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Why do conflicts over scarce renewable resources turn violent? A qualitative comparative analysis

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ABSTRACT

This study addresses the question why intergroup conflicts over scarce, renewable resources in peripheral areas of the global South escalate into violence. In order to do so, twenty cases of such conflicts, seven of which turned violent, are analyzed. The method of fuzzy-set qualitative comparative analysis is used in order to bridge the gap between quantitative and qualitative accounts in the field and to detect patterns of conjunctural causation. In theoretical terms, structural conditions (negative othering and high power differences between the conflict parties) and triggering conditions (external resource appropriation and recent political change) of a violent escalation of renewable resource conflicts are distinguished. The empirical results as well as various robustness checks and comparisons with individual cases suggest that the simultaneous presence of negative othering, low power differences and recent political change is a sufficient condition for the violent escalation of conflicts over scarce renewable resources. I conclude that research on socio-environmental conflicts should pay more attention to conjunctural causation, local power differences and qualitatively different forms of conflict and political change.

1. Introduction

The possible impact of global environmental change on intra-state violent conflict onset has received considerable attention since at least the 1990s, with a special focus on the scarcity of renewable natural resources (Bächler, 1998; Homer-Dixon and Blitt, 1998). In recent years, this research has been related to and picked up by a growing literature on climate change and conflict (e.g. Scheffran et al., 2012; Theisen et al., 2013). But the role of renewable resources for violent conflict onset is not only discussed by scientists, but by policy makers as well. US Secretary of State John Kerry, for instance, recently expressed his concern about the issue: 'If we don't respond adequately to the challenge of global climate change over the course of these next years there will be people fighting wars over water and over land' (U.S. Department of State, 2013).

Research on the possible links between natural renewable resources and conflict has been conducted in a range of disciplines, including geography, political science, sociology and anthropology. But despite considerable research efforts, no scientific consensus on the issue has emerged as yet. Some quantitative studies suggest a link between low precipitation levels (Fjelde and von Uexkull, 2012; Raleigh and Kniveton, 2012) or freshwater scarcity (Gizelis and Wooden, 2010; Raleigh and Urdal, 2007) and intra-state violent conflict, while others find no significant relationship (O'Loughlin et al., 2014; Wischnath and Buhaug, 2014) or even a negative correlation between low rainfall/water scarcity and violent conflict within states (Hendrix and Glaser, 2007; Salehyan and Hendrix, 2014). The same is true for quantitative studies on soil degradation (Hendrix and Glaser, 2007; Raleigh and Urdal, 2007; Rowhani et al., 2011; Theisen, 2008) and deforestation (Esty et al., 1999; Theisen, 2008). The findings of qualitative studies are similarly ambivalent. Some authors claim a role for renewable resource scarcity as a cause of violent conflict in certain cases (Homer-Dixon, 1994; Kahl, 2006; Schilling et al., 2012), some scholars reject such a link (Adano et al., 2012; Selby and Hoffmann, 2014), and some provide mixed results (Benjaminsen and Ba, 2009; de Châtel, 2014).

In order to advance our knowledge about the links between renewable resource scarcity and intra-state violent conflict, scholars have repeatedly emphasized three tasks. First, according to Barnett (2000), scholars have convincingly argued how resource

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scarcity causes grievances, livelihood insecurities and conflicts, but we do hardly know how, when and why such tense situations escalate into open violence. Similarly, Engels/Chojnacki (2012: 94) claim that 'the transition from conflict to violence has not yet been analyzed in a sufficiently sophisticated manner in the literature on "environmental conflicts".'

Second, the inconsistent results of previous studies suggest that renewable resource scarcity is linked to violent conflict only if specific (combinations of) context factors are present. This claim is nowadays shared by nearly all authors in the research field (Homer-Dixon and Blitt, 1998; Scheffran et al., 2012). 'It is important to ask, therefore, why violence [related to scarce resources] occurs in some places and not in others' (Peluso and Watts, 2001: 29). Recently, quantitative studies have tried to address this problem by introducing interaction terms between some independent variables, such as reduced precipitation, political exclusion and economic marginalization (Fjelde and von Uexkull, 2012; Theisen et al., 2012). However, the number of interactions terms that can be used in a statistical regression is limited (Vis, 2012). Case studies, by contrast, are able to consider complex interactions between different variables, but often suffer from a lack of generalizability and comparability.

This relates to a third, more general point. The methods most widely used in the research on renewable resource scarcity and violent conflicts are so far either large-N regression analyses or qualitative single-case studies. The latter have repeatedly been criticized for the low external validity of their findings (Gleditsch and Urdal, 2002; Koubi et al., 2014), although case studies are in principal able to produce generalizable results (Flyvbjerg, 2006). But the shortcomings of large-N regressions have been pointed out as well. Besides their limited ability to consider interaction terms and non-linear effects (Sterzel et al., 2014), they cannot include important variables on which quantitative datasets either do not exist (e.g. resource distribution) or are hard to produce (e.g. identities, traditional conflict resolution mechanisms) (Ide and Scheffran, 2014; Selby, 2014). Other datasets have only a low spatial resolution, usually the national level, or are criticized for their low reliability (Ide and Scheffran, 2014; Koubi et al., 2014). As a consequence, calls have been launched to explore middle ways between qualitative single-case and quantitative large-N studies which combine the strengths of both approaches (Meierding, 2013; Solow, 2013).

All these three suggestions are picked up by this study. In order to do so, it utilizes the rich case-study literature on renewable resource scarcity and conflict. Twenty cases of intergroup conflict around land, water, fish or forest resources are identified, seven of which escalated into open violence, while 13 remained largely non-violent. The twenty cases are compared in a systematic manner with the help of the qualitative comparative analysis (QCA) technique/approach in order to detect the conditions under which conflicts around scarce renewable resources turn violent. QCA is well suited to deal with complex causal relationships and to uncover relevant context factors and interaction effects. Since cases are selected from a variety of locations and contexts, the results are much more generalizable than single-case studies. However, the analysis is still essentially based on the in-depth, qualitative knowledge of the twenty cases under study. In this sense, the QCA provides a middle ground between quantitative large-N and qualitative case studies.

