unter Politikern und Experten ist, dass solche Ereignisse und ihre oftmals katastrophalen Folgen für die betroffenen Menschen zu einer Verschärfung sozialer Konflikte und letztlich zu Gewalt führen können. Krisen in Syrien, Darfur und im westlichen Sahel dienen hierbei häufig als Beispiele.

Trotz plausibler Argumente für einen Zusammenhang zwischen Klimavariabilität und Konfliktrisiko und der wachsenden Popularität des Themas in Politik und Medien, ist es der Wissenschaft bisher nicht gelungen, diesen Zusammenhang empirisch eindeutig nachzuweisen. Im Allgemeinen beobachten wir, dass Menschen, die von klimatischen Schocks betroffen sind, diese viel eher friedlich überwinden oder einfach nur stillschweigend ertragen, als dass sie gewalttätig werden. Dort, wo ein Zusammenhang zwischen Klimavariabilität und gewaltsamen Konflikten auftaucht, ist dieser meist komplex und von weiteren konfliktfördernden gesellschaftlichen Bedingungen abhängig. Unser Wissen über diese Bedingungen ist zurzeit jedoch begrenzt, was unsere Möglichkeiten einschränkt, mögliche Zusammenhänge zwischen Klima und Konflikt zu verstehen und damit verbundene Sicherheitsrisiken einzuschätzen.

Die vorliegende Arbeit befasst sich mit dieser Forschungslücke. Insbesondere setzt sie sich mit Straßen und Wasserinfrastrukturen auseinander und mit der Art und Weise, wie diese eine mögliche Beziehung zwischen Dürre und Konfliktrisiko in Sub-Sahara Afrika beeinflussen. Extreme Trockenperioden und ihre katastrophalen Folgen für den mit Regen bewässerten Ackerbau und die Viehzucht werden in der Fachliteratur häufig als mögliche Bedrohungen für den Frieden und die politische Stabilität Afrikanischer Staaten diskutiert. Gleichzeitig gibt es Gründe anzunehmen, dass wesentliche Infrastrukturen wie Straßen und Wasserversorgungssysteme einen Einfluss darauf haben, inwieweit gewaltsame Konflikte im Zusammenhang mit Dürren auftreten können: a) sie erleichtern die Bereitstellung humanitärer Hilfsgüter, ermöglichen den Zugang zu alternativen Wasserquellen, wenn Regenwasser knapp ist, und reduzieren somit die Vulnerabilität ländlicher Bevölkerungen gegenüber extremen Trockenperioden; b) sie signalisieren die Bereitschaft der Regierung, ihre Bürger vor klimatisch bedingten Gefahren zu schützen und helfen somit dabei, in Dürreperioden das Vertrauen zwischen Bürgern und Regierung aufrechtzuerhalten; c) sie schaffen besondere strategische Gelegenheiten und Einschränkungen für bewaffnete Gruppen und beeinflussen somit militärische Handlungen. Dennoch mangelt es bisher an Studien, die einen möglichen Zusammenhang zwischen Dürren, Infrastrukturen und Konfliktrisiken in Sub-Sahara Afrika explizit und systematisch erforschen.

Die vorliegende Arbeit setzt hier sowohl theoretisch wie empirisch an. Aus theoretischer Sicht befasst sie sich mit möglichen Mechanismen, die Trockenperioden, Infrastruktur und Konfliktrisiko miteinander verbinden. Insbesondere werden Motivationen (*motivations/grievances*) und Gelegenheiten (*opportunities*) für Gewalt unter klimatischen Stressbedingungen identifiziert und darüber reflektiert, inwiefern diese durch die An- oder Abwesenheit relevanter Infrastrukturen beeinflusst werden. Die empirischen Implikationen dieser Arbeit werden in drei wissenschaftlichen Studien erforscht, welche den vermeintlichen Zusammenhang zwischen Dürre, Infrastruktur und Konfliktrisiko aus verschiedenen Winkeln beleuchten. Die erste Studie befasst sich mit der strategischen Bedeutung von Straßen und

Wasserinfrastrukturen und wie diese positive und negative Anreize für Gewalt in dürregefährdeten Gebieten schaffen können. Die zweite Studie erforscht den Einfluss von Infrastrukturen auf das Risiko der Bildung radikaler und gewaltfördernder politischer Einstellungen unter Personen, die von extremer Trockenheit betroffenen sind. Die dritte Studie setzt sich schließlich mit Fragen der Vergabe und (un)gleichmäßigen Bereitstellung wichtiger Infrastrukturen auseinander und damit, wie diese das Risiko von Konflikten in Dürrezeiten beeinflussen.

Zusammengenommen zeigen die Ergebnisse der Dissertation, dass Infrastrukturen durchaus einen Einfluss auf das konfliktverschärfende Potential von Dürren haben. So finde ich heraus, dass Straßen und Wasserinfrastrukturen in Kenias dürregefährdeten Norden eine wesentliche strategische Rolle in gewaltsamen Konflikten um klimasensible natürliche Ressourcen spielen. Hauptverkehrsstraßen haben hierbei eine abschreckende Wirkung, da sie von Polizei und anderen Sicherheitskräften genutzt werden können, um mögliche Ausschreitungen zwischen rivalisierende Gruppen zu unterbinden, während tiefe Brunnen sowohl für Viehdiebe, wie auch in Konflikten über umliegendes Weideland ein bevorzugtes Angriffsziel sind (Artikel I). Ebenso finde ich heraus, dass strukturell vernachlässigte Gebiete mit vergleichsweise schlechtem Zugang zu verbesserten Wasserversorgungsinfrastrukturen und gepflasterten Straßen infolge von extremen Trockenperioden mit höherer Wahrscheinlichkeit von gewaltsamen Konflikten heimgesucht werden (Artikel III).

Diese Ergebnisse bestätigen frühere Argumente, dass gewaltsame Konflikte im Zuge erhöhter Klimavariabilität unwahrscheinlich sind, sofern klimatische Stressfaktoren nicht mit weiteren gesellschaftlichen Problemen interagieren, wie etwa einer stagnierenden wirtschaftlichen Entwicklung, unwirksamen Institutionen oder wesentlichen sozialen Ungleichheiten. Sie zeigen auch, dass die Beziehung zwischen Klima und Konflikt in Afrikanischen Staaten maßgeblich von Faktoren bestimmt wird, die im Ermessen nationaler Eliten und internationaler Geldgeber liegen. Somit ermutigen sie dazu, Klima-Konflikt-Zusammenhänge nicht allein auf ihre vermeintlich „natürliche“ Dimension zu reduzieren, sondern auch soziale, wirtschaftliche und politische Faktoren mit in Betracht zu ziehen.

Die Ergebnisse der Dissertation weisen auch darauf hin, welche Mechanismen Dürren, Infrastrukturen und Konfliktrisiken in Sub-Sahara-Afrika miteinander verbinden. Die Ergebnisse von Artikel I stützen ein o*pportunity*-Narrativ, wobei Gewaltakteure, die den Zugang zu klimasensiblen Ressourcen anstreben, entsprechend situationsbedingter Gelegenheiten und Einschränkungen für Gewalt rational handeln. So gesehen spielen Infrastrukturen insofern eine Rolle im Klima-Konflikt-Nexus, als dass sie die Machbarkeit und den potentiellen Nutzen militärischer Handlungen beeinflussen können. Die Ergebnisse der Dissertation stützen aber auch ein Narrativ, welches vermeintliche Zusammenhänge zwischen Dürren und gewaltsamen Konflikten unter dem Gesichtspunkt von kollektiv empfundenen Missständen oder *grievances* erklärt. Den Ergebnissen von Artikel II und III zufolge ist der Klima-Konflikt-Nexus in Afrika vor allem unter dem Gesichtspunkt kollektiver Unzufriedenheit mit als ungerecht empfundenen Entwicklungspolitiken und der ungleichen Verteilung essentieller Dienstleistungen zu verstehen; vor allem wenn diese benachteiligte Gruppen daran hindern, mit extremen klimatischen Bedingungen fertig zu werden.

Dennoch variieren die Ergebnisse der Dissertation stark, je nachdem welche geographische Skala verwendet-, welche Typen von Infrastrukturen untersucht- und welche Konfliktindikatoren verwendet werden. Unklar bleibt auch,

inwieweit sie verallgemeinert werden können, um mögliche Zusammenhänge zwischen Klimavariabilität und Konfliktrisiko außerhalb Afrikas zu erklären. Bei der Beurteilung ihrer externen Validität ist daher Vorsicht geboten.

Die Dissertation endet mit einer Reihe von Empfehlungen, wie ihre Erkenntnisse fruchtbar gemacht werden können, um die Klima-Konflikt-Forschung voranzubringen. Die Dissertation schließt sich der Forderung anderer Forscher an, die vermeintlichen kausalen Mechanismen, welche empirischen Konkordanzmustern zwischen Klimavariabilität und Konfliktrisiko zugrunde liegen, weiter zu konzeptualisieren und zu spezifizieren. Insbesondere ermutigt sie dazu, sich eingehender mit den wirtschaftlichen und politischen Motiven von Menschen auseinanderzusetzen, die von extremen klimatischen Bedingungen betroffen sind, sowie mit weiteren Umweltbedingungen, die ihr Verhalten beeinflussen. Dies setzt voraus, dass sich Forscher eingehender mit Faktoren wie Terrain, Entfernung, Infrastruktur und relativen militärischen Kapazitäten auseinandersetzen, welche militärisches Handeln situationsbedingt erleichtern oder erschweren können. Gleichzeitig bedarf es aber auch einer genaueren Bestimmung der Bedingungen, unter denen es zur Entstehung gewaltfördernder politischer Einstellungen kommen kann. Eng damit verbunden, ruft die Dissertation auch dazu auf, die räumlichen und zeitlichen Aspekte möglicher Zusammenhänge zwischen Klimavariabilität und Gewalt zu spezifizieren und deren Beziehung zu dritten Faktoren wie etwa dem Bestehen sozialer Ungleichheiten genauer zu ergründen.

Im Rahmen ihrer Fazits diskutiert die Dissertation auch mögliche politische Implikationen. Obwohl meine Ergebnisse teilweise darauf hindeuten, dass Sicherheitsrisiken im Zusammenhang mit Dürren durch die Bereitstellung entsprechender Infrastrukturen vermindert werden könnten, weisen sie aber auch darauf hin, dass Dürren und Infrastrukturen auf vielfältige Weise und mit sehr unterschiedlichen Folgen für die Wahrscheinlichkeit von Konflikten interagieren können. Sollen Infrastrukturen tatsächlich als Mittel der Konfliktprävention genutzt werden, so muss deren Bereitstellung mit Blick auf den sozialen Kontext und mögliche unbeabsichtigte negative Folgen für Frieden und Sicherheit erfolgen.

1. Introduction

Recent years have seen a surge in the number of scientific studies, reports and newspaper articles portraying possible connections between climate variability and violent conflict. As sudden changes in temperature and precipitation are expected to become more frequent in certain areas due to climate change (IPCC, 2014), researchers and decision-makers alike have become increasingly worried about the security implications of extreme events such as droughts and floods.

High profile figures such as the former United Nations Secretary General Ban Ki-moon and former US-president Barack Obama have voiced their concerns that frequent climatic hazards are putting additional strains on fragile states and vulnerable populations in many parts of the world. As people lose their livelihoods, they argue, desperate and violent actions could ensue. People might be inclined to fight each other over access to farmland and water, while radical groups could seize the opportunity to challenge overburdened governments (Ban, 2015; Obama, 2015). These arguments resonate with broader concerns about the consequences of climate change for development and security (Adger et al., 2014; Rüttinger, Smith, Stang, Tänzler, & Vivekananda, 2015).

Discussions about the security implications of climate change and climate variability place a major emphasis on Sub-Saharan Africa, which, due to difficult climatic conditions and socioeconomic challenges, is often assumed to be particularly vulnerable to adverse weather and prone to political instability (Barnett, 2001; Gleditsch, 2011; Hendrix & Glaser, 2007; Niang et al., 2014; Suliman, 1999). In particular, droughts and their disastrous consequences for the many African farmers and pastoralists who depend on sufficient rains for their livelihoods have received considerable media attention (BBC, 2011; Gaulter, 2012)). They are also at the centre of concerns about possible ‘climate wars’ in Africa, with communal conflicts over land rights or access to water in the Sahel and East Africa being frequently cited as examples (Hartmann, 2014; Hokenos, 2015; Selby & Hoffmann, 2014a; Verhoeven, 2014).

Yet, despite the frequency and severity of droughts in Sub-Saharan countries, episodes of violence in connection with drought are relatively rare. Livelihood adjustments, mutual assistance or often just silent suffering are much more common outcomes when rural communities are confronted with extreme precipitation shortfalls (Böhmelt et al., 2014). Why is it then that in some cases droughts do contribute to the violent escalation of social tensions?

