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Climate Change and Land Use Conflicts in Northern Africa

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With 1 Figure and 1 Table

Abstract

For centuries, Arab nomads and African villagers alternately skirmished and supported each other as they raised livestock and tended fields under resource-constrained conditions. The delicate balance has been upset by drought, desertification, crop failure and wide-spread food insecurity. While the interactions are not sufficiently understood, there are growing indications that warming in Africa could become a significant factor of violent conflicts in the coming decades. To test such projections this paper first gives an overview of North Africa's conflict vulnerability and expected climatic changes. Secondly, the paper discusses past and ongoing farmer-herder conflicts in different regions of Mali. Finally, a model framework is built for analyzing the farmer-herder conflict in Northern Africa, taking into account key environmental and economic variables and feedbacks.

Zusammenfassung

Über Jahrhunderte haben sich arabisch-stämmige Nomaden und afrikanische Bauern wechselseitig unterstützt und bedrängt, während sie unter ressourcenarmen Bedingungen ihr Vieh züchteten und ihre Felder bestellten. Diese sensible Balance wurde durch Trockenheit, Desertifikation, Ernteausfall und ausgedehnte Nahrungsmittelunsicherheit gestört. Während die Wechselwirkungen nicht hinreichend verstanden sind, mehren sich zugleich die Anzeichen, dass in den kommenden Jahrzehnten eine Erwärmung in Afrika zu einem bedeutenden Faktor in Gewaltkonflikten werden könnte. Um solche Projektionen zu prüfen, gibt der Artikel zunächst einen Überblick über die Konfliktanfälligkeit des nördlichen Afrikas und die dort zu erwarteten klimatischen Änderungen. Zweitens diskutiert der Artikel vergangene und aktuelle Konflikte zwischen Bauern und Viehzüchtern in verschiedenen Regionen Malis. Drittens wird ein Modellrahmen entworfen mit dem, unter Berücksichtigung von zentralen Umwelt- und Wirtschaftsvariablen, Konflikte zwischen Bauern und Viehzüchtern im nördlichen Afrika analysiert werden können.

1. Introduction

Violent conflicts over land are not a recent phenomenon in Northern Africa. For centuries, the relationship between herders and farmers has been shaped by both *cooperation and violence* (Blench 2004, Breusers et al. 1998, Gallais 1975, Moritz 2006, Scoones 1995, Shettima and Tar 2008). However, strong population growth, wide-spread food insecurity and a recent series of drought events have increasingly challenged traditional resource sharing mechanisms while fights for scarce land resources have intensified (Baechler 1998, Fratkin and Roth 2005, Herrero 2006, Hulme et al. 2001, Hussein 1998, *ILRI* 2006, Turner 2004).[1] Mean-

1 For a general discussion of the security implications of climate change in Africa see Brown and Crawford 2009. An introduction to the climate-security subject is given in Scheffran 2009, 2010. See also Brauch et al. 2003, *UN General Assembly* 2009, *WBGU* 2007, Barnett and Adger 2007, Nordås and Gleditsch 2007.

while there are growing indications that warming in Africa could become a significant factor of violent conflicts in the coming decades (Barnett and Adger 2007, Burke et al. 2009). This raises the question in which way climate change affects the sharing of land resources between farmers and herders. Will it lead to more conflict or will it promote cooperative solutions? The paper explores these questions in three steps. First, it gives an overview of the general *conflict vulnerability* and *expected climatic changes* in Northern Africa.[2] Next, one particular country is selected for a discussion of farmer-herder conflicts. Finally, conclusions are drawn from the previous steps to build a *model framework* for analyzing farmer-herder conflicts in Northern Africa in general.

2. Conflict Vulnerability and Climatic Change in Northern Africa

In this research context Northern Africa refers to the eleven African states whose state territory is mainly or entirely located above 15° N (see Tab. 1).[3] This broader definition allows for a more comprehensive view on the conflict vulnerability and climate change impacts on the region.[4] To estimate the basic conflict vulnerability of the region this section takes a brief look at some indicators that have been identified by previous studies (Collier 2000, 2008, Collier et al. 2003, Homer-Dixon 1994, 1999, 1991) to potentially contribute to violent conflict.[5] According to Homer-Dixon's environmental scarcity theory (1994, 1999) environmental change likely leads to violent conflict when it is combined with *population growth* and *unequal resource distribution*. Northern Africa is an economically, politically and socially heterogenic region.