This article proceeds as follows. In the next section, the theoretical background of the study is developed (2). Afterwards, the research design (3) as well as the results and several robustness checks (4) are presented. In the following discussion, the results are interpreted and compared to in-depth analyses of singular cases (5). Avenues for future research as well as policy implications are spelled out in the conclusion (6).

2. Theoretical background

In this study, a conflict is defined as a manifest clash of the interests of two or more social groups. Violence refers to the use of direct, physical force against human beings. And renewable resource scarcity describes a situation in which the land, water, fish or forest resources in a given area are insufficient to satisfy current human demands for these resources. Such scarcity can be supply-induced, demand-induced, and/or structural (induced by unequal distribution) (Homer-Dixon and Blitt, 1998: 6). But under what conditions do conflicts around such scarce resources turn violent? Albeit not without objections (Selby and Hoffmann, 2014), previous research largely agrees that violent conflicts around scarce renewable resources are most likely to occur in relatively poor countries (often termed global south or non-OECD world), and there especially in rural and peripheral areas where the state's capacity is limited (Bretthauer, 2014; Buhaug et al., 2010). These factors are used to demarcate the 'area of homogeneity' of this study, which makes sure that the cases selected are similar enough to compare them in a meaningful way (Berg-Schlosser and de Meur, 2009: 20f). But poverty and peripheral location are not suitable for distinguishing cases of violent conflict from cases of non-violent conflict about scarce renewable resources, since both conditions are quite prevalent.

A starting point for my theoretical framework is the distinction between structural and triggering conditions (roughly equal to independent variables) of violent conflict escalation (Hendrix and Glaser, 2007; Kaufman, 2001). The former are defined as the pre-conditions of a violent conflict which are largely static and invariant over time, while the latter refer to short-term dynamics or 'precipitating events' (Hislope, 2007: 154) of violent escalations. In the QCA terminology, both structural and triggering conditions are INUS conditions for the violent escalation of conflicts over scarce renewable resources. An INUS-condition 'is an insufficient but necessary part of a condition which is itself unnecessary but sufficient' for the outcome under investigation (Schneider and Wagemann, 2012: 79). Since the number of conditions that should be included into a QCA is limited, the analysis will focus on four conditions, which is in line with recent recommendations (Berg-Schlosser and de Meur, 2009; Marx and Dusa, 2011). The conditions are selected in accordance with the theoretical literature, but also in a dialogue with the cases (Schneider and Wagemann, 2012: 281). Only such conditions can be chosen on which reliable and location-specific information are available for all (potential) cases under study. More specifically, the analysis will focus on two structural and two triggering conditions for the violent escalation of conflicts over scarce renewable resources. It is expected that a combination of structural and triggering conditions is sufficient for the violent escalation of conflicts over scarce renewable resources, while the mere presence of (combinations of) either structural or triggering conditions is neither necessary nor sufficient for such an escalation.

The first structural condition used in the analysis is *negative othering*. The importance of collective identities for the use of violence by conflict parties (Fröhlich, 2012; Kaufman, 2006) as well as the stability of such identities over time (Jabri, 1996) is well known. Identities can be understood as collective social constructs which define who are the members of a given social group, what attributes and goals they share, and how they relate to other groups (Abdelal et al., 2006). The delineation from other groups ('othering') can facilitate the use of violence if the respective Other is portrayed in negative terms (Chatterjee, 2012; Hansen, 2006). The concrete forms of negative othering are time and place specific. But it has been shown that the construction of another group (a) as an aggressor or existential threat to the Self and/or (b) as much lower in value/legitimacy than the Self usually provides motivation and

legitimacy for the use of violence in intergroup conflicts (e.g. Bar-Tal, 1998; Buzan et al., 1998; Kaufman, 2006). When conditions of resource scarcity and perceived aggressive intentions by other groups combine, they potentially produce a strong climate of insecurity in which preliminary attacks to capture resources or weaken the opponent are likely to happen (Kahl, 2006: 46f; Scheffran et al., 2014). If other groups are conceived as having a low status or legitimacy, the inhibition threshold to use violent means in order to prevent these Others from using/acquiring renewable resources recedes (Martin, 2005). Therefore, I expect that negative othering is an INUS condition for the violent escalation of conflicts over scarce renewable resources.

The second structural condition used is *high power differences*. Power has been identified as an important yet understudied factor in conflicts around scarce renewable resources (Houdret, 2012; Selby and Hoffmann, 2014). In this context, Zeitoun (2008: 26–29) distinguishes between three dimensions of power: hard power, relational power, and ideational power. While the latter is crucial for the occurrence or non-occurrence of a conflict and therefore of minor relevance here, the first two dimensions are important in shaping the dynamics of conflicts around scarce resources. Hard power is understood as 'the material capacity of one party to gain the compliance of the others' (Zeitoun, 2008: 26) and includes material wealth as well as the capability to apply direct, physical violence. Relational power refers to the power one group derives from its authority and legitimacy. Concrete manifestations of this power include judicial backing, support from outside actors, media attention, recognition by the international community or issue linkage. But it is still unclear how (hard and relational) power differences shape the escalation of conflicts. Research on international wars has concluded that large and stable power asymmetries reduce the risk of the violent escalation of interstate conflicts, mainly because the weaker party is usually willing to concede in order to avoid open confrontation (Bennett and Stam, 2004). In principle, this argument should hold true for intra-state conflicts around renewable resources as well. On the other hand, some studies suggest that large power differences increase the risk for conflicts around natural resources to turn violent because the stronger party has to fear neither considerable resistance nor sanctions when applying physical force (Simmons et al., 2007; Watts, 2004). Large power differences and the associated political marginalization can also fuel grievances of the weaker party (Raleigh, 2010). Consequentially, no directional expectation regarding the relevance of large power differences as an INUS condition can be made.