Empirical research is just beginning to answer this question. Recent studies show that areas in African states which are highly dependent on rain-fed agriculture, which host a politically excluded ethnic minority or which have dysfunctional resource and conflict management institutions are at greater risk of experiencing social turmoil in the wake of major precipitation shortfalls (Fjelde & Uexkull, 2012; Linke, O’Loughlin, McCabe, Tir,

& Witmer, 2015; Papaioannou, 2015; von Uexkull, 2014; c.f. Benjaminsen, Alinon, Buhaug, & Buseth, 2012; Brosché, 2012; Unruh & Abdul-Jalil, 2012). Similarly, clashes over drought-sensitive resources, such as water or arable land, are found to be more likely in the presence of strained social relations and following recent political change (Ide, 2015; Lecoutere, Exelle, & Campenhout, 2010). Collectively, this research suggests that, where they emerge, drought-conflict linkages are not the result of climatic influences alone, but rather of their interaction with conflict-enabling social, economic and political conditions. Current knowledge about these contextual factors and the way in which they shape climate-conflict dynamics remains limited, however. Consequently, the security implications of extreme precipitation shortfalls in Sub-Saharan Africa cannot easily be assessed.

The present dissertation addresses this gap. In particular, it seeks to determine whether – and if so, how – conflict risk in times of drought is influenced by the presence or absence of infrastructures that help to cope with the adverse effects of extreme precipitation shortfalls. There are indeed reasons to believe that key infrastructures, such as roads and water delivery systems, could prevent any link between drought, resource scarcity, destitution and conflict risk as they facilitate the delivery of humanitarian aid, give access to alternative sources of water and thereby reduce the vulnerability of drought-affected rural communities.[1] Similarly, infrastructures are a very visible and tangible form of public service and, as such, a material expression of 'reciprocal state-citizen relations' (OECD, 2011:74). In times of drought, when they are most needed, they could play an important part in signalling the government's commitment to protect its constituents from climatic hazards and thereby help maintaining more harmonious relations between drought-stricken communities and their government (see Alan, 2008; Mcloughlin, 2015; Rotberg, 2004). Furthermore, infrastructures might influence the risk of violent conflict in times of drought by creating particular strategic opportunities and constraints for prospective conflict actors. Yet, little systematic research has been conducted hitherto on an explicit connection between drought, infrastructures and conflict risk.[2] This is unfortunate, as such research would offer valuable insights on whether and how infrastructure provision – a central aspect in development policy – could be an effective tool of conflict prevention in drought-prone areas.

The present dissertation addresses this lacuna both theoretically and empirically. From a theoretical perspective, it identifies possible mechanisms linking drought and conflict risk and the particular role that infrastructures play in them. In doing so it draws upon arguments from different literatures that have been considered largely in isolation of each other. Using insights from disaster politics (e.g. see Pelling & Dill, 2010), spatial conflict analysis (e.g. see Buhaug, 2010; Hegre, Østby, & Raleigh, 2009) and the growing literature on public service provision, legitimacy and political stability (see Mcloughlin, 2015), the dissertation expands upon common

1 In fact, infrastructures figure prominently in the literature on climate vulnerability and resilience (see Abid, Scheffran, Schneider, & Ashfaq, 2015; Brooks, Neil Adger, & Mick Kelly, 2005; de Sherbinin, 2014), while climate vulnerability is assumed to be an essential component of the climate-conflict-nexus (see Eriksen & Lind, 2009; Fjelde & Uexkull, 2012; Raleigh, 2010; Salehyan & Hendrix, 2014). Studying the conflict-dampening effect of infrastructures in the context of drought thus seems like a natural extension of the recent literature on climate variability, coping capacity, and conflict risk (in particular see von Uexkull, 2014 and von Uexkull, Croicu, Fjelde & Buhaug, 2016).

2 A recent exception, aside from this dissertation, being Landis, Rezaee Daryakenari, Zhang, Thies, & Maciejewski (2017).

explanatory models of the climate-security literature. Particular emphasis is placed on identifying motivations and opportunities for violence under conditions of climatic stress (c.f. Most & Starr, 1980; Nel & Righarts, 2008) and on understanding how these are influenced by the presence or absence of relevant infrastructure.

The empirical implications of this work are tested in a series of quantitative analyses that have been published as three research articles in *Political Geography* and the *Journal of Peace Research*. The analyses are designed in such a way that they shed light on different facets of the supposed relationship between drought, infrastructures and conflict risk. The first analysis emphasises the strategic role of road and water infrastructures and the way in which they can provide (dis-)incentives for violence in a drought-prone environment. The second analysis is concerned with the possible influence of infrastructures on political attitudes and support for political violence among drought-stricken people, while the third analysis emphasises issues of distributional justice in the provision of essential infrastructures and how those are likely to affect conflict risk in times of drought.

Moreover, the three analyses account for the possibility that different types of infrastructure might interact in different ways and at different scales with drought and conflict risk. Indeed, it has been suggested that distinct public services might have diverging political effects, depending among other things on how easily they can be attributed to specific political actors and on what expectations people have about their provision in the first place (see Mcloughlin, 2015). Similarly, it has been stressed that different types of violent conflicts involve different actors with distinct motivations, logics of action and reactions to ambient climatic conditions (Buhaug, 2015; Salehyan, 2014). This is exemplified in a study by Raleigh & Kniveton (2012), who find that communal conflicts in East Africa, which often revolve around livestock and other pastoral resources, tend to occur in wet periods, when these resources are more plentiful. Civil conflicts, on the other hand, are more prevalent during dry periods, when idle farmers can more easily be recruited as fighters.[3] Finally, connections between climate variability, infrastructure and conflict risk at the local level are not necessarily comparable to connections at a higher level. For example, the absence of irrigation infrastructure can exacerbate local conflicts between drought-stricken farmers. However, at the transnational level, it is the presence of such infrastructures that can fuel tensions between states, for instance when upstream countries in a transboundary river basin build large dams in order to increase their irrigation capacities at the expense of water availability for their downstream neighbours.

The geographical focus of the dissertation is on Sub-Saharan Africa, which is in line with frequent concerns about the detrimental effect of droughts and their implication for African politics (Hendrix & Glaser, 2007; Niang et al., 2014). Far from subscribing to sweeping generalisations about African states and their vulnerability to climatic hazards and political crises (see Selby & Hoffmann, 2014; Verhoeven, 2014 for a critique), the dissertation acknowledges the diversity between and within African states and reflects upon how this diversity is likely to produce very heterogeneous outcomes in the event of drought.

3 See section three for a definition of 'civil' and 'communal conflict'.

There is also a practical advantage to this: Sub-Saharan Africa being one of, if not the most studied region in climate-conflict research (Detges, 2017a:5), the literature offers a wealth of empirical results against which to compare and discuss the findings of this dissertation. Moreover, the availability of fine-grained conflict data – which are required to conduct analyses at different spatial levels – has been generally better for African countries. One might mention here the Armed Conflict Location and Event Database (ACLED) (Raleigh, Linke, Hegre, & Karlsen, 2010), the Uppsala Conflict Data Program Georeferenced Event Dataset (UCDP-GED), the Social Conflict in Africa Database (SCAD) (Salehyan et al., 2012) and the Event Data on Conflict and Security (EDACS) Project (Chojnacki, Ickler, Schoenes, Spies, & Wildemann, 2012), of which I utilise the former two for this dissertation project.

The remainder of this synthesis is structured as follows: section two situates the dissertation in the context of previous research and highlights its main contributions. Section three defines the key concepts of the dissertation. Section four presents an overarching conceptual framework. Section five summarises and compares the results of the three research articles, on which this dissertation is based. Section six concludes with a discussion of these results and of their wider implications for research and policy-making.

2. Previous research

The following section situates the dissertation within the existing literature on climate and conflict risk. Particular emphasis is placed on the quantitative comparative literature, to which the dissertation is mainly contributing.

Arguments linking climatic changes and violent conflicts in Sub-Saharan countries have become increasingly popular in the media and among practitioners and policy-makers (Boas & Rothe, 2016; Schäfer, Scheffran, & Penniket, 2016). Yet, the nature of the relationship between climate and conflict in Africa, or elsewhere, remains a subject of vivid scholarly debate. Researchers disagree on whether climatic extremes (if anything) should be seen as a security threat or an opportunity for peaceful collaboration between affected communities (Böhmelt et al., 2014; Kallis & Zografos, 2014; see also Tubi & Feitelson, 2016; Witsenburg & Adano, 2007), on whether their effect should be considered as important or marginal in comparison to the effect of other variables (see Benjaminsen et al., 2012; Gleick, 2017; Hsiang, Burke, & Miguel, 2013; Selby, Dahi, Fröhlich, & Hulme, 2017) and on whether it would even be helpful to think about climate-society relations in such terms (Buhaug, 2015; Selby, 2014).

Much discord in climate-conflict research stems from the lack of conclusive comparative evidence (Buhaug, 2015; Salehyan, 2014; Scheffran, Brzoska, Kominek, Link, & Schilling, 2012a). Quantitative analyses of the nexus between climate variability and conflict risk have produced a multitude of seemingly contradictory

findings (see Figure 1). While certain studies reveal positive correlations between temperature variations, abrupt precipitation shortages and the incidence of armed violence in different parts of the world (e.g. Burke, Miguel, Satyanath, Dykema, & Lobell, 2009; Hendrix & Salehyan, 2012; Maystadt & Ecker, 2014; von Uexkull, 2014), other studies challenge these results (e.g. Buhaug, 2010a; Couttenier & Soubeyran, 2014; Theisen, 2012; Theisen, Holtermann, & Buhaug, 2011), or find mixed evidence (e.g. O'Loughlin et al., 2012; Raleigh & Kniveton, 2012; Wischnath & Buhaug, 2014).

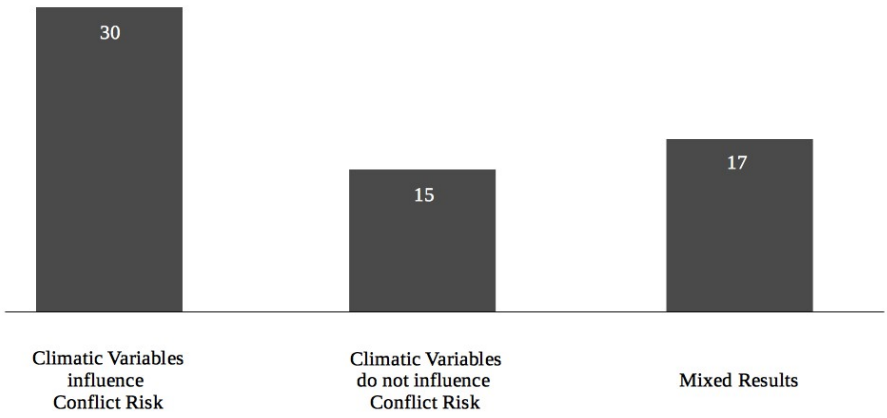

Fig 1. Distribution of quantitative studies that substantiate a connection between indicators of climate variability and violent conflict, that do not substantiate such a link, or that find mixed evidence (source: Detges, 2017a:2).[4]

This 'cacophony of different findings' (Salehyan, 2014:2) makes it extremely difficult to come to a final conclusion. If anything, the quantitative literature on climate variability and conflict risk shows that the social effect of climatic influences can be very heterogeneous, depending on the context in which they occur (Detges, 2017a:6ff). Effects often differ between countries, regions and periods, suggesting that pre-existing social, economic and political conditions play an important part in shaping the relationship between climatic extremes and conflict risk. This is also in line with the case study literature, which tends to emphasise the complexity and social anchoring of possible climate-conflict connections. For instance, Benjaminsen et al. (2012) emphasise the role of biased agricultural policies in exacerbating disputes between Sahelian farmers and herders in times of drought. Likewise, studies conducted in Sudan, Burkina Faso and Kenya identify legal uncertainty, dysfunctional resource management institutions and contested administrative boundaries as major factors of tension when communities need to adapt to stressful climatic conditions (Hagberg, 1998; Kirchner, 2013; Markakis, 2003; Unruh & Abdul-Jalil, 2012).

4 Data are based on a comprehensive selection of peer-reviewed quantitative studies by Hsiang, Burke, & Miguel (2013), which was complemented by a list of newer articles that cite studies from the original selection. Whilst this list is not exhaustive, it nevertheless comprises the majority of peer-reviewed articles published on the subject, including the most influential ones, and thus gives a fair representation of the state of the art. A list of all articles can be found in Detges (2017a:17ff).

Building on this discussion, more recent quantitative analyses have started to incorporate interactions between climatic and societal variables into their statistical models to explicitly account for a contingent effect of climate variability. Their results are often close to what would be expected from the case study literature and highlight the moderating influence of several socioeconomic and institutional factors. For example, Fjelde & Uexkull (2012) find that negative precipitation shocks in combination with political exclusion increase the local risk of communal violence in African countries (see von Uexkull et al., 2016 for a similar finding). They explain that marginalised ethnic minorities are less likely to benefit from state-sponsored disaster relief efforts and might therefore be more inclined to rely on violent self-help strategies when their livelihoods are threatened by drought (c.f. Raleigh, 2010). Similarly, von Uexkull (2014) shows that rain-dependent agricultural areas in Sub-Saharan Africa are more likely to see armed violence following drought. Poverty and famine among drought-stricken rural populations, she argues, would facilitate recruitment by prospective rebels that offer food and money to their fighters (for a similar argument see Buhaug, Benjaminsen, Sjaastad, & Theisen, 2015; Salehyan & Hendrix, 2014). Finally, Linke et al. (2015) find that rural communities in Kenya that engage in frequent dialogue on conflict and resource management issues are less likely to endorse political violence in times of drought (see also Linke, Witmer, O'Loughlin, McCabe, & Tir, 2017 for a similar result).