However, the states share a common development: *strong population growth*. The total population of the region is expected to grow from currently 247 million to 322 million in 2025 and 430 million in 2050 (see Tab. 1). Mali and Chad are expected to double and Niger even to almost triple their population by 2050. Sudan is projected to see an increase of 34 million people between now and 2050. For the region as a whole and especially for the states mentioned, it can be stated that the population pressure will increase considerably over the next 40 years. Since no state-based index exists that measures the distribution of land resources, the Gini index is used to assess the wealth distribution within the countries. Most considered states show a *medium level of economic inequality* of around 40 (Tab. 1). Positive exceptions are Egypt and Algeria, while Niger has the highest level of economic inequality.

Unlike Homer-Dixon (1991, 1994, 1999), Collier (2008) does not consider inequality to be a major driver for civil war. He rather stresses the importance of *poverty* as a precondition for violent conflict (Collier 2008). Additionally, he and his associates conclude that states who have experienced violent conflicts before face a significantly higher risk of

2 This should not be misinterpreted as a simplification of the climate-conflict complex but rather be seen as a first basic identification of possible conflict vulnerable regions which already are facing significant climatic changes.

3 Thereby the definition extends the UN definition of Northern Africa by three states (Mauritania, Mali, Niger) usually attributed to Western Africa and Chad, usually attributed to the Central or Middle Africa (*UN* 2000).

4 Based on the UN's definition of vulnerability, we define conflict vulnerability as the measurement of the extent to which a community, structure, service or geographical area is likely to be damaged or disrupted by the impact of violent conflict (*UN* 1997, p. 76).

5 We define violent conflict as a conflict between two or more parties in which at least one party uses violence to achieve its goal. For a typology of violent conflicts over natural resources see Hussein et al. 1999 (p. 401).

Tab. 1 Population, economy, human development and conflicts in Northern Africa (*PRB* 2009, *PRIO* 2009a, b, *UNDP* 2009)

State	Population (in millions)			Gini index[1]	GDP[2] per capita (PPP US$)	HD[3] in 2007	Number of conflicts 1989–2008	Dominant conflict intensity
	2009	2025	2050					
Sudan	42.3	56.7	75.9	N/A	2,086	medium	20	war
Algeria	35.4	43.7	50.5	35.3	7,740	medium	18	minor armed conflicts and war
Chad	10.3	13.9	20.5	39.8	1,477	low	16	minor armed conflicts
Niger	15.3	27.4	58.2	43.9	627	low	8	minor armed conflicts
Egypt	78.6	99.1	122.3	32.1	5,329	medium	6	minor armed conflicts
Mali	13.0	18.6	28.3	39.0	1,083	low	4	minor armed conflicts
Morocco	31.5	36.6	42.4	40.9	4,108	medium	1	minor armed conflicts
Western Sahara	0.5	0.8	0.9	N/A	N/A	N/A	1	minor armed conflicts
Libya	6.3	8.1	9.8	N/A	14,364	high	0	
Mauritania	3.3	4.6	6.9	39.0	1,927	medium	0	
Tunisia	10.4	12.2	13.9	40.8	7,520	medium	0	
Total	246.9	321.7	429.6				74	

[1] average 1991–2007, the Gini index lies between 0 and 100. A value of 0 represents absolute equality and 100 absolute inequality; [2] in 2007; [3] Human Development

violence, especially within the *5 year post-conflict phase* (Collier 2008). Table 1 shows that 8 out of the 11 states considered have experienced armed conflicts in the period between 1989 and 2008.[6] Following PRIO's definition, the vast majority of these armed conflicts were internal and of minor conflict intensity.[7] Only in Algeria and Sudan conflicts were temporarily or mainly classified as war.[8] Most armed conflicts of minor intensity took place in Chad followed by Niger, Egypt and Mali.

The economic situation expressed in per capita income shows a clear north-south distinction. While the northern states are economically stronger, the poorest countries namely Niger, Mali and Chad, are all located in the south of the considered region. The degree of human development mainly mirrors the economic situation, with Libya being the only highly developed nation. Niger is last on the human development ranking which includes 182 states, closely followed by Mali (rank 178) (*UNDP* 2009). After this first evaluation of regional conflict vulnerability, three states seem to be adequate for a more detailed discussion. Mali, Niger and Chad meet the population growth criteria by Homer-Dixon (1991, 1994, 1999) as well as the poverty and previously-violent conflict criteria by Collier (2008). The following

6 PRIO uses the UCDP definition of armed conflict: "a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths" (*PRIO* 2009a, p. 1).