The first triggering condition included in this study is *external resource appropriation*, which is inspired by the political ecology literature (e.g. Peluso and Watts, 2001; Robbins, 2004: 9–16). Some authors argue that commercialization, understood as the increasing exchange of natural resources on markets rather than within local systems of reciprocity and subsistence, is an important factor for the violent escalation of conflicts over scarce renewable resources (Assies, 2003; Yeh, 2000). Other scholars highlight the relevance of privatization, defined as the transformation of a resource from an open access or common pool to a private good, for the violent escalation of resource conflicts (Jewitt, 2008; Simmons et al., 2007). State interventions aimed at conservation or national development, such as natural parks (Duffy, 2002) or state-led water redistribution (Lynch, 2012), are claimed to have an escalating effect as well. The hypothesized causal mechanisms represented by the concepts of commercialization, privatization and state intervention are very similar: Either are local groups aggrieved since they are excluded from the use of scarce renewable resources, for instance because of higher prices (commercialization), an increasing scarcity due to resource exports (commercialization) or the enclosure of resource-rich areas (privatization, state intervention). Or powerful actors use violent means in order to enforce property claims (privatization), resource control (state intervention) or access to valuable resources (commercialization). Therefore, and because only a limited number of conditions can be used in a QCA, I follow the suggestion of Schneider/Wagemann (2012: 277) to create a 'master or macro-variable'. External resource appropriation refers to a situation in which commercialization and/or privatization and/or state intervention are present. It can be defined as a recent increase in the appropriation of renewable resources by actors which are external to the local conflict context (e.g. transnational companies, national governments, urban consumers) and which do not use these resources for subsistence purposes. The directional expectation is that external resource appropriation is an INUS condition for the violent escalation of conflicts over scarce renewable resources.

The second triggering condition used in the analysis is *recent political change*. There is a large consensus about the importance of regime change for the eruption of civil wars (Dixon, 2009). This might be the case because regime change is already the result of a severe (violent) conflict. But it is also possible that regime change provides opportunities (e.g. low state capability to enforce law and order) or motivations (e.g. resistance against the new regime's policies) for the use of violence. These arguments are also valid for conflicts around scarce natural resources (Timura, 2001). However, the focus on regime change alone might be too narrow. Changes of major elements of the political system (which are not always accompanied by regime change) can also have escalating effects on conflicts about renewable resources. The re-drawing of administrative boundaries, for instance, might cause the escalation of conflicts around land or water resources in areas contested between different groups (Kahl, 2006). Changes of policies related to renewable resources, such as water privatization, can have similar consequences (Assies, 2003). Therefore, political change is defined here as a modification of (a) the characteristics of the political system and/or its spatial organization, and/or (b) the laws or policies related to the disputed renewable resources. However, some forms of political change, such as the introduction of more constitutional rights or the democratization of resource management, might mitigate the use of violence in resource conflicts (Ratner et al., 2013). Therefore, I do not formulate directional expectations regarding recent political change as an INUS condition for the violent escalation of conflicts over scarce renewable resources.

3. Research design

3.1. QCA in a nutshell

QCA was developed in the 1980s in order to compare causal patterns among a medium number of cases in a systematic way (Ragin, 1987). More specifically, QCA aims at identifying necessary and sufficient conditions for a certain outcome. In order to do so, it applies a set-theoretic perspective (Schneider and Wagemann, 2012), i.e. it analyzes whether given sets of cases stand in a subset-relationship or superset-relationship to each other. Regarding the paper at hand, the question is then whether the set of cases in which conflicts over scarce renewable resources turn violent is a subset (indicating necessity) or a superset (indicating sufficiency) of one of the (combinations of) conditions discussed in section 2, or if no set relations can be detected (indicating the absence of causal relationships).

When comparing cases, QCA obliges researchers to decide for each case whether it belongs to the set of cases sharing a certain condition (e.g. experiencing violence) or not (calibration). The more recent variant of fuzzy-set qualitative comparative analysis (fsQCA) allows researchers to go beyond simple in-out (1 or 0)

dichotomies and calibrate cases as having a partial membership in a set (Ragin, 2009). However, the qualitative threshold of 0.5, distinguishing between cases which are more in than out of a certain set and vice versa, remains important (Schneider and Wagemann, 2010). All cases can therefore be thought of as combinations of different conditions, such as being a member of set A (condition A is present), but not of B and C (conditions B and C are not present). All possible combinations of conditions are listed in a so-called truth table. Each of the cases investigated can be assigned to one (and only one) combination of conditions (called a truth table row), while often some possible combinations (logical remainders) are not covered by real cases. The number of truth table rows, and thus the number of logical remainders, grows exponentially with the number of conditions included. A high number of conditions in combination with a low number of cases thus raises problems of limited diversity (Ragin and Sonnett, 2005), theoretical interpretation (Schneider and Wagemann, 2010: 402) and validity of the results (Marx and Dusa, 2011).

Hug (2013) has recently argued that QCA scholars often do not account for possible measurement errors during the calibration process However, the fact that the calibration of the membership scores is usually based on an in-depth knowledge of the cases under consideration strongly reduces the number of measurement errors (de Meur et al., 2009). The same is true for various robustness checks of the results (see Skaaning, 2011 and Section 4). Once the cases are calibrated, one can check which combinations of conditions are linked to the outcome of interest, and these combinations/truth table lines are minimized in order to achieve the so-called solution formula or solution term. The solution formula/term indicates the (combinations of) conditions which are sufficient for the outcome of interest (Ragin, 2009).

QCA is therefore based on three key assumptions (Schneider and Wagemann, 2012: 78). *Equifinality* means that the same phenomenon can potentially be explained by different, mutually non-exclusive sets of conditions. *Conjunctural causation* refers to the possibility that a certain condition has no effect on the outcome on its own, but only in combination with other conditions, for instance in the form of INUS conditions. Both assumptions resonate very well with the theoretical assumptions discussed above as well as with recent efforts to introduce interaction effects in the research on socio-environmental conflicts (Theisen et al., 2012). Finally, *causal asymmetry* implies that the (combination of) conditions causing a certain outcome (here: violent escalation) are not necessarily a mirror image of those conditions causing the absence of this outcome. This is in line with the widely shared sentiment in peace and conflict research that violent conflict and its absence cannot be treated as simple binary oppositions (Chenoweth and Cunningham, 2013).