The inclusion of moderating societal conditions and contingent effects in climate-conflict models is certainly an important innovation. It is also a first step towards reconciling the quantitative literature with those that have criticised it for adopting a de-politicised perspective on nature-society relations (Chojnacki & Engels, 2015; Livingstone, 2015; Selby & Hoffmann, 2014b; see also Barnett, 2009). But much remains to be done. So far, only a handful of moderating conditions have been identified in systematic comparative analyses and the processes underlying observed correlations have remained ambiguous in most cases. In particular, there is a dearth of quantitative research designs that disaggregate possible causal chains[5] or that allow to empirically distinguish between mechanisms that involve *grievances* – i.e. motivations for violence – from mechanisms that are driven by rational decisions with regards to situational *opportunities* and constraints for the use of violence. The distinction between grievance- and opportunity-based accounts has become seminal for the quantitative conflict literature (e.g. see Collier & Hoeffler, 2004; Fearon & Laitin, 2003) and is often also a central element in the development of hypotheses about the supposed relationship between climate variability, extreme weather events and conflict risk (e.g. see Nel & Righarts, 2008; Theisen et al., 2011; von Uexkull, 2014). Yet, research designs in current climate-conflict research usually do not allow to distinguish between variables that affect the motivations of conflict actors and variables that influence their possibilities of action. This makes it all the more difficult to explain the influence of intervening social, economic and political variables. For example, Fjelde & Uexkull (2012) find that politically excluded ethnic groups in African countries are more likely to be involved in communal clashes following drought, but it remains unclear why. It could be that marginalised people are more vulnerable to the effects of drought and thus have a higher stake in fighting for a dwindling resource base

5 A handful of large-N analyses have started to use instrumental variable designs to test for an indirect effect of climate variability on conflict risk via its negative effects on agricultural production and rural livelihoods (e.g. Bergholt & Lujala, 2012; Caruso, Petrarca, & Ricciuti, 2016; Dube & Vargas, 2013; Maystadt & Ecker, 2014). But these studies do not emphasise contingent effects and rarely test for them.

(c.f. Raleigh, 2010), but this result could also be due to a greater ability of minority groups to mobilise and fight for a common cause (c.f. Cederman, Weidmann, & Gleditsch, 2011:482; Gates, 2002; Simpson & Macy, 2004).

One reason for this problem is that most large-N analyses in climate-conflict research – even those that account for contingent effects – tend to focus on aggregate entities like countries (e.g. Couttenier & Soubeyran, 2014; Salehyan & Hendrix, 2014), sub-national administrative units (e.g. Bhavnani & Lacina, 2015; Dube & Vargas, 2013), arbitrary square units or 'grid cells' (e.g. O'Loughlin et al., 2012; Theisen, 2012) or social groups (e.g. von Uexkull et al., 2016). Studies that analyse climate-conflict linkages and the circumstances that enable them at the level of individuals remain the exception (e.g. Linke et al., 2015, 2017). This is problematic, because it is precisely at the micro level that the factors affecting the motivations of conflict actors could best be identified and differentiated from the factors that influence their possibilities of action.

As a further difficulty, little attention is paid to scaling issues when exploring the conditions that enable climate-conflict linkages. Whereas quantitative climate-conflict research in general has become increasingly involved with methodological questions about the right spatial, temporal and social scale to choose in order to capture relevant patterns between indicators of climate variability and conflict risk (see Buhaug, 2015; Salehyan, 2014; Seter, 2016 for a comprehensive review), such issues are rarely reflected when discussing contingent effects in particular. Yet, the results of previous analyses show that the same moderating variable can have distinct effects when measured at a different spatial scale and used in connection with different indicators of conflict risk. For instance, Fjelde & Uexkull (2012) find that negative precipitation anomalies increase the risk of communal conflicts in African countries when they occur in administrative regions that host a politically excluded ethnic minority. On the other hand, Theisen et al. (2011) do not find convincing evidence for an interactive effect of drought and political exclusion on the risk of civil conflict onset in Africa. Besides using a different indicator for conflict risk they also rely on a different spatial unit of analysis (i.e. grid cells of 50km side-length vs. first order administrative sub-units). Ignoring such heterogeneity bears the risk of misjudging the scope of contingent effects and confounding distinct mechanisms that play out at different scales and produce different social outcomes.

The present dissertation contributes in several ways to the literature on climate variability and conflict risk. First, it continues and complements recent efforts in systematic comparative research to identify key societal and economic factors that moderate the relationship between climate variability and conflict risk. The focus is on road and water infrastructures and the ways in which they shape the drought-conflict-nexus in Sub-Saharan Africa by a) influencing the ability of people to cope with drought stress b) affecting people's attitudes towards incumbent political elites and c) providing situational opportunities and constraints for the use of violence. In order to engage with this plurality of possible roles, the dissertation builds a bridge between the fields of quantitative climate-conflict research, vulnerability research, the literature on service provision, legitimacy and political stability, as well as the literature on infrastructure, military strategy and spatial patterns of violence.

This provides the opportunity to expand upon common explanatory models of the quantitative climate-conflict literature, but also to feed important insights back into the respective literatures, from which the dissertation is drawing.

Secondly, the dissertation seeks to identify relevant mechanisms that drive observed relationships between drought exposure, infrastructure, and conflict risk. Innovative research designs allow it to isolate and differentiate the effect of infrastructures on opportunities (Article I) and on motivations (Article II) for violence in connection with drought and thus allow for a more precise assessment.

Thirdly, in order to capture postulated mechanisms empirically, the dissertation takes great care to design statistical tests at an appropriate spatial scale and with appropriate measures of drought stress, infrastructure provision and conflict risk. Taking advantage of recent innovations in data disaggregation, it is not only able to distinguish between different types of violent conflicts at different levels of spatial aggregation, but also between manifest and latent forms of violence – e.g. attitudinal support for political violence. As part of this effort, the dissertation conducts the hitherto largest micro-level analysis on drought exposure and individual support for violence in Sub-Saharan Africa (Article II) and the first fine-grained quantitative analysis of spatial patterns of violent conflict over drought-sensitive natural resources (Article I).

3. Central concepts

The overarching concepts of interest are ‘drought exposure’, ‘infrastructure’ and ‘conflict risk’. Different facets of the relationship between these concepts are explored in the three research articles on which this dissertation is built.

3.1. Conflict risk

Under ‘conflict risk’ I consider the probability of a violent conflict event happening at a certain time and location. ‘Conflict’ is defined here as the pursuit of incompatible goals by more or less organised social groups (Bonacker & Imbusch, 2010; Ramsbotham, Woodhouse, & Miall, 2016:34). Those groups might use non-violent or violent means, in which case scholars usually talk about ‘violent conflict’ or ‘organised violence’ (e.g. see Salehyan & Hendrix, 2014:240). A distinction is sometimes made in the literature between ‘violent conflict’ and ‘armed conflict’, which might include violent, but also non-violent actions such as military manoeuvres (Ramsbotham et al., 2016:34). For the sake of simplicity, this distinction is not made here and henceforth I use ‘conflict’, ‘violent conflict’, ‘armed conflict’, ‘organised violence’ and ‘collective violence’ synonymously, if not specified otherwise. In line with extant quantitative climate-conflict research, I also adopt a narrow definition of violence that focuses on acts of manifest physical violence, such as murder, bodily harm or direct physical threats, as opposed to a broader definitions of violence, which would also include suffering from exploitative social relations (structural violence), or permissive attitudes and beliefs (cultural violence).

Nevertheless, these dimensions are reflected when discussing the possible precursors and enabling conditions for manifest physical violence (c.f. Galtung, 1990).

The quantitative comparative literature often distinguishes between inter-state and different forms of intra-state conflicts (see Gleditsch, Wallensteen, Eriksson, Sollenberg, & Strand, 2002; Pfetsch & Rohloff, 2000). The governments of sovereign states are the main protagonists in inter-state conflicts and use military force to pursue what they define as national interests. The number and intensity of these conflicts has steadily declined since the 1950s (Themnér & Wallensteen, 2011). Intra-state conflicts include state and non-state armed groups – sometimes only non-state armed groups – and are mainly fought within- or in close proximity to the boundaries of a given country, although they can have wider geopolitical implications and often have far reaching economic ramification (e.g. through the trade of drugs, precious minerals and weapons). Owing to recent progress and distinctions made in conflict data creation (e.g. see Sundberg, Eck, & Kreutz, 2012), *communal conflicts* and *civil conflicts* are now the most widely studied types of intra-state conflicts in quantitative climate-conflict research (Detges, 2017a).

Communal conflicts are fought between non-state armed groups that self identify along the lines of a common ethnic, religious, or other identity. Violence is used collectively to gain control over territory and resources, or advance other interests of the group and its members (Raleigh & Kniveton, 2012:53). Pastoralist violence and farmer-herder conflicts have received particular attention in climate-conflict research as specific types of communal conflicts that often involve struggles over climate-sensitive resources, such as livestock, land and water (e.g. Adano, Dietz, Witsenburg, & Zaal, 2012; Benjaminsen et al., 2012; De Juan, 2015; Fjelde & Uexkull, 2012; Turner, 2004). In contrast, civil conflicts involve the armed forces of a sovereign state and usually more formally organised non-state armed groups, often called ‘rebels’ or ‘insurgents’. These compete for power, resources and territory with the national government (see Pettersson & Wallensteen, 2015; Raleigh & Kniveton, 2012). Among the two conflict types, communal violence has been considered by some researchers as a more likely outcome in connection with adverse climatic conditions (Fjelde & Uexkull, 2012; Hendrix & Salehyan, 2012; Theisen, 2008), but recent studies have made convincing arguments connecting climate variability to civil conflict violence as well (e.g. Buhaug et al., 2015; Salehyan & Hendrix, 2014; Theisen et al., 2011; von Uexkull, 2014).

The distinction of conflict types is relevant to the study of drought and conflict risk, as different types of organised violence are driven by different dynamics and determinants and might thus show a different relationship (if any) with climate variability (Raleigh & Kniveton, 2012:52). Indeed, previous studies show that rainfall deviations can have very different impacts on the risk of communal or civil conflicts (e.g. Fjelde & Uexkull, 2012; Raleigh & Kniveton, 2012; Theisen et al., 2011).

For the purposes of this dissertation, I adopt the popular distinction between civil and communal conflict risk and conduct statistical tests for both conflict types. Moreover, Article II considers instances of riots and violent protests in its broader conceptualisation of political violence, whereas Article I focuses on clashes between Kenyan pastoralists as a specific type of communal violence. The dissertation does not consider militarised inter-state disputes, though, as these are generally considered an unlikely outcome in connection with environmental stress (see Gleditsch, 2012; Raleigh & Urdal, 2007; Salehyan, 2008). This does not mean that climate variability might not contribute to diplomatic tensions short of violent conflict, but I leave such considerations for others to explore.

3.2 Drought exposure

'Drought' is defined here as 'a condition of insufficient moisture caused by a deficit in precipitation over some time period' (McKee, Doesken, & Kleist, 1993). Droughts result from extreme and unexpected deviations from normal (i.e. average) historical rainfall patterns for a specific region and time period. Along with other events such as heat waves and extreme downpours, they are possible manifestations of climate variability, defined by the Intergovernmental Panel on Climate Change (IPCC, 2014:1451) as variations in the mean or other statistics (e.g. variance) and the occurrence of extremes in climatic variables at temporal scales beyond that of individual weather events.

Several types of drought can be identified. *Meteorological drought* is concerned with the immediate effects of precipitation deficits such as reduced infiltration, runoff and groundwater recharge. *Agricultural drought* relates these effects to the physical and biological properties of soils, as well as to the specific water requirements of local crops. *Hydrological drought*, which is usually out of phase with- or lags meteorological drought, is concerned with how rainfall deficits affect different parts of the hydrologic cycle (e.g. soil moisture, stream flow, groundwater and reservoir levels). Finally, *socioeconomic drought* relates the different aspects of meteorological, agricultural and hydrological drought to local water requirements, given specific economic activities, levels of water-use-efficiency, as well as storage, diversion and extraction capacities (Wilhite & Glantz, 1985). In some contexts, hydrological rather than meteorological concerns might be more relevant to agricultural production (e.g. see De Châtel, 2014:523). This is not necessarily the case in Sub-Saharan Africa, however, where water extraction capacities are limited in most cases, making people particularly vulnerable to the immediate effect of precipitation shortfalls (Calow, MacDonald, Nicol, & Robins, 2010; NEPAD, 2013; Niang et al., 2014). A focus on meteorological drought thus seems reasonable for the purpose of this dissertation.

Besides, this has the advantage that meteorological drought can be conceptualised as an exogenous variable. Early works on environment-conflict linkages have been criticised for their use of explanatory variables such as land degradation or water availability, which are co-determined by environmental, but also demographic, socioeconomic and political influences, but also violent conflict (see Chojnacki & Engels, 2015). Arguably, measures of rainfall deficiency are not plagued by such endogeneity problems, as (at least in the short term) the

global processes contributing to climate variability and drought risk unfold largely beyond the influence of those who are locally most exposed to them (Koubi, Bernauer, Kalbhenn, & Spilker, 2012:119; see also Theisen et al., 2011:94; von Uexkull, 2014:20). Consistent with the conceptualisation of (meteorological) drought as an exogenous variable, it is also important to distinguish between drought exposure as a *natural hazard* and its potential adverse consequences (e.g. famine, disruption of livelihoods, mass exodus) as drought-related *disasters*.[6] Making this distinction, it is possible to reconcile climate-conflict research with some of its criticism and emphasise the complementarity of both social and environmental factors in enabling drought-conflict linkages.