7 "Internal armed conflict occurs between the government of a state and one or more internal opposition group(s) without intervention from other states" (*PRIO* 2009a, p. 7). A conflict of minor intensity has between 25 and 999 battle-related deaths in a given year (*PRIO* 2009a, p. 7).

8 To be classified as "war" the number of battle-related deaths in a given year has to reach at least 1000 (*PRIO* 2009a, p. 7).

paragraph will briefly describe the current climatic situation in Northern Africa and discuss the expected changes.

Large parts of Northern Africa are covered by the Sahara desert and shaped by a semi-arid to hyper-arid climate (DePauw 2000, Tucker and Nicholson 1999). The region has an overall low level of soil moisture with strong seasonal variations (see *Japan Aerospace Exploration Agency* 2004). Between 1901 and 2005, the annual precipitation has declined in all states, in the majority by more than 40 % (Bates et al. 2008).[9] The surface temperature in Northern Africa has increased by 1 to 2 °C between 1970 and 2004 (*IPCC* 2007). Projections of precipitation and temperature change for Northern Africa currently lack precision due to insufficient climate data and limited computational and human resources (Boko et al. 2007, Ceccato et al. 2007, Giannini et al. 2008, Stuut et al. 2008). However, most studies suggest a continuation of the current trend of *increasing temperature and decreasing precipitation* (Bigio 2009, Burke et al. 2009, Hulme 2001, Paeth and Thamm 2007, Stige et al. 2006). The IPCC estimates a temperature increase for Northern Africa of 2 to 3 °C until 2100 compared to 1900 (Christensen et al. 2007). Based on data from the Hadley Centre, the German Advisory Council on Global Change expects a significant increase of drought risk, especially for the western part of the considered region (compare *WBGU* 2007, p. 61). UNEP estimates that the boundary between semi-desert and desert has shifted southward by 50 to 200 km since 1930, and it is expected to continue to do so as precipitation declines (*UNEP* 2007).[10] Between 90 million and more than 140 million people in North Africa could suffer from *water stress* in 2055 if the global temperature exceeds 1.8 °C compared to preindustrial levels (Boko et al. 2007).

Even without climate change several countries in North Africa will exceed the limits of their economically usable land-based water resources by 2025 (Bates et al. 2008). While the food consumption in the northern countries of the considered region is currently high and only expected to deteriorate slightly in the future (by about 4.4 % between 2008 and 2018 on average), the states of the Sahel already face *wide-spread food insecurity* which is expected to worsen (*FAO* 2009, Herrero 2006, Shapouri et al. 2009). Cline (2007) roughly estimates the agricultural productivity for Morocco, Algeria, Mali and Sudan to drop by more than 25 % until 2080 (compared to 2003 levels), even if effects of carbon fertilization are incorporated. Niger is estimated to see a decline of agricultural productivity between 15 and 25 % while Egypt could increase its agricultural productivity over the same time period by more than 25 % (Cline 2007).[11] A recent study by the International Food Policy Research Institute calculates that due to climate change the rice production in the Middle East and North Africa could be 30 to 40 % lower in 2050 compared to a situation without climate change, while the production of other crops (wheat, maize and millet) would experience a reduction of less than 10 % or even a slight increase of less than 1 % in the case of sorghum (Nelson et al. 2009, p. 19).[12] In summary, the majority of studies indicate that *climate change will aggravate water stress and scarcity*. That "could generate conflicts over water, particularly in arid and semiarid regions" (Bates et al. 2008, p. 79). Against this background, Mali appears to be particularly appropriate for a climate change related discussion of farmer-herder conflicts.

9 It is noted that for most parts of the Sahara desert data are not sufficient to produce reliable trends (Bates et al. 2008).