3.2. Case selection

The selection of cases is driven by several criteria. First, all cases are supposed to be characterized by a conflict about scarce renewable resources. Second, cases have to be part of the area of homogeneity, so the conflicts should have taken place in peripheral, rural areas of countries in the global south. Third, since conflict patterns during the Cold War era might differ significantly from post-Cold War conflict dynamics, a temporal dimension is added to the homogeneity space: The study is limited to conflicts which took place after 1989. Similarly, only intra-state conflicts are considered because violent inter-state conflicts about renewable resources are very unlikely (Gleditsch, 2012). Fourth, in order to increase the generalizability of the results through a diverse case selection strategy (Gerring, 2007: 97–101), conflict cases are chosen which

- took place during different time periods (between 1990 and 2010),
- took place in different geographical locations within the global south (Asia, Africa, Latin America, Middle East, and the Pacific),
- took place at various (sub-national) spatial scales (ranging from village to federal state level), and
- involved different kinds of renewable resources (land, water, fish, forest).

Fifth, the analysis only includes cases on which sufficient and reliable information is available. This implies that the cases are discussed by several studies from different authors, that the various studies and authors agree in their description of the cases, and that at least parts of this literature should be peer-reviewed. One should note that this prerequisite potentially reduces the generalizability of the results due to research or publication biases. Sixth, I consider only cases which are representative of their region. In other words: If a conflict over scare renewable resources became violent in one village, but not in the surrounding villages which are characterized by similar conditions, then this conflict is not used in the analysis.

When taking all six criteria into account, a sample of twenty cases of conflicts over scarce renewable resources can be derived from the rich qualitative literature on socio-environmental conflicts. Fig. 1 summarizes the sample of these cases. Appendices 1 and 2 contain more information on all twenty conflicts, including short descriptions of and a full list of references for each case.

3.3. Calibration

As discussed above, it is important that the calibration process is based on a good knowledge of the cases and on clearly defined thresholds between the different set membership scores (Schneider and Wagemann, 2012: 32). In order to gain an in-depth knowledge, desk-based studies of the twenty cases selected are conducted. Existing studies on conflicts about scarce renewable resources are used and complemented by more general publications on the relevant countries/regions. The Polity IV index (Marshall et al., 2012) is also consulted when membership scores for recent political change are assigned. If I was unsure about a specific calibration decision or if less information was available for one case than for other cases, I contacted experts on the conflicts or regions under investigation to provide additional insights (see acknowledgements). Many cases were also discussed with colleagues and student research assistants in order to increase the reliability of the calibration process. In appendix II, I provide short descriptions of all cases and justifications for the calibration decisions. Appendix I gives information on the literature used for the calibration of each case.

This study uses a four-value scheme for the calibration process. Membership scores for the conditions and outcomes can be calibrated as 0 (fully out of the set), 0.33 (more out than in), 0.67 (more in than out) and 1 (fully in). Such as scheme 'is especially useful in situations where researchers have a substantial amount of information about cases, but the nature of the evidence is not identical across cases' (Ragin, 2009: 90). It allows for capturing the diversity of social reality beyond 1–0 dichotomies, but does no contain too many values which would make proper calibration unreliable (Ragin, 2009). In the following section, information about the qualitative anchors and the graded membership definitions used in the calibration procedure is provided (Schneider and Wagemann, 2012: 32, 277).

- If direct, physical violence was used frequently and in a systematic manner by at least one conflict party and caused

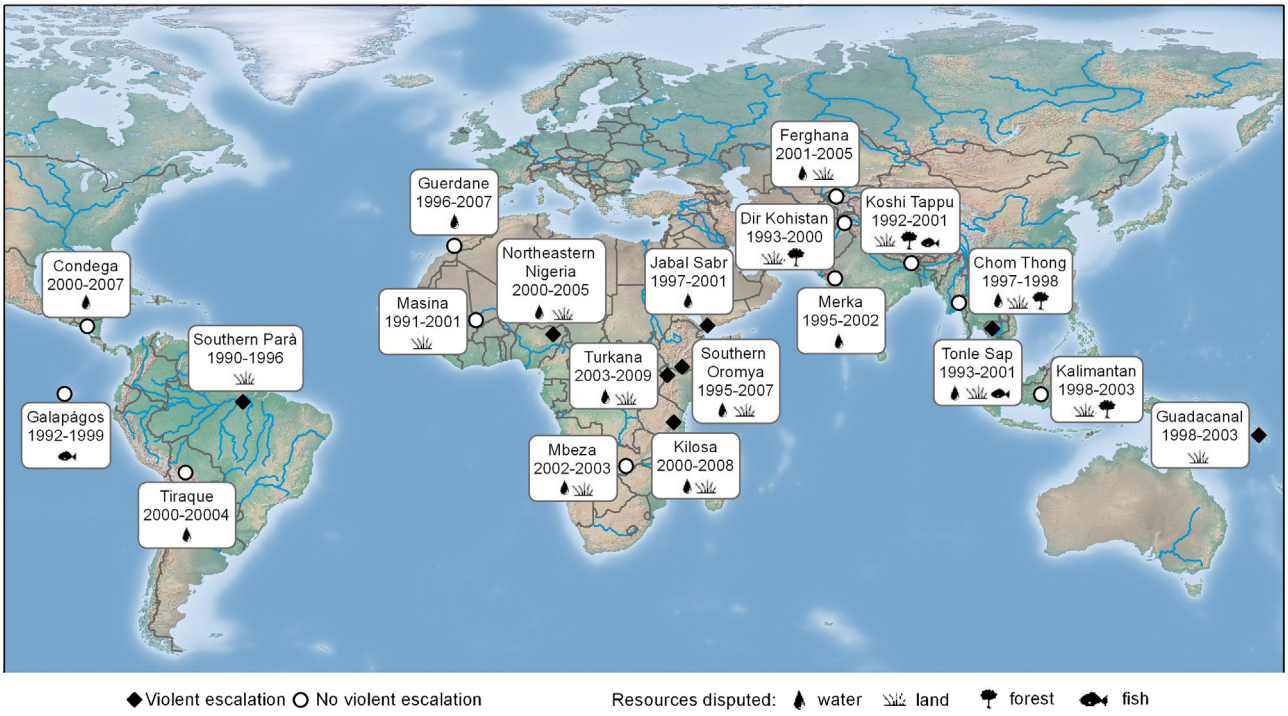

Fig. 1. Sample of cases analyzed.

several fatalities, the case is calibrated as fully violent (1). A membership score of 0.67 is attributed if at least one conflict party used violence frequently, causing several fatalities, but the use of violence was not systematic and the majority of conflict actions were still non-violent. The 'point of maximum indifference' (Schneider and Wagemann, 2012: 32) is passed when violence was used only sporadically and unsystematically, but caused one fatality (0.33). A case is considered completely non-violent if no or hardly any physical violence was used and no fatalities are reported (0).