3.3 Infrastructure

'Infrastructure' refers to collectively utilised facilities and systems that serve and connect communities and settlements. The focus of this dissertation is on road and water infrastructures, which influence people's ability to withstand extremely dry periods (Brooks et al., 2005; de Sherbinin, 2014; Deligiannis, 2012). Climate vulnerability and coping capacity have received considerable attention in the recent climate-conflict literature as potential moderators of the relationship between drought and conflict risk (von Uexkull, 2014, 2016). Until now, this literature has largely focussed on socioeconomic status and production modalities – i.e. rain-fed vs. irrigated agriculture (e.g. Buhaug et al., 2015; Fjelde & Uexkull, 2012; Salehyan & Hendrix, 2014; Uexkull, 2016). The present dissertation adds to this literature by exploring the potential influence of infrastructures on drought vulnerability and drought-conflict relations.

Moreover, roads – and to a lesser extend also water infrastructure – have figured prominently in the literature on tactical aspects of collective violence. Roads and water facilities are often key strategic assets, while also serving to project military power (see Chojnacki & Metternich, 2008; Gleick, 2014:336; O'Loughlin & Witmer, 2011; Witsenburg & Adano, 2009; Zhukov, 2012). As such, they are likely to affect drought-conflict dynamics beyond their immediate influence on drought vulnerability and coping capacities. Article I in particular examines the geo-strategic importance of roads and water facilities in violent conflicts over drought-sensitive natural resources.

Importantly for this dissertation, roads and water infrastructure are also key public services. The peace-building and governance literature contend that public services form an essential part of the social contract between the state – understood here as a grouping of actors and agencies entrusted with the implementation and enforcement of rules and provision of collective goods (Draude, Schmelzle, & Risse, 2012:9) – and its constituents. In other words, they are visible manifestations of the commitment of incumbent elites to fulfil an often essential part of their mandate. As such, they arguably have a bearing on collective perceptions of the legitimacy of the

6 For a more extensive discussion of the difference between hazard and disaster and its relevance for the literature on disasters and conflict risk, see Hollis (2017) and Wisner, Blaikie, Cannon, & Davis (2004).

government and its agencies (Bellina, Darbon, Eriksen, & Sending, 2009; Corbridge, 2005; Rotberg, 2004; Whaites, 2008).

Service delivery is often associated with *performance legitimacy* – that is, an acceptance of the state's right to rule based on a positive assessment of its performance and the outputs it produces (Bellina et al., 2009; OECD, 2011), or, as Weber (1962) puts it, legitimacy of the "legal-rational" variety. But it also touches upon normative expectations towards incumbent elites, for example in regards to equity and transparency (normative legitimacy) or the modalities of services provision (process legitimacy)[7] (see Mason, 2012; Mcloughlin, 2015).

It is important to note that services are not exclusively provided by the government and its agencies. Private companies, civil society organisations and communities all play an important role, most often under the auspices of the government. Non-state actors might even play a central role in situations where the government is either reluctant or unable to offer adequate services (see Krasner & Risse, 2014). In such situations, the relationship between service provision and legitimacy might be more ambiguous (see Sacks, 2009; Kooy, Wild, & Mason, 2015; Pelling & Dill, 2010; Stel, Boer, & Hilhorst, 2012); but this is beyond the scope of this dissertation.

In the Sub-Saharan context, both water and road infrastructures are highly visible and salient services, which people rely on especially in times of drought. What is more, African governments usually assume a central responsibility for the provision of these services. Even where non-state actors (e.g. private companies, NGO's etc.) participate in the building and maintenance of roads and water infrastructure, central and local governments assume an essential guiding and coordinating role, setting sector strategies, regulating the private sector and channelling donor funding (Banerjee & Morella, 2011; Briceño-Garmendia, Smits, & Foster, 2008; Calow et al., 2010; Olschewski, 2016:6ff). In most cases, successes or failures in providing adequate road and water infrastructures are thus somehow attributed to local and national governments (see Mason, 2012; Mcloughlin, 2015) - even though there are exceptions to this in areas with limited government presence (e.g. Somalia for much of the 1990s and 2000s).

4. Conceptual framework

This section presents an overarching conceptual framework that presents and links the different facets of the drought-conflict nexus explored in this dissertation. The different arguments are further detailed and contextualised in the three research articles along with additional examples to illustrate key ideas and hypothesised relationships.

4.1. Possible mechanisms linking drought stress and conflict risk

Droughts can have various economic and social effects, some of which can lead to a higher or lower risk of violent conflict. Taking stock of the literature on drought and conflict risk, it is helpful to distinguish between arguments that focus on *motivations* and *opportunities* for violence. In line with the work of Most and Starr

7 See Scharpf (1999) and Schmidt (2013) for a more comprehensive discussion of performance, process and normative legitimacy.

(1980), this allows a systematic survey of the impulses and rational evaluations made by conflict actors under conditions of drought (i.e. of costs/feasibility vs. likely benefits of military actions) and highlights the complementary nature of both opportunity and willingness as necessary conditions for collective violence. The distinction between opportunities and motivations for violence is in fact quite common in theories linking climate variability and conflict risk, as it offers a simple, yet comprehensive conceptual framework for differentiating possible climate-conflict connections (e.g. see Nel & Righarts, 2008:162; Scheffran, Link & Schilling, 2012).

4.1.1. Drought and opportunities for violence

Under 'opportunities' I consider attributes of the environment that facilitate collective violence and make military strategies more likely to succeed (c.f. Gamson, 1975; Oberschall, 1973; Tilly, 1978). Opportunities include, among other things, the absence of effective constraints on violence, the presence of strategically advantageous terrain, the existence of socioeconomic and political conditions that facilitate military mobilisation and recruitment, as well as a weak opponent (Branovic & Chojnacki, 2011; Buhaug & Gates, 2002; Buhaug & Rød, 2006; Cunningham, Skrede Gleditsch, & Salehyan, 2009; Ide, 2015; Le Billon, 2001).

Arguments linking climatic extremes to increased opportunities for armed groups to recruit destitute farmers and challenge an overburdened government have become increasingly popular in climate-conflict research (e.g. see Nel & Righarts, 2008; Theisen et al., 2011; von Uexkull, 2014). Extreme and unexpected precipitation shortfalls undermine agricultural production and threaten the livelihoods of local farmers and pastoralists; especially where access to alternative sources of water – e.g. through irrigation – is limited. Loss of livelihoods and the prospects of famine, in turn, lower the opportunity costs of joining armed groups (see Collier & Hoeffler, 2004; Gates, 2002). Rebels further co-opt/coerce support from drought-affected communities by offering material rewards and controlling the distribution of food and relief aid (Hendrix & Brinkman, 2013). Thus, in times of drought, prospective rebels and extremist groups face improved recruitment opportunities among vulnerable rural communities (Bergholt & Lujala, 2012; Buhaug et al., 2015; Caruso et al., 2016; Dube & Vargas, 2013; Fjelde, 2015; Maystadt & Ecker, 2014).

Major droughts and their humanitarian consequences can also place additional pressures on governments. Droughts can provoke economic downturns, reduce tax income and thus also the coercive capacities of the government (Koubi et al., 2012:117; Salehyan et al., 2012:38). Furthermore, public administrations must divert what limited resources they have to prevent famine, accommodate large numbers of displaced people and contain potential disputes over access to scarce land, water and relief goods. As a consequence, capacity and performance might decline in other sectors, which can then be exploited by political challengers (Berrebi & Ostwald, 2011; Bueno de Mesquita & Smith, 2010; Carlin, Love, & Zechmeister, 2014a; Drury & Olson, 1998; Quiroz Flores & Smith, 2013). Moreover, state security forces might become more vulnerable to guerrilla tactics when providing humanitarian assistance in remote and isolated areas (Eastin, 2016).

Yet, droughts can also reduce incomes for rebels that are based on the taxation of agricultural activities or reduce the pool of available combatants, as drought-stricken communities are busy keeping their crops and livestock alive (Hendrix & Brinkman, 2013). Likewise, droughts provide opportunities for government security forces to gain popular support through the successful delivery of humanitarian aid (Eastin, 2016). Whether incumbent elites or their challengers are more likely to profit from the strategic opportunities offered by drought thus remains undefined and is determined by contextual factors.

Strategic opportunities for violence in connection with precipitation shortages have received particular attention in the literature on violent conflicts between pastoralists in the Sahel and East Africa. Violence between pastoralists often serves the purpose of livestock raiding; a practice that has historically helped pastoralist communities coping with the harsh and uncertain weather conditions of African rangelands, but is often also exploited by outside actors for economic and political gain (Adano, Dietz, Witsenburg, et al., 2012; Eaton, 2008; Greiner, 2013; Krätli & Swift, 1999; McCabe, 1990). Scholars have argued that droughts would create particular opportunities for livestock raiding, as they force pastoralists to change their movements and grazing patterns – e.g. move to distant mountain ranges or close to perennial water sources – which makes it easier for rival groups to attack them (Ember et al., 2014; Eriksen & Lind, 2009:827; Opiyo, Wasonga, Schilling, & Mureithi, 2012:446).

On the other hand, droughts might just as well reduce strategic opportunities for livestock raiding. First, stolen animals are less healthy and likely to survive during dry periods. Second, vegetation is thinner and cannot be used as cover for attacks by surprise. Third, herders are busy keeping their animals alive and restrain from violent activities (Meier, Bond, & Bond, 2007; Witsenburg & Adano, 2009). They might even be more inclined to seek cooperation with neighbouring communities to secure access to shared wells and dry season pastures. Indeed, field research conducted in Kenya points out that fighting in times of drought is considered suicidal by many herders (Adano et al., 2012:71; Eaton, 2008:101). Overall, it remains debated in the literature whether extremely dry or wet conditions would be more conducive to pastoralist violence (Ember et al., 2014; Opiyo et al., 2012; Schilling, Akuno, Scheffran, & Weinzierl, 2011; Witsenburg & Adano, 2009).

4.1.2. Drought and motivations for violence

Scholars usually agree that the existence of opportunities for violence is in most cases not a sufficient condition for collective violence. It is rather when favourable strategic conditions coincide with strong *motives* for violence that we see people fight (Most & Starr, 1980). Motivations for violence can emerge in situations where people perceive a gap between what they have and what they feel they are entitled to – a situation known as *relative deprivation* (Davies, 1962; Gurr, 1970). Frustrations over perceived inequalities and injustices can lead to radical attitudes and ultimately violence as a means to address the sources of social grievances. This can happen in the presence of pronounced income and wealth inequalities between people and social groups, when minority groups are excluded from political power, or when people are denied essential goods and services (Alexander, 2010; Buhaug, Cederman, & Gleditsch, 2014; Cederman et al., 2011; Eckstein, 1980). Other

motives for violence include more mundane economic preoccupations, such as the lure of valuable natural resources and immediate material rewards from looting and extortion (Kurrild-Klitgaard & Svendsen, 2003; Lujala, 2005; Mehlum, Moene, & Torvik, 2002; Ross, 2004).

It has been argued that severe drought conditions could influence people's motivations and attitudes towards supporting and participating in collective violence (Nel & Righarts, 2008; Seter, 2016; von Uexkull, 2014). Droughts can seriously reduce the availability of local natural resources, such as water or farmland. This can result in fierce competition over the distribution and access to these resources among people and groups who heavily depend on them (Homer-Dixon, 1999; Kahl, 2006). Competition can in turn lead to violence in the absence of effective conflict mitigation and restrictions on violent behaviour (Raleigh, 2010). Arguably, the risk of violence is particularly high in the presence of weakened conflict management institutions, when legislation governing the distribution and use of resources is ambiguous or disputed, when competing groups have a history of animosity, when inter-group tensions are exploited by elites with a vested interest in violence, or when competing claims on resources blend with broader historical grievances – e.g. in situations where politics are strongly biased towards one group (Benjaminsen et al., 2012; Boone, 2011; de Waal, 2007; Ide, 2015; Kahl, 2006; Lund & Boone, 2013; Seter, Theisen, & Schilling, 2016; Unruh & Abdul-Jalil, 2012).

Moreover, resource competition and the prospects of being attacked by rival groups might incite pre-emptive violence following the logic of the intra-state security dilemma (Posen, 1993; Roe, 1999). This is in line with social psychological research that finds hostile attitudes towards other social groups and extreme pre-emptive measures to be more likely in volatile and insecure settings (Canetti-Nisim, Halperin, Sharvit, & Hobfoll, 2009; Canetti, Elad-Strenger, Lavi, Guy, & Bar-Tal, 2017; Hirschberger & Pyszczynski, 2009).