10 For a critical discussion of this estimate see Benjaminsen 2008.

11 No estimates were provided for the remaining countries considered here.

12 The study did not consider the use of carbon fertilizers.

3. Farmer-Herder Conflicts in Mali

Mali's population combines diverse lifestyles and ethnicities. The dominant group is the Manding including the Bambara and Malinke who are farmers and together account for about half of the total population. Other groups of mostly settled farmers are the Senoufo (9.7 % of the total population), the Songhai (7 %) and the Soninké (7 %). The nomadic Tuareg and Maur herders (together 5 %) are a minority while the Fulani, a hybrid group of cattle herders and sedentary farmers, are the second largest ethnic group (*Minority Rights Group International* 2007). For centuries the different groups have lived side-by-side in *both supportive and conflictive relationships*.[13] However, over the past decades indications of *intensifying land use conflicts* in Mali have accumulated (Ba 1996, 2008, Beeler 2006, Benjaminsen 2008, Benjaminsen and Ba 2009, Moorhead 1991, Pedersen and Benjaminsen 2008, Turner 1999, 2004). Beeler (2006) reports how Fulani herders increasingly have difficulties to find pasture and access to waterholes in north-west Mali. The local Soninké farmers accuse the herders of letting their livestock consume the millet stalks after the harvest, occasionally leading to the killing of stray animals by the Soninké.[14] This conflict is superposed by conflicts over land and water within groups of farmers and herders (Beeler 2006). Another region of conflict is the inland Niger delta of Mali located in the Sahel (100 to 600 mm of annual rainfall) which stretches roughly south from Timbuktu to Segou along the Niger river (see *Economist Intelligence Unit* 2010, p. 2; *FAO* 1997). While paddy rice is planted in shallow water, burgu grows in deeper water (de Vries et al. 2010, Dingkuhn 1995). Since 1950 the maximum flood levels of the Niger river have decreased overall and especially during the droughts of the 1970s and 1980s (Direction Nationale de l'Hydraulique et de l'Energie, Bamako, in Benjaminsen and Ba 2009). This has led the Songhai farmers to move their rice field continuously into the burgu growing areas (Moorhead 1989). Over the past 50 years about one quarter of the burgu areas in the delta has been converted to rice fields (Kouyaté in Benjaminsen and Ba 2009). Since the Tuareg depend on the burgu to feed their productive livestock during the dry grazing season from December to June, a land use conflict has evolved which occasionally leads to violence between the Tuareg and the Songhai (Benjaminsen 2008).

At the same time the delta has seen a strong population growth of about half a million people between the mid 1960s and the late 1990s (Cotula and Cissé 2006).[15] While recognizing this development, Benjaminsen and Ba (2009) warn against seeing the combination of droughts and the growing population as the main cause for conflict. The authors rather identify a policy driven marginalization and discrimination of herders as well as a general state agenda of agricultural modernization as root causes. However, they state that "the droughts of the 1970s and 1980s played a role in the agricultural encroachment that was driving the conflict" (Benjaminsen and Ba 2009, p. 79). After analyzing the impact of the same droughts on the Tuareg rebellion in Northern Mali between 1990 and 1996, Benjaminsen (2008) draws a similar conclusion. The rebellion was mainly based on dissatisfaction with state policies which economically

13 Tonah speaks of "symbiotic economic relationships" (Tonah 2006, p. 157) between farmer and herders in Ghana, while Moritz even sees agriculture and pastoralism in West Africa as "one integrated production system" (Moritz 2006, p. 8).

14 An overview of the growing and harvesting season as well as of the herder movement can be found in *USAID* 2009 (p. 1).

15 Also see Table 1.

and socially strongly disadvantaged the herders. Only the migration movements of young men to Algeria and Libya "where they were exposed to revolutionary discourses" (Benjaminsen 2008, p. 832) were attributed to the droughts. Baechler (1998) as well as Kahl (2006) put a stronger emphasis on the relationship between land scarcity and the outbreak of the Tuareg rebellion. "Land and water stress is severe in Mali" states Kahl (2006, p. 233) and stresses that the fear of the Tuareg was mainly fuelled by "the biased manner in which the government handled famine relief during the periods of droughts" (Kahl 2006, p. 235).[16]

As we have seen, *farmer-herder conflicts are highly complex* since they are affected by a variety of ethnic, socio-economic and political factors. Climate change already acts as an *additional factor* and will likely continue to do so. How exactly and to what extent is not yet fully understood. To overcome this knowledge gap and to better understand the diverse feedbacks caused by climate change new approaches need to be developed. Moritz (2006, p. 28) urges "to consider more explicitly that individuals are strategic actors who may have to gain from the conflicts". Benjaminsen and Ba (2009, p. 79) also call for "a combination of structural and actor-oriented approaches". The following model framework presents such an approach.

4. Model Framework for Analyzing Farmer-Herder Conflicts in Northern Africa

The previous sections have shown that causal relationships within and between the human and the climate system are complex. To improve the understanding of these relationships it is important to describe them *schematically and actor-centered*.[17] The impact graph in Figure 1 visualizes some of the most important relationships between system variables and key actors.