- Negative othering: A case is considered as a full member of the set if all or the large majority of groups involved perceived it's Others as an existential threat or as vastly inferior (1). When the majority of conflict parties shared such perceptions, a set membership score of 0.67 is assigned. The point of maximum indifference is passed if only a minority of the parties perceived its opponent(s) as an existential threat and/or strongly inferior (0.33). If no parties involved in the conflict shared such perceptions, the case is considered as fully out of the negative othering set (0). In order to account for the possibility of reverse causality (the use of violence causes negative othering), I primarily use studies which trace the relevance of negative othering for (and before) the onset (and violent escalation) of the conflicts.
- High power differences: If one group had a considerable advantage in terms of both hard and relational power, the case is considered as a full member of the power differences set (1). If one group commanded significantly more hard or relational power and the other groups were not able to compensate this by advantages (or at least equivalence) regarding the other dimension of power, the case is calibrated as 0.67. The point of maximum indifference is crossed if one group was more powerful with regard to one dimension of power, but this advantage was largely 'balanced' by an advantage of the other group or an equilibrium between both groups with regard to the other dimension of power (0.33). If all parties involved in the conflict had an equal amount of hard and relational power at their disposal, the case is considered as fully out of the set (0).
- External resource appropriation: Full membership is assigned if recent increases in external resource appropriation led to a situation in which access of local groups to the renewable resource was severely restricted or completely denied (1). If considerable commercialization, privatization or state intervention processes took place in the last (approximately) five years and caused a situation in which a significant amount of the resource was appropriated by outsiders, in turn strongly influencing the livelihoods of the groups in conflict, the case is considered as more out than in (0.67). By contrast, if the degree of external resource appropriation remained limited in spite of recent increases, thus only marginally influencing local livelihood patterns and strategies, the case receives a membership score of 0.33. A case is calibrated as being fully out of the set when no or hardly any external appropriation of the disputed renewable resource occurred (0).
- Recent political change: The difference between minor and major political changes is crucial in this context. A change is considered minor if it affects secondary characteristics of the political system (e.g. electoral thresholds) or the resource regime (e.g. documentary procedures for obtaining land titles) and major if it affects defining characteristics of the political system (e.g. shift from autocracy to democracy) or resource regime (e.g. legalization of the sale of communal land). Full membership is assigned if major changes in both the political system and the regime concerning the disputed resource took place in the last (approximately five) years (1). If either the political system or the renewable resource regime experienced major changes, the case is calibrated as 0.67. The point of maximum indifference is passed when recent changes of the political system and/or the renewable resource regime took place, but can be characterized as minor (0.33). A case is considered to be fully out of the set if neither its political system nor the relevant renewable resource regime has changed in the last (approximately five) years.

4. Results

In the first step, it should be analyzed whether there is any necessary condition for the outcome (Ragin, 2009). The most important factor is assessing necessity in the consistency value, which indicates the degree to which a condition leads to the outcome across the cases. It is good practice to consider only those conditions as necessary which have a consistency value of 0.9 or higher (Schneider and Wagemann, 2012: 278). In this study, neither the presence nor the absence of any of the four conditions discussed in section 2 passes this threshold. The presence of negative othering (0.83), the absence of high power differences (0.83) and the presence of recent political change (0.79) have the highest consistency values.

When applying the logical minimization procedure to the truth table rows in order to detect sufficient conditions, three solution terms can be produced. The conservative solution is only based on those truth table rows which correspond to empirically observed cases. The intermediate solution draws on all empirically observed truth table rows and those combinations of conditions which do not correspond to empirical cases (logical remainders), but which contribute to the parsimony of the solution terms and can be assumed to produce the outcome of interest (here: violent escalation). Finally, the solution based on all empirically observed cases as well as all those truth table rows contributing to the parsimony of the solution term is called the parsimonious solution. The latter is usually considered as problematic since it can be based on truth table rows which are neither empirically observed nor in line with theoretical expectations (Schneider and Wagemann, 2012: 151–177). Proponents of fsQCA consider the intermediate solution as superior (Ragin, 2009: 111), while other scholars criticize the inclusion of non-observed cases and recommend relying on the conservative solution (de Meur et al., 2009).

In this study, the logical minimization only includes truth table rows backed by empirical cases which pass a raw consistency threshold of 0.8 (Ragin, 2006). Five out of sixteen truth table rows remain as logical remainders. When these are included in the analysis, using the directional expectations spelled out in Section 2, the intermediate and the conservative solution are the same. This solution formula is depicted in Table 1 and can be read as follows: The combination of negative othering, the absence of high power differences between the conflict parties and either recent political change or external resource appropriation is a sufficient condition for the violent escalation of conflicts over scarce renewable resources. The solution is characterized by a high consistency value (0.89) and can explain five out of seven cases of violent escalation. Only Southern Pará and Tonle Sap remain unexplained. In addition, none of the thirteen cases without violent escalations is characterized by this combination of conditions (although this statement should be treated with caution due to QCA's assumption of causal asymmetry).

Table 1
Conservative/intermediate solution for the violent escalation outcome.