On the other hand, environmental stress and resource scarcity might also encourage peaceful relations between drought-affected people. Authors such as Slettebak (2012) have argued that climatic shocks can spawn a sense of solidarity and common identity around a common externalised threat, leading to cooperation and the peaceful sharing of resources (see also Burton, Kates, & White, 1993; Dynes & Quarantelli, 1975; Fritz, 1996). This is consistent with the observation that violent conflicts over resources tend to diminish in times of drought in some parts of northern Kenya (Witsenburg & Adano, 2009; Witsenburg & Adano, 2002) and is also illustrated by cases of cooperation between Jewish farmers and Muslim Beduin herders in Israel's drought-prone northern Negev region (Tubi & Feitelson, 2016; for similar examples, see Bogale & Korf, 2007; Owuor, Mauta, & Eriksen, 2011; Unruh & Abdul-Jalil, 2012).

However, it has been argued that the positive social effects of disasters are often short-lived, as solidarity and concerns for survival gradually give way to previous cleavages and rivalries (Hollis, 2017). Moreover, external interventions by governments and humanitarian organisations might prevent drought affected people from seeking collective internal solutions (c.f. Dynes & Quarantelli, 1975; Wicke & Cohen, 2015).

These explanations emphasise possible effects of precipitation shortfalls on the risk of inter-personal or inter-group violence. Borrowing from the disaster politics literature, it is also possible to envisage how droughts can aggravate political grievances and encourage anti-government violence in the form of civil conflicts, riots and violent protests. Proponents of disaster politics argue that political crises and anti-state grievances following major climatic shocks are largely attributable to the failure of responsible authorities to prevent climatic hazards from turning into disasters (Drury & Olson, 1998; Nel & Righarts, 2008; Pelling & Dill, 2010). In most cases, governments play a central part in preventing and mitigating the effects of droughts. By offering essential services, protection, subsidies and/or relief aid, they can avoid or at least attenuate possible impacts, such as famine, mass displacements and epidemics. Success in doing so is likely to increase popular support for the government. Failure, on the other hand, is likely to be met with strong resentment (Arceneaux & Stein, 2006; Drury & Olson, 1998; Jennings, 1999; Nel & Righarts, 2008). This can encourage collective violence as a means to protest negligent political elites, embolden opposition groups to remove elected leaders by unconstitutional means and/or prompt violent repression by the government itself (Carlin et al., 2014a; De Châtel, 2014; Hollis, 2017; Olson & Gawronski, 2010; Wood & Wright, 2016). As explained by Pelling & Dill (2010:27), failure of the government to prevent and mitigate the adverse effects of climatic shocks can be considered as a breach of the social contract between the government and its constituents, which opens space for renegotiation by violent and non-violent means. Seen from this perspective, collective grievances and violence in times of drought would be the result of unfulfilled expectations regarding the commitment and performance of incumbent elites (see Olson & Gawronski, 2010).

Acute feelings of relative deprivation and resentment against government elites are likely to emerge in situations where disaster-prevention and responses are highly uneven. In particular, politically excluded minorities and peripheral rural communities are less likely to be on the receiving end of state-sponsored development and relief efforts, placing them into a particularly vulnerable position vis-à-vis climatic extremes (Pelling & Dill, 2010; Raleigh, 2010). In the wake of droughts they are not only disproportionately affected, but also brutally made aware of their marginal status and irrelevance for the sitting regime. This situation is further aggravated when political elites capture vital resources (Homer-Dixon, 1999; Nel & Righarts, 2008), or deliberately deprive certain groups of aid in order to weaken political opponents (Hollis, 2017). Examples include the embezzlement of drought relief aid by Malian elites in the 1990s (Benjaminsen, 2008) or the denial of food aid as counterinsurgency strategy in Ethiopia and Sudan (Downes, 2007; Valentino, Huth, & Balch-Lindsay, 2004; see also Klein, 2008 for a similar example in Myanmar). Seen from this perspective, droughts do not only have the potential to increase inequalities and grievances by disproportionately affecting vulnerable groups, but, above all, also highlight and exacerbate pre-existing cleavages in society (Cretney, 2017; Le Billon & Waizenegger, 2007; Pelling & Dill, 2010).

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The mechanisms outlined in this section are not mutually exclusive. The motivations for certain actors to use violence can in fact create strategic opportunities for other actors that operate at a different level. For instance, de Waal (2007) describes how the different sides in the civil war in Darfur have instrumentalised and exacerbated local resource competition between farmers and herders as a way to weaken their opponent (see also Brosché & Rothbart, 2013; De Juan, 2015). Even mechanisms that seem contradictory can coexist or rapidly succeed each other. For instance, pastoralists might seek alliances with neighbouring groups in times of drought to obtain safe passage to essential resources. As climatic conditions return to normal, these alliances could be dissolved again, as herders engage in livestock raiding to compensate for animals lost during drought (Adano, Dietz, & Witsenburg, 2012).

Whether one or more (if any) of the mechanisms described in this section apply to a given situation depends on context-specific factors. For instance, it should be clear from the above that resource competition in times of drought is contingent on highly resource-dependent, drought-vulnerable livelihoods and limited access to external markets; as are opportunities for rebels to recruit drought-stricken farmers (c.f. von Uexkull, 2016). Similarly, disaster-prevention efforts and also expectations vis-à-vis the government might vary over time and, depending on circumstances, produce varied assessments of the government's commitment and performance (see Mcloughlin, 2015; Olson & Gawronski, 2010). One of these context-specific factors, I argue in this dissertation, is the provision of key infrastructures that help to cope with extremely dry conditions.

4.2. The moderating role of road and water infrastructure

Infrastructures such as roads and water systems play an important part in disaster resilience and are thus likely to interrupt, or at least attenuate any drought-conflict connection that would be created by a rapid deterioration of drought-sensitive livelihoods. At the same time, they are also major strategic assets and determinants of mobility and military potency, which is likely to influence the dynamics of collective violence under drought conditions. Finally, they are also tangible and highly visible manifestations of the government's commitment (or lack thereof), thus potentially playing a major part in attenuating (or exacerbating) anti-government grievances in times of drought (see Figure 2).

4.2.1. Infrastructure and capacity to cope with drought

Effective infrastructure and service provision goes a long way in reducing people's vulnerability to unexpected precipitation shortfalls (Brooks et al., 2005; Sherbinin, 2014). Experiences in Ethiopia and Bangladesh show that sustained investments in agricultural services, social safety nets and infrastructures can sensibly augment the resilience of rural communities vis-à-vis drought and famine-like conditions (Babu & Dorosh, 2017). In particular, roads play an important part by extending drought-coping options (access to distant markets, agricultural inputs, veterinary services etc.) and by facilitating the work of (non-) governmental relief agencies (GWPEA, 2015). Water infrastructure (e.g. dams, canals, pipes, boreholes) also facilitates access to alternative water sources when rainwater becomes scarce and is instrumental in controlling the outbreak of diseases that can result from sharing limited water resources (Baird, 2010; Calow et al., 1997; Deligiannis, 2012; Deressa,

Hassan, & Ringler, 2008; Schilling et al., 2011). As shown by a report of the Inter Agency Working Group on Disaster Preparedness for East and Central Africa, communities in the Horn of Africa, which have benefited from water infrastructure programmes, have been able to better cope with recurring droughts than their neighbours (IAWG, 2017). On the other hand, poor access to infrastructure limits the range of coping options and is likely to result in greater hardship for drought-affected people (Abid et al., 2015; Eriksen & Kelly, 2007; Landis et al., 2017:80).

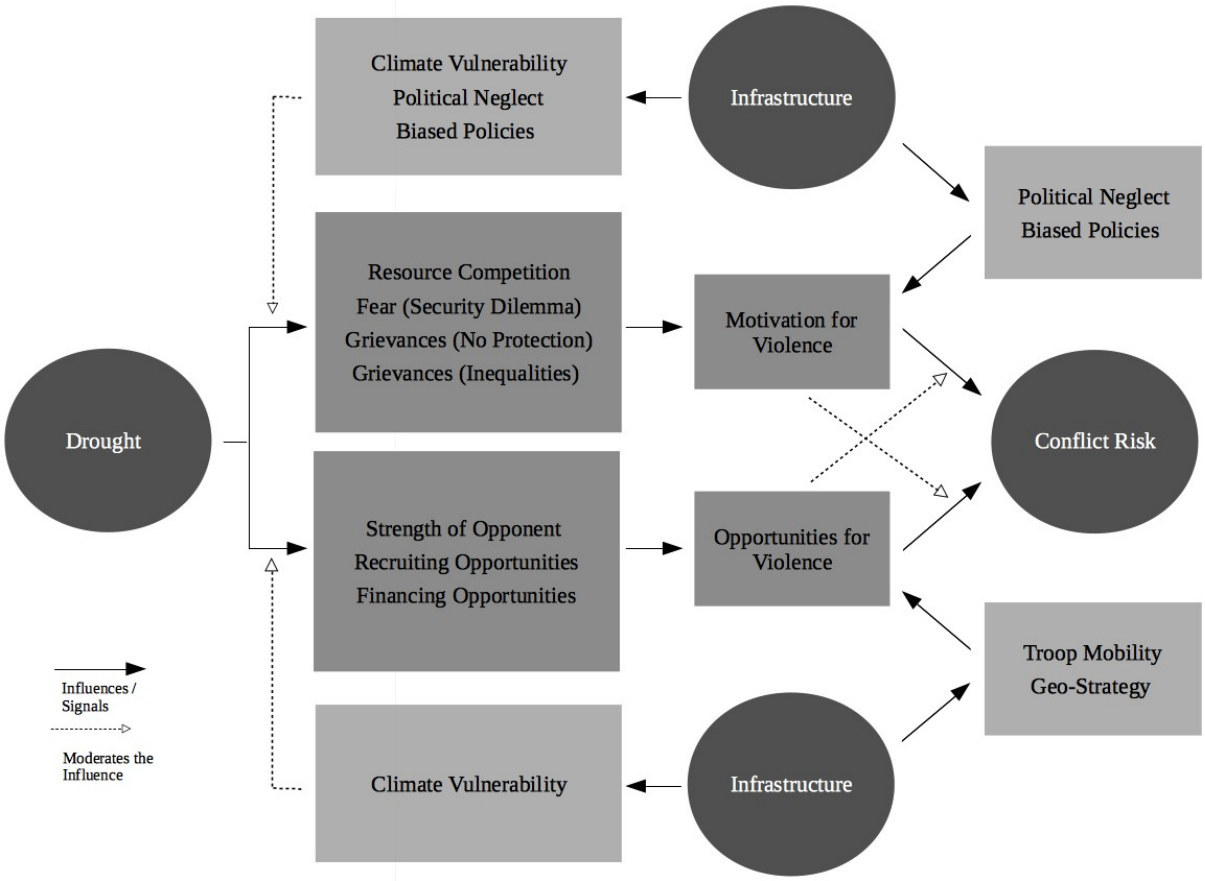

Fig 2. Potential influence of road and water infrastructures on the relationship between drought and conflict risk. Individual connections are described in greater detail in the remainder of this section.

Vulnerability to climatic extremes, in turn, can raise the risk of violent conflict in connection with drought (von Uexkull, 2016). Arguably, climate-vulnerable farmers and pastoralists are more likely to be severely affected by drought and thus more likely to fight over their means of living or to be recruited by prospective rebel groups – granted, of course, that such groups exist. Studies conducted in African and Asian countries have shown that violent conflicts following severe drought are more likely where people depend on climate-vulnerable agricultural practices (von Uexkull, 2014; von Uexkull et al., 2016). In a similar vein, people who lack access to

essential road and water infrastructures could be more inclined to fight over scarce resources or to join a militant organisation in times of drought, because they have fewer possibilities to cope otherwise.

Opinions diverge on the type of collective violence that might result from drought and vulnerability. Some researchers argue that the most vulnerable members of society lack the financial and organisational resources to sustain a military campaign against their government and are therefore more likely to resort to more sporadic forms of violence that require less resources and organisation, including communal clashes and riots (Fjelde & Uexkull, 2012; Raleigh, 2010; Salehyan & Hendrix, 2014:240), or refrain from violence altogether (Adano, Dietz, Witsenburg, et al., 2012; Eaton, 2008). However, Theisen, Buhaug and Holtermann (2011:98) explain that insurgencies are often organised by aspiring and well-connected elites that are largely insulated from drought-stress and can use external sources of funding to recruit and mobilise drought-stricken people.

4.2.2. Infrastructure and tactical opportunities

Key infrastructure often assumes a key strategic role, defining opportunities and constraints for the use of violence by state and non-state actors. Roads can be used to transport military personnel and supplies and thus facilitate the projection of military force and diffusion of violence. Better road infrastructure arguably increases the mobility of state security forces and thus their possibilities to suppress the activities of non-state armed groups in remote and otherwise inaccessible locations (Buhaug & Rød, 2006; Herbst, 2000). Accordingly, we would expect both anti-government and communal violence to be less likely in the presence of better road infrastructure. Moreover, well-maintained roads facilitate the distribution of humanitarian aid, thereby possibly undermining rebel recruiting efforts in drought-affected regions.

On the other hand, it has been argued that roads could just as well profit rebel groups by allowing them to transport troops and supplies (see Zhukov, 2012). It has been shown that major roads and road junctions in war zones can be the locus of battles, sabotage and road-side bombings, thus leading to a pattern whereby conflict events tend to cluster along these roads (see Chojnacki & Metternich, 2008; Landis et al., 2017; O'Loughlin & Witmer, 2011; Zhukov, 2012). However, such situations seem contingent on the ability and willingness of non-state armed groups to effectively engage and harm state security forces. In contrast, communal groups competing over access to resources under conditions of drought do not have an interest (or the military capacities) a priori to challenge the government and thus will probably abstain from fighting close to major transport axes, where police and security forces can easily intervene. Similarly, aspiring rebel groups conducting an asymmetrical war against the government would avoid well connected regions and rather launch their military operations from remote and inaccessible places (Toleffsen & Buhaug, 2015).