In the course of climate change precipitation is likely to decrease in Northern Africa while land degradation is expected to increase (see previous section). This development negatively affects the two central resources needed by both farmers and herders: water and land. While only a small portion of water is consumed or used by farmers and herders directly for their own wellbeing, the major amount of water is consumed by plants or animals respectively. The two groups of actors may manage to cope with a certain reduction of available land and water and therefore a reduced yield or livestock production. However, if the loss of production reaches a critical threshold which threatens the minimum calorie intake of one or both groups, the *actors are forced to act*. Then, several options are possible. Theoretically, farmers could switch to a crop and herders to a livestock that needs less water while guaranteeing a similar production level. Since the plants and animals can already be considered to be well adapted to the given resource basis and a shift would require significant investments, this option does not seem to be likely. Another option could be to more effectively use the resources through an increase of labor or through closer cooperation.[18] The already existing exchange of goods such as milk for rice could be intensified or the lifestyles could partly converge.[19]

16 The preferential treatment of farmers over herders by the state government was also identified by Clanet and Ogilvie (2009) as a central cause for conflict between the two groups in the Volta Basin.

17 For an introduction on theories and models of the climate-security link see Scheffran 2010, Scheffran et al. 2010.

18 For example a better use of the livestock's excrement as manure for the fields.

19 Cissé sees the "transformation of nomadic herders into cultivators and the tendency for cultivators to become herder-farmers" Cissé 1981, p. 321) as a result of the droughts in the 1970s and 1980s.

To preserve their original lifestyle, both groups could move to more fertile areas. Especially, herders could use this option as they have a higher level of mobility. However, with an *overall reduction of fertile land* this can become increasingly difficult. The example of Mali shows how a direct movement of farmers into grazing areas and of herders into farming land can lead to conflict. This is especially likely when the movement by one actor is perceived as an aggressive act by the other and when this perception is combined with additional factors such as political and social marginalization (Tuareg in Mali), migration and population growth (see Fig. 1 and Tab. 1).

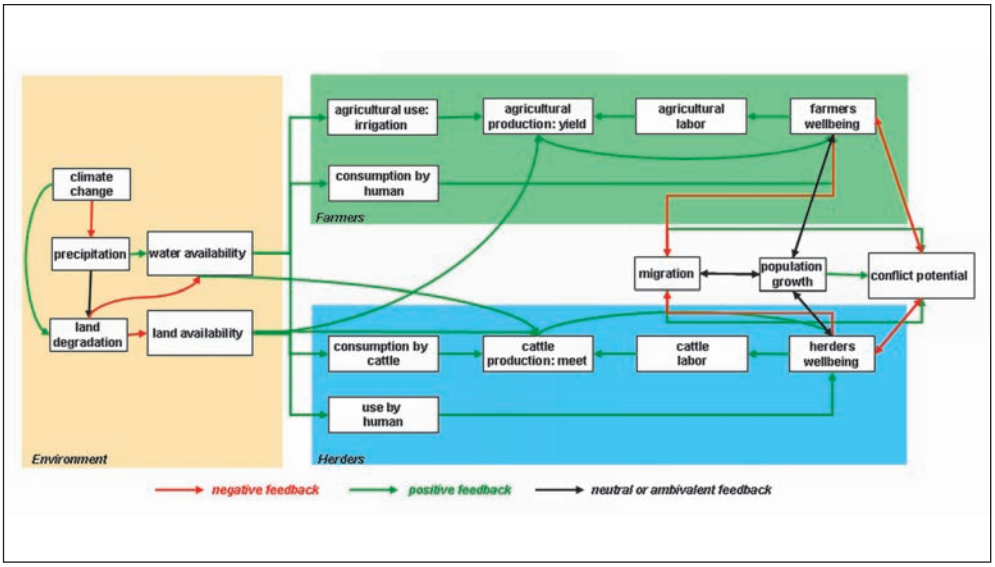

Fig. 1 Schematic overview of the water and land use conflict in Northern Africa

5. Conclusion

Conflicts between herders and farmers over resources are neither a recent phenomenon nor directly caused by climate change. However, climate change will likely *aggravate resource scarcity* in Northern Africa. As seen in Mali, climate change does play a role in conflicts. The extent to which climate change is relevant for conflicts is currently discussed controversially and not yet fully understood. To contribute to the understanding of the linkages between climate change and farmer-herder conflicts, a model framework has been presented. This framework serves as a basis for social network analysis and agent-based modeling, which, combined with qualitative case-studies, further deepens the understanding of the processes driving land use conflicts in Northern Africa.

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