Causal pathway	negaoth * ∼hipowdiff * politchang	negaoth * ∼hipowdiff * extappro
Consistency	0.88	0.86
Raw coverage	0.58	0.50
Unique coverage	0.17	0.08
Cases covered	Jabal Sabr, Northern Nigeria, Southern Oromiya, Turkana	Guadalcanal, Southern Oromiya
Solution formula	negaoth * ∼hipowrdiff * (politchang + extappro) → violence	
Solution consistency	0.89	
Solution coverage	0.67	

* = and.
+ = or.
∼ = absence of.
→ = sufficient for.

In recognition of QCA's assumption of causal asymmetry (Schneider and Wagemann, 2010), the absence of the outcome is investigated. No necessary condition for conflicts over scarce, renewable resources to remain non-violent can be found. Regarding sufficiency, I use the directional expectations discussed in Section 2. The resulting conservative solution is quite complex and its theoretical interpretation would go beyond the scope of this paper. The intermediate solution considers the absence of negative othering in combination with either high power differences or recent political change as sufficient for a conflict about scare renewable resource to be carried out non-violently (consistency: 0.9; coverage: 0.72).

Before the results are discussed in the subsequent section, their robustness should be tested with a focus on the sufficient conditions for violent escalation. In general, fsQCA is considered as a quite robust method due to the researcher's deep knowledge of the cases analyzed (de Meur et al., 2009) and because the consistency values of the truth table rows are based on evidence from all cases analyzed (Ragin, 2009: 119). Nevertheless, Schneider/Wagemann (2012: 284–295) and Skaaning (2011) emphasize the importance of checking the robustness of the results vis-à-vis changes in (a) the frequency thresholds, (b) the consistency thresholds, (c) the cases analyzed, (d) the conditions used, and (e) the calibration decisions. In an analysis with twenty cases, any other frequency threshold than (at least) one (case per truth table row) is hard to justify (Ragin, 2009: 107). The remainder of this section is used to perform the other four robustness tests. If not stated otherwise, a consistency threshold of 0.8 for the inclusion of truth table rows into the minimization procedure is used and the intermediate and conservative solutions are identical.

Firstly, the consistency threshold for the inclusion of truth table rows in the minimization procedure (0.8 in the original analysis) can be changed. A lowering of this threshold is not feasible since the next lowest consistency score of a truth table row is beyond the acceptable minimum threshold of 0.75 (Schneider and Wagemann, 2010). If the analysis is run again with a higher threshold of 0.85, the solution formula looks very similar to the original solution formula, but the absence rather than the presence of external resource appropriation is identified as an INUS conditions for violent escalation (Table 2, row 2).

Secondly, the robustness of the results vis-à-vis a changing population of cases should be checked. One might argue that Guadalcanal differs from the other cases in which violence was used because the conflict escalated into a civil war and a coup d'état (although due to the weak nature of the Solomon state, the small territorial size of the country and the forms of organized violence used, the dynamics of violence were similar to those in other cases, such as Turkana or Oromiya). It could also be claimed that in southern Pará, land was abundant, maldistributed and hardly accessible (given the poor road infrastructure) rather than scarce (although this argument would be based on a limited understanding of resource scarcity). Finally, one might recommend dropping the cases of Condega and Dir Kohistan since no article on them is published in peer-reviewed journals (although sufficient and reliable information on both cases are available from edited volumes, working papers and personal communication with experts). If I run the analysis again but drop those four cases, the only difference to the original solution formula is that external resource appropriation is no longer included (Table 2, row 3). This change is driven by the removal of Guadalcanal from the analysis, since it is the only case of violent escalation uniquely covered by the causal combination of negative othering, low power differences and external resource appropriation.

Table 2
Original solution and results of the robustness tests.

Row	Analysis	Solution formula	Cons.	Cov.
1	Main analysis	negaoth * ∼hipowrdiff * (extappro + politchang) → violence	0.89	0.67
2	Higher consistency threshold	negaoth * ∼hipowdiff * ∼extappro * politchang → violence	0.86	0.50
3	Four cases dropped	negaoth * ∼hipowdiff * politchang → violence	0.87	0.77
4	Condition low development included	negaoth * ∼hipowdiff * politchang * lowdev → violence	0.87	0.54
5	Condition high education included	negaoth * ∼hipowdiff * politchang * ∼hiedu → violence	0.88	0.58
6	Resource regime rather than political change	negaoth * ∼hipowdiff * (∼resregchang + extappro) → violence	0.84	0.67
7	Political system rather than political change	negaoth * ∼hipowdiff * polsystchan → violence	0.93	0.54
8	Violence threshold = one fatality	∼hipowdiff * (∼extappro * politchang + negaoth * extappro) → violence	0.85	0.59
9	Southern Pará and Tonle Sap dropped	negaoth * ∼hipowdiff * (extappro + politchang) → violence	0.88	0.79

Thirdly, a QCA with twenty cases can also be run with five instead of four conditions (Marx and Dusa, 2011), although the number of logical remainders grows with the inclusion of each additional condition. Recent research has emphasized the importance of education for the prevention of violence over scarce renewable resources. Well-educated individuals can, for example, introduce technologies to use scarce resources more efficient or seek employment in the secondary/tertiary sector (Bretthauer, 2014). Similarly, a low level of development is argued to facilitate the violent escalation of conflicts over scarce renewable resources, for instance because opportunity costs for joining a violent group are lower (Barnett and Adger, 2007; Fjelde and von Uexkull, 2012). I therefore run the analysis two additional times, once with high levels of education (hiedu) and once with low levels of development (lowdev) as an additional condition. The percentage of the population which completed primary education is used as a proxy for high education, while a high under-five mortality rate indicates a low level of development. Sub-national (although not case-specific) data on both indicators are obtained from the Demographic and Health Survey Program (2013) (see appendix III for more information on the calibration procedure, which has been based on natural gaps in the data).

In accordance with theoretical expectations, the presence of low levels of development and the absence of high levels of education are identified as INUS conditions for the violent escalation of conflicts over scarce renewable resources. But more important is that negative othering, the absence of high power differences and recent political change are again highlighted as INUS conditions for violent escalation, while (the presence or absence of) external resource appropriation is not part of the solution formulas (Table 2, rows 4 and 5).