A similar argument can be made about the tactical relevance of water infrastructures under conditions of drought. In arid and semi-arid areas, deep wells and boreholes are fixed points that people need to attend when drought conditions make other water sources (e.g. surface water and shallow wells) unavailable. Hence, they

offer strategic opportunities for ambushes by raiders and bandits (Turner, 2004:877; Witsenburg & Adano, 2004:275ff; Witsenburg & Adano, 2002:11). This is especially true in areas with generally poor water infrastructures, where single access points are scattered through the landscape and people need to travel long distances in order to reach them (Mason, 2012). In such areas, well sites are also strategic focal points in contests over scarce natural resources. As the access to well sites dictates the use of surrounding land in times of drought, violence at these sites can effectively deter and oust rival pastoralist groups. There is indeed anecdotal evidence linking fights over permanent water sources to dry conditions in Kenya (Schilling, Opiyo, & Scheffran, 2012:11; Witsenburg & Adano, 2009:526).

There are also some indications in the literature that water infrastructure is occasionally targeted by armed groups. For instance, Gleick (2014:336) describes how the protagonists of the Syrian civil war have intentionally damaged pipelines and fought over hydroelectric dams because of their strategic value. Yet, it remains uncertain whether such a pattern should be systematically expected in drought-related conflicts.

4.2.3. Infrastructure, state-citizen relations and motivations for violence

Infrastructure is also a key public service and tangible manifestation of the government's commitment to fulfil its obligations vis-à-vis its constituents. By signalling the government's performance and responsivity, it is likely to influence political attitudes and trust in incumbent elites (Levi, Sacks, & Tyler, 2009; Robins, 2013). It has been argued that infrastructure and more generally public service provision is essential to political stability, even for highly authoritarian regimes (Acemoglu, Verdier, & Robinson, 2004; Bueno de Mesquita, Smith, Siverson, & Morrow, 2003; Gerschewski, 2013), and also a key strategy for non-state armed groups to assert their political claims and gain popular support (see Enia, 2008; see also De Juan & Bank, 2015; Fjelde & De Soysa, 2009; Fjelde & Uexkull, 2012; Taydas & Peksen, 2012). On the other hand, failure of responsible authorities to provide adequate services and infrastructure has been associated with grievances, political tensions and a higher risk of political violence (Alexander, 2010; Gilley, 2006; Kooy et al., 2015). An explanation for this can be found in the literature on public services, legitimacy and peace:

> *"From a functional perspective, the delivery of collective goods and services is a central factor that stabilizes the state via output legitimacy. In this perspective, the legitimacy of the state derives from a relational approach in which the state delivers a social order— which includes the provision of public goods and services—acceptable to its population and the population in turn agrees to comply with the state and not to take up arms against it (Lake 2009; Levi 1989, 1997). Even when citizens have internalized the state's rightfulness of rule today, there is no guarantee that citizens would continue to accept its rule and obey its dictates if the state began to fail with respect to output legitimacy."*
>
> (Lee, Walter-Drop & Wiesel, 2014:637)

Poor service provision is likely to be a particularly salient issue in times of drought. As explained by Olson and Gawronski (2010:207f), the potentially disastrous consequences of severe droughts constitute a 'Maslowian shock' in the sense that affected people who were pursuing higher order goals are abruptly plunged into a very

precarious situation, where they struggle to fulfil even their most basic needs. This situation is likely to alter their priorities and therefore their stance on public services that are essential to the fulfilment of these basic needs. Lack of access to roads and water infrastructure, which might just be a nuisance in normal times, can become a major source of grievances when it restricts people's possibilities to cope with a life-threatening situation.

Moreover, drought conditions can orient perceptions and public opinion towards drought-relevant services and hence reveal pervasive failures in infrastructure provision that had gone largely unnoticed, or whose implications might not have been as clearly understood before. Indeed, it has been argued that information asymmetries may condition the legitimising effect of service provision (Mcloughlin & Batley, 2012; Sacks, 2011). Seen from this angle, droughts might function as revelatory moments that highlight political deficiencies and thereby catalyse anti-government grievances (c.f. Carlin, Love, & Zechmeister, 2014b; De Châtel, 2014; Le Billon & Waizenegger, 2007; Pelling & Dill, 2010; Quiroz Flores & Smith, 2013; Wood & Wright, 2016).

Although intuitive, this argument might need further refinement. For instance, proponents of the public service and peace-building literature argue that the legitimising effect of service provision largely depends on the visibility of services and the degree to which specific political actors can be credited or blamed for their delivery (De Juan & Bank, 2015; Kooy et al., 2015; Mcloughlin, 2015). Likewise, performance assessments and judgements depend on prior expectations regarding the effectiveness of service delivery, which differ across contexts (Mcloughlin, 2015). Expectations over government-sponsored service provision can be very low to begin with, as seen in remote rural areas of the Democratic Republic of Congo, so that poor service provision might not amount to much more discontent with incumbent elites (see Brinkerhoff, Wetterberg, & Dunn, 2012; Stel et al., 2012). Still more importantly, expectations regarding the fairness of service delivery are likely to play a major moderating role. It has been argued that service provision might be a particularly salient political issue in situations where services are unequally distributed, potentially giving rise to strong feelings of relative deprivation among excluded groups (Brinkerhoff et al., 2012; Dix, Hussmann, & Walton, 2012; Rothstein, 2009). For example, de Juan and Bank (2015) find that Syrian localities with more frequent power cuts were comparably more likely to become hotbeds of violent contestation against the Assad regime. Accordingly, it could be more reasonable to expect that unequal access to infrastructure, rather than infrastructural deficits per se is a factor of anti-government grievances in the wake of major precipitation shortfalls.

Moreover, it might be advisable to further differentiate between infrastructures. Road and water infrastructures are both highly visible and salient in Sub-Saharan Africa; especially in times of drought. Yet, there could be differences in the way they are provided and how far success and failure in their provisions is attributed to the government. As argued by Ndaruhutse et al. (2011), communities and the private sector often play a greater role in water supply than in other sectors. In many rural areas of Sub-Saharan Africa, water infrastructure is provided by NGOs and increasingly frequently also by private companies (Kleemeier, 2010). Furthermore, water points

in rural areas are typically maintained and managed by local governments and community organizations, which leads to a devolution and distribution of responsibilities and hence leaves less room for blaming national elites for infrastructural deficits (cf. Banerjee & Morella, 2011; Jaglin, Repussard, & Belbéoc'h, 2011). On the other hand, road construction and maintenance amount for a major part of public spending in African countries (Briceño-Garmendia et al., 2008), which, in some cases, makes them an important vehicle for political patronage (see Burgess, Miguel, Jedwab, & Morjaria, 2015). It is thus possible that roads might be a more salient political issue than water infrastructure, with a more direct implication for public perceptions of the government's legitimacy in times of drought.

5. Results

Three research articles test the implications of the above framework. Their main empirical findings are discussed below. For an in-depths presentation and discussion of utilised data and methods the reader is referred to the respective methods section of each article.

5.1 Article I

Article I (Detges, 2014) explores the tactical relevance of infrastructures in line with the arguments presented in section 4.2.2. Adopting an *opportunity-centred* perspective, it assesses whether spatial patterns of violence in conflicts over drought-sensitive resources follow the spatial distribution of major roads and water access points. The emphasis is on pastoralist conflicts in northern Kenya. Much of the case study literature on drought and conflict focuses on violence between East African pastoralists. In particular, communal clashes in northern Kenya have become emblematic of the academic discussion on climate variability and conflict (e.g. see Meier et al., 2007; Raleigh & Kniveton, 2012; Schilling et al., 2012; Theisen, 2012; Witsenburg & Adano, 2009). Given the wealth of anthropological fieldwork linking rainfall variability, resource competition and the risk of violence in this region, northern Kenya is an ideal case for studying the spatial patterns of communal conflicts over drought-sensitive resources and how these patterns are influenced by the presence of relevant infrastructure. Focussing on northern Kenya also has the advantage that, contrary to neighbouring regions, this area has remained largely unaffected by civil conflict, which makes it easier to isolate and study the covariates of local disputes over livestock, land and water (c.f. Theisen, 2012).[8]

The results of Article I suggest that roads and water infrastructures do influence spatial patterns of violence between Kenyan pastoralists by creating opportunities and constraints for using violence as a means to gain access to contested resources. I find violent events to be more likely in the vicinity of deep wells and boreholes that offer access to groundwater in times of drought. In line with the argument in section 4.2.2., it can be argued that these sites are frequently visited by pastoralists and their herds and therefore offer favourable conditions for

8 The reader is referred to Detges (2014:58ff) for a more comprehensive discussion of the Kenyan case, of the motivations of livestock raiders in northern Kenya and of the way in which these relate to drought and resource scarcity.

livestock raiding. Moreover, groundwater access points are scant and scattered in northern Kenya, which gives them a particular strategic value in conflicts over access to surrounding grazing land (see Detges, 2014:60). Similarly, the results show that violence between pastoralists tends to occur further away from major roads that can be used by security forces and the police to quickly intervene in communal clashes.

These results offer valuable insights into to the influence of infrastructures on patterns of violence in connection with climate variability. Whether they apply to situations outside Kenya or to other conflict types still remains an open question. The general lack of infrastructure in northern Kenya could be an important scope condition and results could be different for better serviced areas, where individual roads and wells would most certainly not have the same strategic value. Likewise, patterns of violence involving more powerful armed groups or groups, which, unlike most raiding parties in northern Kenya, are eager to confront state security forces, could have a different relationship to road infrastructures – i.e. occur close to major roads (see O'Loughlin & Witmer, 2011; Zhukov, 2012). Nevertheless, the results support the general idea that road and water infrastructures matter from a strategic point of view. Yet, the strengths and direction of their relationship with drought and conflict risk is likely to vary across contexts and should be subjected to further inquiry.

In addition, I find pastoralist violence to be more likely in places that receive more rainfall on average. Relatively humid and cool places, often situated in mountainous terrain, are fall-back areas that pastoralist rely on during dry periods, when the availability of grazing land is generally reduced. Consequently, these places attract a high number of herders from different, and sometimes rival groups, thereby creating both the pretext and the opportunity for violent conflicts over livestock, land and water (see McCabe, 2004; Mureithi & Opiyo, 2010; Opiyo et al., 2012).

Whilst not directly relevant for my research question, this result is interesting as it corroborates earlier findings about the timing of pastoralist attacks in Kenya (e.g. Ember et al., 2014; Meier et al., 2007; Raleigh & Kniveton, 2012; Theisen, 2012; Witsenburg & Adano, 2009) and indicates that spatial (like temporal) patterns of violent conflicts over climate-sensitive resources are foremost determined by tactical considerations. That is, violent conflicts over grazing land and livestock take place where (and when) the chances of gaining access to these resources is highest (see also De Juan, 2015 for a similar example in Sudan's Darfur region). This simple logic is also likely to apply to other conflicts over climate-sensitive renewable resources. However, different resources might be associated with distinct patterns of appropriation and thus imply a somewhat different spatial distribution of conflict events (see Detges, 2014:63 for a more extensive discussion).

It is also an important finding because it shows that violent conflicts over climate-sensitive resources do not necessarily occur where climate pressures on these resources are most severe. Despite the fact that a number of pastoralist conflicts in northern Kenya are exacerbated by droughts (see Ember et al., 2014; Opiyo et al., 2012), they do not take place where drought conditions are most severe. To the contrary, drought-related violence in northern Kenya is more likely to take place in relatively wet places, where people and livestock tend to be concentrated during extended dry periods (Detges, 2014:61). This is contrary to what is often implicitly

assumed in climate-conflict research (e.g. see Theisen, 2012) and should incite greater sensibility towards the trans-locality of climate-conflict connections – that is, the possibility that climatic extremes in one place influence conflict risk in other places. As highlighted in Article I, this is particularly important when analysing climate-conflict connections at a high spatial resolution. But it is also relevant for the study of transnational climate-conflict connections, for example via migration or trade, which deserve more scientific attention going forward (see Rüttinger et al., 2015:26f; Seter, 2016:7; De Juan, 2015; Selby, 2014:838).

5.2. Article II

As a counterpart to the first article, Article II (Detges, 2017b) emphasises possible *motivations* for endorsing violence against the government and its (presumed) political supporters under conditions of drought. The analysis emphasises attitudes towards political violence in 23 Sub-Saharan countries and how these attitudes are affected by a combination of serious drought conditions and poor access to essential services. Due to data restrictions, the analysis focuses on access to paved roads. Water infrastructure is not considered. Consistent with the argument made in section 4.2.3., the analysis focuses on countries in which the national government assumes a key responsibility with regard to service provision and is a central reference for political preoccupations and potential grievances. Fragile and war-torn areas like Somalia or the Eastern Democratic Republic of Congo, in which service delivery and more generally state-citizen relations might follow a different logic, are excluded (see Figure 2, Detges, 2017b:93). To further scrutinise the argument that attitudes towards incumbent elites – whether expressed around service provision or other issues – moderate the relationship between drought and support for political violence, the analysis further includes measures of trust in the government and state-citizen relations.[9]

Looking at the results of Article II, infrastructure provision *per se* does not seem to have an influence on whether drought-affected people are more or less likely to endorse political violence. People without access to a paved road are neither more nor less likely to support political violence than their better-connected counterparts. This holds in normal times, as well as after drought. Unfortunately, available data do not allow at this point to test whether unequal access to road infrastructure has an effect, or whether effects vary for different types of infrastructure, as suggested in section 4.2.3.