Fourthly, the scope for setting alternative calibration thresholds is limited if the calibration procedure is based on deep qualitative evaluations rather than on quantitative datasets. However, two calibration-related robustness tests seem appropriate here. Firstly, it might be argued that the recent political change condition mixes up two too different concepts, namely changes of the political system and changes of the resource regime. Therefore, the political change condition is divided into two crisp-set (binary calibrated) conditions: recent change of the political system (polsystchang) and recent change of the resource regime (resregchang). If the latter is used in the analysis, the solution formula identifies negative othering, low power differences and either external resource appropriation or the absence of recent resource regime change as sufficient for a violent escalation (Table 2, row 6). This contradicts the results of the previous specifications, which all identify the presence (rather than the absence) of political change as an INUS condition for violent escalation. When running the analysis with the recent political change condition, a higher consistency threshold for the inclusion of truth table rows (>0.8) is chosen in order to produce a solution formula with a consistency which is sufficiently high and comparable to those of the other solution formulas. The combination of negative othering, low power differences and recent changes of the political system appears to be sufficient for violent escalation (Table 2, row 7). This result is in line with most other robustness tests. However, the solution formulas based on the inclusion of either recent political system change or recent change of the resource regime are not as robust as the solution formulas identified when using the condition of recent political change (results not shown).

Secondly, it can be argued that conflicts with one fatality (calibrated as 0.33 in the analyses above) are more in than out of the set of cases which experienced a violent escalation (Sundberg and Melander, 2013). Therefore, the analysis is re-run with a violent escalation outcome that is strictly calibrated according to quantitative criteria: cases with zero fatalities are calibrated as 0, cases with one fatality are calibrated as 0.67 and cases with more than one fatality are calibrated as 1. The resulting solution formula emphasizes the relevance of negative othering, recent political change and especially low power differences, but is ambivalent about the impact of external resources appropriation (Table 2, row 8).

Where do these robustness checks with varying consistency thresholds, cases included, conditions used and calibration decisions leaves us? From Table 2, it can be seen that the presence of negative othering and the absence of high power differences are (parts of) INUS conditions for the violent escalation of conflicts over scarce renewable resources in all eight solution formulas found. The presence of recent political (system or resource regime) change appeared as (a part of) an INUS condition in seven of the eight analyses. The results regarding external resource appropriation are ambivalent and in four robustness tests, neither its presence nor its absence is identified as (part of) an INUS condition. More importantly, the simultaneous presence of negative othering, low power differences and recent political change is a perfect superset of or identical to five of the eight solution formulas produced, and a partial superset of seven of the eight solution formulas. Hence the claim that this combination of conditions is sufficient for the violent escalation of conflicts over scarce renewable resource is consistent and robust. Replication data for all analysis presented in this section can be found in appendix III.

5. Discussion

The causal pathway identified as consistent and robust in the previous section (negaoth * ∼hipowdiff * politchang) explains four of the seven cases of violent escalation (Jabal Sabr, Northern Nigeria, Southern Oromiya, Turkana) and is absent in all thirteen conflicts which have not experienced a violent escalation. The violent escalation of land conflicts on Guadalcanal in 1998 might also be considered as covered by this causal pathway, because although the Solomon Islands did not see a major change of the political system or the land regime between 1993 and 1998, it experienced four different governments, three governmental changes and tremendous political volatility in this period (Moore, 2004).

In-depth investigations of the case of Southern Oromiya (Ethiopia, 1995–2007) confirm the causal mechanisms suggested by the most robust solution formula. This vast, semi-arid region is inhabited by various pastoralist ethnic groups (e.g. Borana, Digodi, Guji) which frequently engage in (sometimes violent) conflicts with each other. In the absence of lasting peace agreements, these conflicts have not been resolved yet because the groups involved are similarly powerful. Rather, continuing conflicts have been a source of mistrust, fear and depreciation (negative othering). The conflicts between the various pastoralist groups often concern water, land and cattle resources, which became increasingly scarce due to severe droughts in the 1980s. The replacement of the communist Derg regime by a democratic and federalist political system between 1991 and 1994 triggered an intensification and escalation of conflicts around land and water resources from 1995 onwards. Firstly, activities by the new government to commercialize agriculture in Southern Oromiya increased resource scarcity and access insecurities for pastoralists. Secondly, efforts by the state to increase its presence in peripheral lowlands led to a weakening of traditional conflict resolution mechanisms. And finally, the attempt to fix the boundaries between the territories of various ethnic groups ('ethnic federalism') caused increasing territorial conflicts between pastoral groups, particularly around key water points and grazing areas (Hagmann and Mulugeta, 2008; Temesgen, 2010).

However, the cases of Southern Pará and Tonle Sap are not covered by the most robust solution formula. Schneider and Rohlfing (2013: 567f) discuss three causes of deviant cases regarding coverage: a misspecified population, calibration errors and omitted conditions. A misspecification of the population is supposedly of minor relevance here because Southern Pará and Tonle Sap do not belong to a set of extreme or specific cases of the population studied. But a focus on calibration errors seems promising. The most robust solution formula covers all five cases in which the use of violence was largely two-sided, while it cannot account for those two cases in which violence was primarily exercised by one side. If the analysis is re-run without the cases of Southern Pará and Tonle Sap, the robust solution formula identified above is largely confirmed (Table 2, line 9). This suggests that the outcome should be re-calibrated as 'escalation into two-sided violence'.

In order to detect omitted conditions, the conduction of an in-depth dissimilar-outcome comparison between the deviant cases for coverage and individually irrelevant cases from the same truth table rows is recommended (Schneider and Rohlfing, 2013). For the analysis discussed here, this means comparing Southern Pará (violent escalation despite of large power differences) to Dir Kohistan (same truth table row but no violent escalation) and Tonle Sap (violent escalation under conditions of high power differences and low negative othering) to Galapágos and Koshi Tappu (same truth table row but no violent escalation). In the latter comparison, the issue of state strength appears to be salient. In the case of Tonle Sap (Cambodia, 1993–2001), the country just recovered from decades of intense (internationalized) civil war, with fighting activities still going on in some regions. Trust in state institutions as well as the administrative and financial capacities of the state were also low (Kiernan, 2002; Seng et al., 2005). By contrast, the conflict about land, forest and fish resources in Koshi Tappu (Nepal, 1992–2001) took place before the intense phase of the civil war. As in Galápagos (Ecuador, 1992–1999), state institutions were effectively able to control the region and prevent the widespread use of violence (Karki et al., 2006; Quiroga, 2009).

When comparing Southern Pará (Brazil, 1990–1996) and Dir Kohistan (Pakistan, 1993–2000), one might conclude that the relevance of the contested resource for the livelihoods of the local population is an important, but omitted variable. In Dir Kohistan, forest products and timber royalities only complemented subsistence agriculture as the main source of livelihood (Khan et al., 2006). In Southern Pará, by contrast, highly unequal land distribution and a lack of adequate agricultural plots posed a strong threat to the livelihood of many local inhabitants since few employment opportunities outside of subsistence agriculture were available (Simmons et al., 2007). This is a plausible reason why land conflicts in Southern Pará escalated beyond the threshold of systematic, deadly violence, while forest conflicts in Dir Kohistan did not. Unfortunately, the operationalization of the concepts of resource dependence (for livelihoods) and state strength remain contested in the literature (Deligiannis, 2012; Newman, 2009). Calibrating them for all twenty cases and re-running the analysis is therefore beyond the scope of this study.

In theoretical terms, the most robust solution formula confirms the expectation that neither (combinations of) structural nor (combinations of) triggering conditions by themselves are necessary or sufficient for the violent escalation of conflicts over scarce renewable resources. This could be one reason why large-N studies on resource scarcity and small-scale violence have so far not produced consensual results (Selby, 2014). They are often based on additive models that tend to miss a link between renewable resource scarcity and violent conflict if causal relations are conjunctural. The discussion of the cases not covered by the most robust solution formula also suggest that different causal pathways facilitate the escalation of renewable resource conflicts into either one- or two-sided violence, while most of the literature focuses on reciprocal violence (Scheffran et al., 2014: 371). In addition, the results add further strength to the claim that a stronger differentiation between causes of conflicts over renewable resources (e.g. external resource appropriation) and causes of the violent escalation of such conflicts (e.g. low power differences) is necessary (Barnett, 2000). The finding that external resource appropriation is not a robust INUS condition for violent escalation contradicts parts of the political ecology literature (e.g. Allen, 2013; Jewitt, 2008).

The results indicate that lower power differences are robustly identified as an INUS condition for violent escalation. By contrast, many other studies hypothesize that conditions associated with large power differences, such as exclusion, marginalization and discrimination, facilitate the violent escalation of renewable resource conflicts (Fjelde and von Uexkull, 2012; Kahl, 2006; Reuveny, 2007). Recent political change also has been found to be a triggering INUS condition for violent escalation, but has hardly been considered in cross-case analyses of socio-environmental conflicts. Finally, the relevance of negative othering as an INUS conditions supports the growing, but still small number of constructivist studies which argue for a stronger incorporation of narrative and discursive factors in the research on socio-environmental conflicts (Fröhlich, 2012; Stetter et al., 2011; Zeitoun et al., 2013).

6. Conclusion

Given the contradictory results previous studies report on the issue, this study asked why some conflicts over scarce renewable resource escalate into violence, while others do not. In order to answer that question, twenty such conflicts, seven of which turned violent, were analyzed. The method of fuzzy-set qualitative comparative analysis (fsQCA) was employed in order to bridge the gap between quantitative and qualitative approaches in the research field. My main result is that no single condition could be identified as necessary or sufficient, but that the simultaneous presence of two structural conditions (negative othering and low power differences) and one triggering condition (recent political change) is sufficient for the violent escalation of renewable

resource conflicts. By contrast, high power differences (which are implied by concepts like ethnic marginalization) and external resource appropriation, which have been discussed as facilitating conditions for the violent escalation of such conflicts (Fjelde and von Uexkull, 2012; Jewitt, 2008), were not identified as robust INUS conditions.

These findings open several prospects for future research on renewable resource scarcity and violent conflict, an issue which is currently mostly discussed in terms of climate change and conflict. Firstly, it would be interesting to further test the most robust solution formula through regression analyses and in-depth studies of additional cases. Especially relevant in this context are cases which are characterized by the presence of both structural conditions, but none of the two triggering conditions for violent escalation. No such case was used in this analysis. Secondly, my results suggest that the relationship between resource scarcity and violent conflict is conjunctural, therefore encouraging the use of interaction terms (Theisen et al., 2012) and set-theoretic methods (Bretthauer, 2014) in future studies. Thirdly, the factors causing conflicts over renewable resources are not identical to those causing a violent escalation of such conflicts. Subsequent analyses should account for this fact, for instance by drawing on datasets for nonviolent conflicts (Day et al., 2015). Fourthly, I have created several macro-variables for this analysis. But the results of the robustness checks as well as theoretical reasons suggest that a disaggregation of these conditions might provide additional insights. This applies to different forms of recent political change (political system vs. resource regime change, democratization vs. autocratization) and violence (one-sided vs. two-sided), but also to the various dimensions of external resource appropriation (commercialization, privatization, state intervention) and power differences (hard vs. bargaining power). And fifthly, state strength and the importance of renewable resource for livelihoods were identified as potential omitted conditions by dissimilar-outcome comparisons of contradictory truth table rows. Future studies should focus on these factors and dedicate more efforts to operationalize and collect data on them.

When it comes to policy implications, this study clearly shows that there is no automatic link between renewable resource scarcity and violent conflict. Rather, this relationship is mediated by three INUS conditions. Each of these conditions can be addressed through policy measures, and if only one of them is (significantly) changed, the violent escalation of conflicts over scarce renewable resources becomes unlikely. Since the prevention of political change and the perpetuation or creation of large power differences are at odds with democratic norms and human rights, I would opt for reducing the amount of negative othering between the competing groups. This can be done through, for instance, discursive conflict transformation (Ramsbotham et al., 2005: 288–301) or narrative conflict resolution (Buckley-Zistel, 2006).

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.gloenvcha.2015.04.008.

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