On the other hand, I find support for political violence to be significantly more likely among drought-affected people who do not trust their head of state or who perceive strong political discriminations against their ethnic group. These findings suggest that state-citizen relations and attitudes towards the sitting regime do matter for the formation of anti-state grievances under conditions of drought.[10] This is a noteworthy finding as such immaterial or ‘soft’ factors are rarely discussed in the climate-conflict literature (Linke et al., 2015, 2017 are rare exceptions), but probably play a central part in the processes connecting climatic shocks and collective motivations for violence (see Ide, 2016). Taken together, the findings of Article II suggest that poor service

9 More details on utilised data and methodology can be found in Detges (2017b:91ff).
10 For a lengthier discussion of these results the reader is referred to Detges (2017b:91,95f).

delivery *per se* does not necessarily exacerbate drought-related political grievances. However, *unequal delivery* could still be a polarising issue in times of drought. This would also be consistent with the finding that perceived political discriminations moderate the relationship between drought exposure and support for violence.

5.3. Article III

Article III analyses the combined effect of drought and infrastructure provision on conflict risk at the level of first order administrative subunits. The utilised sample comprises all administrative regions in Sub-Saharan Africa, for which suitable data were available for the period 1990-2010. The emphasis is on regional inequalities in access to key infrastructures, which help to cope with drought stress. Moreover, different types of infrastructure, i.e. paved roads and water infrastructure, are considered to test for a different effect on drought-related grievances and conflict risk. The article also differentiates between civil and communal conflict risk to further assess the external validity of the above findings. In particular, the research design of Article III allows comparisons with violent conflicts outside Kenya and their relationship to local infrastructures.[11]

The results of Article III show that infrastructures do have an influence on the risk of violent conflict in connection with drought, but this effect is different for distinct infrastructures and types of conflict. Low *density of paved roads* in combination with drought increases the local risk of *civil conflict incidence*. This might be because poor road coverage at the administrative unit level signals a region's marginal political status and little commitment of national authorities to invests in local infrastructures. In line with arguments in section 4.2.3., such a situation is susceptible to escalate in the wake of major precipitation shortfalls.

An alternative explanation might be that poor coverage of paved roads impedes people's capacities to peacefully cope with drought and hence makes them more likely to be recruited by local rebel groups, which then have greater military capacities and are thus more likely to engage state security forces (see section 4.2.1.). However, this seems unlikely in view of the fact that road density has no influence on whether or not drought-affected regions experience communal violence (I come back to this result later). There is no reason a priori to expect drought-vulnerability to have a lesser effect on the risk of communal violence than on the risk of civil conflict incidence. Some scholars have even argued that civil conflict would be a less likely outcome in the wake of drought (see Fjelde & Uexkull, 2012; Raleigh, 2010; Salehyan & Hendrix, 2014).

Similarly, it is unlikely that this result would stem from a lower capacity of state security forces to intervene in poorly connected regions and hence greater incentives for rebel groups to target such areas (see section 4.2.2.), given that low road density alone has no significant effect on the risk of civil conflict incidence. Interestingly, though, it has a positive effect on the risk of communal violence. A possible explanation could be that communal conflicts usually involve comparably weak armed groups with no specific interest in challenging the national government. These would most likely avoid fighting in places where state security forces could easily

11 A more detailed presentation and discussion of the research design and data can be found in Detges (2016:700ff).

intervene. On the other hand, civil conflicts involve rebel groups of very different strengths and with very different objectives. Hence, well developed road infrastructure would not consistently have a deterring effect on this type of violence (c.f. Zhurkov, 2012; O'Loughlin & Witmer, 2011).

Table I. Combined effect of drought and low regional road density on support for political violence

	DV = Probability of support for political violence		
	(1)	(2)	(3)
Constant	-1.444 (0.088)**	-1.456 (0.086)**	-1.444 (0.089)**
Moderate drought			0.012 (0.045)
Extreme drought	-0.045 (0.081)	-0.033 (0.078)	
Low road density in admin. region	-0.037 (0.086)	-0.040 (0.082)	-0.088 (0.088)
Moderate drought * Low road density in admin. region			0.333 (0.072)**
Extreme drought * Low road density in admin. region	0.483 (0.128)**	0.474 (0.126)**	
Group treated unfairly	0.189 (0.029)*	0.210 (0.028)**	0.188 (0.029)**
Low trust in the head of state	0.333 (0.026)**	0.320 (0.025)**	0.333 (0.026)**
Rural area	-0.032 (0.032)	-0.027 (0.031)	-0.034 (0.032)
Victim of violence	0.231 (0.035)**		0.228 (0.035)**
Proximity to violent event		0.012 (0.041)	
Age	-0.008 (0.001)**	-0.008 (0.001)**	-0.008 (0.001)**
Male respondent	0.093 (0.024)**	0.095 (0.023)**	0.096 (0.024)**
Education	-0.009 (0.017)	-0.003 (0.017)	-0.010 (0.017)
Socio-economic status	0.017 (0.010)	0.024 (0.010)*	0.017 (0.010)
Different language	-0.058 (0.028)*	-0.066 (0.028)*	-0.061 (0.028)*
Respondent dishonest	0.192 (0.030) **	0.214 (0.029)**	0.191 (0.030)**
N. observations	50,100	50,100	50,100

† p<0.1; * p<0.05; ** p<0.01. Standard errors in parentheses. All models contain administrative unit random effects for the 1st and 2nd administrative sub-level.

To further validate a possible drought-conflict link working through increased grievances and motivations for violence, I combine road access data from Article III with attitudinal data from Article II. Results are shown in table I (regression models include the same control variables as those in Article II and are subjected to the same robustness tests). Consistent with my expectations, drought-affected people in poorly connected regions are more likely to support political violence than their better serviced counterparts, which supports the argument that unequal access to roads moderate the relationship between drought stress, political grievances and anti-state violence. It could be that poor access to paved roads becomes a more salient factor of grievances and political violence when it is experienced by a larger group of people that live in the same area; either because government neglect is more visible when it affects more people, or because people from the same region might share a common identity, which facilitates mobilisation for the expression of collectively experienced grievances around uneven service provision (c.f. Buhaug et al., 2014; Cederman et al., 2011; Stewart, Brown, & Mancini, 2008).

It is interesting to note in this context that no significant effect on the risk of *civil conflict incidence* is obtained when interacting drought with *poor access to water infrastructure*. This could mean that roads are more relevant than water infrastructure when it comes to drought-related grievances about poor service provision, which would be in line with the assumption made in section 4.2.3. that road provision and maintenance is more easily attributable to the government and therefore a more salient political issue in times of drought. Likewise, *low density of paved roads* does not influence *communal conflict* risk in connection with drought. This could indicate that civil conflict, as a form of violence that targets the government more directly, is a more likely outcome of drought-induced grievances than communal conflict. However, further research would be necessary to confirm these assumptions.

The second major finding of Article III is that *communal conflicts* tend to occur in administrative regions that are both hit by drought and poorly endowed with *water infrastructure*. A possible explanation could be that poor water infrastructure and scant access to groundwater sources force drought-affected people to travel greater distances in order to reach distant wells and boreholes. This, in turn, provides opportunities for livestock raiding and can also generate disputes between farmers and herders when herd movements towards water sources lead to crop damages (see Benjaminsen et al., 2012 and Kirchner, 2013 for examples in Mali and Kenya). This would corroborate arguments about the tactical relevance of water infrastructure made in section 4.2.2.

Another possibility could be that restricted access to wells and other water infrastructure makes local communities more vulnerable to the effect of drought and hence more likely to fight over livestock and access to essential resources, as suggested in section 4.2.1. There is a caveat to this argument, however, as poor road infrastructure in combination with drought does not lead to a higher risk of communal conflict incidence. Nor does drought in combination with poor water infrastructure raise the risk of civil conflict. It could be that from a vulnerability perspective water infrastructure is more relevant than roads for African communities and hence would have a greater influence on the relationship between drought and communal (but not civil) conflict risk.

However, to the best of my knowledge, there are no compelling arguments in the climate-conflict literature that this would be the case.

As a third possibility, better access to water infrastructure could be indicative of better functioning institutions and more harmonious social relations. It has been argued indeed that water infrastructure provision and maintenance offers opportunities for cooperation between communities, civil society and governmental agencies, and thus could have a pacifying effect (Kooy et al., 2015; Mason, 2012; OECD, 2008). Conversely, poor coverage could be indicative of dysfunctional institutions (both formal and informal) and of pervasive tensions in the water sector, which would be likely to escalate in times of drought. Again, it would be worthwhile further exploring this possibility in future analyses.

Table II. Summary of results

Result	Scope	Evidence
• Road and water infrastructures influence the relationship between drought and conflict risk. • However, their influence is not homogeneous across scales, geographic contexts, conflict types and types of infrastructure.	Sub-Saharan Africa	Article I, II & III combined
• From a strategical point of view, road and water infrastructures matter for climate-conflict connections if they determine the feasibility and likely benefits of military actions, given the means and goals of local armed groups. • In particular, this seems to be the case in regions with a drought-sensitive population, poor overall availability of infrastructures and frequent inter-communal tensions.	Northern Kenya and comparable regions	Article I & (to a minor extent) III
• Poor provision of infrastructure per se does not influence whether drought-affected people are more likely to hold strong grievances and support political violence. • On the other hand, regional inequalities in the access to essential infrastructures moderate the relationship between drought stress, political grievances and anti-state violence in Sub-Saharan Africa. • This is true for access to paved roads, but not for access to water infrastructure. • A central role of the government in infrastructure provision/maintenance and clear attribution are likely to be important scope conditions for this finding.	Sub-Saharan Africa; in particular countries covered by the Afrobarometer survey	Article II & III

6. Discussion

At the outset of this project I asked whether – and if so, how – road and water infrastructures influence the risk of violent conflict following drought in Sub-Saharan Africa. The initial intuition was that these infrastructures, which strongly affect people's ability to cope with extreme climatic events, would have a discernible influence on the social and political consequences of extreme precipitation shortfalls. Looking at my results, the first part of this question can clearly be answered with yes: infrastructures do make a difference when it comes to the conflict-exacerbating potential of droughts. Roads and water infrastructures are found to play a key strategic role in armed contests over climate-sensitive natural resources in Kenya's drought-prone North. Here, major roads act as a constraint to livestock raiding and communal clashes over grazing land by allowing police and security forces to quickly intervene in local disputes, while deep wells are key assets in territorial conflicts and are also a privileged spot for livestock raiding (Article I). Similarly, I find that structurally neglected administrative regions in Sub-Saharan Africa with poor overall access to improved water sources and paved roads are more likely to experience violent conflicts following drought (Article III).

These results are in line with prior reflections and anecdotal evidence about the conflict-inhibiting role of infrastructures in a context of climatic stress. For instance, infrastructures are included in the climate-conflict model of the German Advisory Council on Global Change as a variable that moderates the relationship between climate-related food crises and the risk of political instability and conflict (see WBGU, 2008:103). Likewise, roads and other critical infrastructure have been referred to in the theoretical and case study literature as a factor that could potentially interrupt any direct relationship between climate variability and conflict risk (e.g. De Châtel, 2014; Raleigh, 2010:77; Schilling et al., 2011).

They also corroborate previous arguments that climate variability per se is unlikely to augment the risk of violence, unless it interacts with other issues, such as low levels of economic development, high dependence on rain-fed agriculture, ineffective institutions and major social inequalities (see Böhmelt et al., 2014; Fjelde & Uexkull, 2012; Ghimire & Ferreira, 2016; Koubi et al., 2012; Linke et al., 2015; Schleussner, Donges, Donner, & Schellnhuber, 2016; Wischnath & Buhaug, 2014). This stands in contrast to stronger claims made in the climate-conflict literature that important deviations from normal rainfall and temperatures would systematically lead to a higher risk of violence and political instability (Burke, Hsiang, & Miguel, 2015; Hsiang et al., 2013).

Interestingly, these results also show that possible climate-conflict linkages in African countries are shaped by factors and decisions at the discretion of governments and political elites. Service provision – including key infrastructure – is often considered as one of the essential responsibilities of the state (see Draude et al., 2012; Lee et al., 2014). Showing that service provision plays a moderating role in the drought-conflict nexus in Sub-Saharan Africa helps emphasising that 'natural' factors alone are not to blame for climate-related processes of social polarisation and violent conflict escalation (c.f. von Uexkull, 2016:32). In the wake of major disasters and political crises, climate change, climate variability and extreme weather events have at times been conveniently used as a scapegoat for policy failures (see Hollis, 2017; Theisen et al., 2011:105). Yet, the findings of this dissertation suggest that political decisions – for example the decision to favour the infrastructural development

of certain regions at the expense of others (see Article III) - are at the heart of the climate-conflict nexus. It is precisely in the interaction of external climatic influences with internal societal issues that so called 'natural' disasters and their political consequences must be understood (Quarantelli, 1998; Wisner et al., 2004; Hollis 2017). In highlighting the role of infrastructures – but also of political discriminations and strained state-citizen relations (see Article II) - the dissertation contributes to a growing body of academic work that criticises de-politicised perspectives on nature-society relations and advocates for a greater consideration of social, economic and political factors when analysing possible climate-conflict connections in Africa and elsewhere (c.f. Chojnacki & Engels, 2015; De Châtel, 2014; Hagmann & Mulugeta, 2008; Hartmann, 2014; Hendrix, 2017; Le Billon, 2001; Schilling et al., 2017; Selby, Dahi, Fröhlich, & Hulme, 2017a).

That said, the results presented here vary greatly depending on the spatial scale and the indicators of conflict risk used in the analysis, as well as depending on the type of infrastructure that is considered. I find that roads and water infrastructure have distinct effects at the local and provincial (i.e. first order administrative unit) level (Article I & Article III) and with regard to civil and communal conflict risk (Article III). Roads do not have the same influence on support for violence in times of drought (Article II) than on the location of violent conflicts over drought-sensitive resources (Article I). Water infrastructures reduce the risk of conflict at the provincial level (Article III), but are hotspots for violent clashes between pastoralists at the local level (Article I). This observation is in line with recent reviews of the literature that find great variation in the results of climate-conflict analyses conducted at different scales and with different indicators of conflict risk (see Salehyan, 2014; Buhaug, 2015). It warrants caution when assessing the external validity of the results of individual studies that were obtained with particular research designs.

Moreover, it is important to point out that the dissertation focusses exclusively on African countries and that it remains unclear how far its findings can be generalised to explain possible linkages between climate variability and conflict risk elsewhere. More specifically for Article I, Kenya's marginalised and drought-prone North is not directly comparable to the wealthier south of the country. Climate-conflict connections seen there might be context specific and less likely to materialise in other parts of the country. On the other hand, areas outside Kenya with a similar ecologic, socioeconomic and political situation might show similar patterns of violence in relation to local road and water infrastructures. Likewise, Article II, focusses on comparatively stable African countries where the state assumes a central responsibility in the provision of key services and infrastructures. This might be an important scope condition for my finding concerning the salience of unequal infrastructure provision with regard to drought-related political grievances. Contexts where state capacities are very limited and/or where attribution is less clear due to a multitude of state and non-state providers with ill-defined responsibilities might be characterised by a different relationship between climate variability, service provision and political attitudes (c.f. Batley & Mcloughlin, 2010; Mcloughlin, 2015). These issues need to be considered when assessing the findings of this dissertation.

The answer to the second part of my research question needs to be more nuanced. Some postulated mechanisms and assumptions are better supported by the data than others. The results of Article I support an *opportunity* narrative, whereby violent actors seeking access to climate-sensitive natural resources act rationally according to situational opportunities and constraints for violence. This is in line with earlier economic theories of conflict (e.g. see Blattman & Miguel, 2009; Collier & Hoeffler, 2004; Fearon & Laitin, 2003; Gates, 2002; Tilly, 1978), which emphasise that violence in armed conflicts is not only an expression of political frustrations, but also involves considerable strategic thinking and requires the presence of favourable conditions for the organisation and implementation of military actions (see also Branovic & Chojnacki, 2011). Seen through this lens, infrastructures matter for climate-conflict connections if they determine the feasibility and likely benefits of military actions, given the means and goals of local armed groups.

The results of the dissertation also support a *grievance* narrative that connects climate variability and conflict risk. Together, Article II and III suggest that the drought-conflict-infrastructure nexus in Africa can be understood through the lens of popular dissatisfaction with biased development policies and unequal access to essential services; in particular if those represent an impediment to people's ability to cope with extreme weather events. This is in line with earlier arguments in climate-conflict research that link climate variability to a higher disposition of marginalised social groups to take up arms against their government (Theisen et al., 2011; von Uexkull et al., 2016), as well as with much of the literature on disasters, grievances and political unrest (e.g. see Drury & Olson, 1998; Le Billon & Waizenegger, 2007; Pelling & Dill, 2010; Carlin et al., 2014).

On the other hand, the results of the dissertation offer no new insights into the role of infrastructures as a factor that affects people's *capacity to cope* with climatic extremes and hence potentially moderates the relationship between climate variability and conflict risks. Other scholars have argued that people affected by adverse climatic conditions are unlikely to become involved in violent conflicts unless these conditions have a profoundly destabilising effect on their livelihoods. Sensitivity to climatic extremes (e.g. among rain-dependent farmers and pastoralists) and a lack of coping capacities would thus be important parts of the nexus between climate variability and conflict risk (see von Uexkull, 2016). The results of the dissertation neither support, nor refute this. Climate vulnerability might be a part of the explanation linking drought, poor infrastructure provision and conflict risk in parts of Sub-Saharan Africa (see Article III), but only under the (as yet unverified) assumption that the relationship between drought exposure, availability of infrastructure and conflict risk would be different for different types of infrastructures and violent conflict.

It is reasonable to assume that infrastructures and their effect on climate vulnerability would moderate the relationship between climate variability and conflict risk, but their role might not be as straightforward as previously assumed. Material factors like infrastructure can significantly affect people's ability to withstand extreme climatic events, but their mere presence does not automatically imply that people will be able to use them. For instance, the access to deep wells in drought-stricken regions might be restricted to members of a certain communal group, as well as by economic barriers or by ongoing violence – e.g. when people have to pay for access, or when people are afraid to use wells in a disputed territory (see Eriksen & Lind, 2009; Witsenburg & Adano, 2009 for examples in Kenya). These possibilities warrant further consideration of contextual factors

that are likely to moderate the relationship between infrastructure availability, climate vulnerability and conflict risk.

Beyond their immediate implications for climate-conflict research, the results of this dissertation can also inform other literatures. There is a vivid debate, notably in the development and peace-building literature, whether and how far public service provision can foster popular support for local and national governments and thereby contribute to peace- and state-building efforts in fragile and post conflict situations (see Bellina et al., 2009; Carpenter, Slater, & Mallet, 2012; DFID, 2010; Kooy et al., 2015; Mockaitis, 2003; OECD, 2008; J. Unruh & Shalaby, 2012; USAID, 2012). This debate is particularly relevant from a policy perspective, as service provision – including the construction and maintenance of key infrastructure – represents a relatively straightforward entry point for international donors, international organizations, national political actors, civil society and the private sector.

Yet, empirical studies of the link between service provision, political support and peace have produced mixed results (e.g. see Brinkerhoff et al., 2012; Bueno de Mesquita et al., 2003; De Juan & Bank, 2015; Fjelde & De Soysa, 2009; Gilley, 2006; Levi et al., 2009; Taydas & Peksen, 2012). It has been argued that the political effect of service provision would be contingent – among other things – on the expectations people have about service provision in the first place, on how far service provision is attributed and attributable to specific political actors, and on how far service provision fulfils normative expectations about distributional justice, transparency and accountability (see Batley & Mcloughlin, 2010; Mcloughlin, 2015).

Those factors are not only highly context dependent, but also likely to be affected by climatic shocks. For instance, extreme weather events, such as droughts or extreme downpours, could draw attention to flawed development policies and shortcomings in disaster preparedness, which had gone largely unnoticed, or whose implications might not have been as clearly understood before (c.f. Jilke, 2013; Mcloughlin & Batley, 2012). Likewise, such shocks could lead to a re-assessment of people's priorities and a shift in their expectations about policies and services that directly affect their coping capacities. As explained by Olson and Gawronski (2010:207f), public expectations are higher during emergencies and hence performance, equity and accountability in service delivery are likely to be appraised differently. Seen from this angle, there is a potential to advance current research on the effect of service provision on legitimacy and political stability by reflecting about a possible conditioning effect of climatic shocks and other unexpected large-scale events.[12]

12 A similar argument can be made for including climatic variables as moderating influences in research on strategic opportunities for armed violence. For example, heavy rains can lead to floods, which obstruct roads and thereby restrict access to strategically important locations. The role of roads in determining opportunities and constraints for military action would thus depend at least partially on climatic conditions.

6.1. Recommendations

Going forward, one of the greatest challenge for climate-conflict research will be to specify the causal mechanisms underlying observed pattern of concordance between climate variability and conflict risk, and assess the role of intervening social, economic and political variables. Looking at the findings of this dissertation and research gaps revealed along the way some suggestions can be made to this effect. To begin with, my results (in particular those of Article I) highlight the importance of rational decisions made by armed groups in conflicts over climate-vulnerable natural resources and of the environmental features that influence them, an aspect that is frequently overlooked in climate-conflict research.[13] Future analyses in this literature would profit from further involvement with the tactical decisions made by conflict actors and by including strategically relevant factors such as infrastructure, distance, terrain or relative military capacity as moderating variables (for an example, see Ide, 2015). As seen in Article I, this is also likely to advance our understanding of the spatial, and by analogy also temporal logic of climate-conflict dynamics.

A fruitful avenue for future research would also be to further explore how- and under what conditions climate variability can contribute to popular grievances and processes of political radicalisation. The results of the dissertation (in particular those of Article II) suggest that the combination of extreme climatic stress with pervasive political neglect plays an important part in this regard. In doing so, they build a bridge between classical explanations of climate-related violence and the literatures on disaster politics, service provision and state building – but, obviously, more research is needed. In particular, more clarity is required on how climatic extremes can influence public perceptions of state legitimacy, under what circumstances this is likely to happen, and what implications this can have for the radicalisation and mobilisation of conflict groups. An important part of this research agenda will be to further investigate the role of public expectations and perceptions of service delivery[14] and how those can change in a context of severe climatic stress (see Mcloughlin, 2015; Olson & Gawronski, 2010), but also to elucidate how collectively perceived inequalities in the distribution of climate vulnerability and coping capacities can contribute to political radicalisation and conflict group formation. Here, a look at the broader literature on horizontal inequalities and group-discriminations as facilitators of collective violence might help (see Gates, 2002; Kalyvas, 2006; Petersen, 2002; Simpson & Macy, 2004; Stewart et al., 2008). Moreover, the mechanisms and conditions that facilitate the transition from collectively experienced grievances to manifest violence need to be further specified (see Chojnacki & Engels, 2015).

13 There are a few exceptions. For instance, a handful of studies highlight the tactical relevance of seasonal variations in temperature and precipitation for counterinsurgency strategies in Afghanistan or for cattle raids in East Africa (Carter & Veale, 2013; Ember et al., 2014; Landis, 2014; Meier et al., 2007; Schilling et al., 2011; Witsenburg & Adano, 2009).

14 This also includes reflecting on the role of non-state service providers and on how far they affect perceptions and legitimacy of state providers (c.f. Krasner & Risse, 2014; Batley & Mcloughlin, 2010), as well as on the role of political communication in shaping expectations and attitudes towards state providers (see Mcloughlin, 2015; Olson & Gawronski, 2010).

Closely tied to the question of possible mechanisms and processes linking climate variability and conflict risk, there is also the question of the spatial and temporal dimension of these processes. Major uncertainties remain as to how fast climatic pressures can transform into social, economic and political challenges, or as to how far away from the location of extreme climatic events those challenges can materialise. One might mention here arguments about the potential of climatic shocks on having a delayed effect on social tensions in distant countries, because of their effect on international food prices (Sternberg, 2013; Rüttinger et al., 2015). So far, climate-conflict research has only be able to scratch the surface of these issues (e.g. see arguments in Seter, 2016; Schilling et al., 2011; Opiyo et al., 2012; Salehyan, 2014). Further specifying the spatial and temporal aspects of possible connections between climate variability and violent conflict, and also how these aspects relate to moderating societal conditions, would allow for more specific theory and a more precise assessment of climate-related security risks.

As for policy recommendations, the results of the dissertation indicate that well-developed infrastructures help reduce the risk of violent conflict in connection with drought. Yet, building new infrastructure in drought-prone areas will not necessarily result in less conflict. As highlighted in this dissertation, the mechanisms connecting drought, infrastructure and conflict risk are multiple and possibly working in opposite directions. Infrastructures can increase local resilience to climatic extremes and foster positive state-citizen relations, but they can also facilitate and attract violence. This means that infrastructure development can have unintended negative implications for security, even if conducted in view of promoting peace. For example, newly built boreholes reduce local vulnerability to drought and thus possibly also the risk of conflicts over drought-sensitive resources. But, at the same time, they can also incite livestock raiding and create disputes over newly accessible grazing areas for which there are no established use rights (Article I; Krätli & Swift, 1999; c.f. Benjaminsen et al., 2012). Similarly, the allocation of water infrastructures to particular communities can be perceived as favouritism and aggravate social tensions (Harris, 2008). Road construction can, under certain conditions, encourage corruption, facilitate land grabbing, exacerbate political grievances, and present armed groups with opportunities to extort money from construction companies (see Unruh & Shalaby, 2012; Wallace, 2014; Wood & Wright, 2016). To avoid this, interventions need to take into account the multiplicity of possible effects of infrastructure development and determine which of these effects are most likely to materialise given the context at hand. In other words: they need to be ‘context-’ and ‘conflict-sensitive’ (see Dabelko, 2013; Tänzler et al., 2010).

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