

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/270875496>

Climate and Mobility in the West African Sahel: Conceptualising the Local Dimensions of the Environment and Migration Nexus

Chapter · August 2015

DOI: 10.1007/978-94-017-9322-3_5

CITATIONS

24

2 authors:



Clemens Romankiewicz

University of Bayreuth

14 PUBLICATIONS 345 CITATIONS

SEE PROFILE

READS

673



Martin Doeverspeck

University of Bayreuth

48 PUBLICATIONS 773 CITATIONS

SEE PROFILE

Chapter 5

Climate and Mobility in the West African Sahel: Conceptualising the Local Dimensions of the Environment and Migration Nexus

Clemens Romankiewicz and Martin Doevenspeck

Abstract Despite the theoretical and methodological critique of deterministic and linear explanations of migration under changing climatic conditions, many empirical case studies in this field remain deeply entrenched in static push-pull frameworks and tend to reproduce simplistic causal relationships. Drawing on results from an interdisciplinary research project in Mali and Senegal, the chapter presents a methodological approach that emanates from past analytical shortcomings. By adopting a local perspective on migration, we consider cultural norms, the migration history and people's interpretations of weather and environmental changes. Moreover, we argue for a multilevel, multi-method research that seeks to separate the two research topics of migration and climate/environment; for example, by avoiding explicit questions about possible linkages. Contrasting results from ethnographic fieldwork concerning migration, climate and environment with 'hard' data on climate and vegetation allows us to become more susceptible for the social construction of alleged 'facts' such as droughts and land degradation as drivers for migration. We place a focus upon local meanings of weather and environment by considering how they are being assessed by the people, within a context of not only climatic but rather multiple changes.

5.1 Contextualising the Argument: Introduction

This chapter addresses the potential impacts of climate change on population movement by adopting a local perspective. Two case studies from rural Mali and Senegal serve to reveal the ambiguous relationship between climate change, environmental changes and migration. The relevance of the topic seems to be apparent in relation to the West African Sahel, given that the region's population is one of the most mobile in the world (Ammassari and Black 2001), while mean annual temperatures

C. Romankiewicz (✉) • M. Doevenspeck
Department of Political Geography, Institute of Geography, University of Bayreuth,
95440 Bayreuth, Germany
e-mail: romankiewicz@mailbox.org; doevenspeck@uni-bayreuth.de

have risen since the 1960s and increased precipitation variability is predicted for the future (Boko et al. 2007). Moreover, the severe droughts of the 1970s and 1980s involved massive changes in vegetation patterns, thus rendering the African Sahel a hotspot of environmental degradation and desertification (Kandji et al. 2006). Assumptions of this kind, embedded in the highly politicised discourse on climate change, perpetuate the belief that there is a growing impact of climate factors on population movements (Piguet et al. 2011), especially in developing countries, leading to estimates of the future magnitude of climate-related population displacements. However, most scholars oppose such estimated numbers and refer to people being at risk of becoming displaced rather than depicting possible migration flows (see p. 8 in Black 2001). The *IPCC*'s 4th assessment report emphasises the importance of migration as one of the key options for adaptation to climate stress, as well as underlining that a variety of other factors may contribute to the decision to migrate (Boko et al. 2007). This complexity of migration points to fundamental shortcomings in much of the scientific and public discourse on the environment-migration nexus. This chapter contributes to the present volume's concern with context regarding the explanatory power of climate for changes within social systems. Accordingly, it seeks to re-contextualise assumed 'natural' drivers of migration processes in order to balance simplified assumptions of the relationship between climate, environment and migration.

In order to identify population movements that are affected by climate change, it is necessary to understand the linkages between environmental changes and migration, considering multiple levels of analysis and different temporal and spatial scales (Kniveton et al. 2008). Moreover, further challenges that arise in understanding the migration-environment nexus include the lack of a clear definition and use of controversially discussed terms such as 'environmental refugees'¹ or 'climate refugees,' the general scarcity of migration data, especially in developing countries (particularly longitudinal data), the lack of detailed knowledge about the impacts of climate change on environmental conditions (e.g. the evolution of local vegetation trends), and the failure to consider adaptive practices other than migration (cf. Adamo 2008; Bates 2002; Black 2001; Castles 2002; Renaud et al. 2007).

The simplified portrayal of environmental changes as root causes of migration has been contested by many scholars, both theoretically and empirically (de Haan et al. 2002; Findley 1994; Van der Geest et al. 2010; Henry et al. 2003; Piguet 2008; Doevenspeck 2011). Argumentation within the static push-pull framework has been further criticised for being too deterministic, since it suggests that migrants are being 'pushed' out of degraded areas, rather than allowing for the various other dimensions of human migration (Jónsson 2010). With the exception

¹Essam El-Hinnawi (1985, p. 4) defines environmental refugees as "those people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardized their existence and/or seriously affected the quality of their life. By 'environmental disruption' in this definition is meant any physical, chemical, and/or biological changes in the ecosystem (or resource base) that render it, temporarily or permanently, unsuitable to support human life."

of extreme events such as flight after natural disasters, “[it] thus seems analytically impossible to identify a migration stream as principally environmentally-induced” (see p. 51 in Doevenspeck 2011). Therefore, further research faces the challenge of balancing the multitude of factors shaping migratory patterns in the context of environmental change, in order to grasp the internal logics of migration dynamics (cf. p. 420 in Castles 2011). Similarly, changes of climatic conditions are unlikely to directly cause people to move, yet may produce environmental effects and exacerbate current vulnerabilities in a way that may render migration one possible strategy of adaptation.

Any attempt within the vast spectrum of approaches to understand the linkages between climate, environmental changes and migration also faces severe methodological challenges (cf. Piguet 2010). One major and general difficulty is to evaluate an isolated correlation between climate or environmental parameters and migration variables, considering the complexity of other contextual effects on migration processes. Ethnography applying thick description through observation, in-depth and biographical interviews with individual migrants can avoid some of the difficulties of other methods, given that it is a place-sensitive approach and provides an insight into social constructions of alleged ‘facts,’ such as environmental degradation and droughts, people’s perceptions and experiences (see Meze-Hausken 2000; McLeman and Smit 2006; Mortreux and Barnett 2009). However, there are three essential shortcomings related to conceptual flaws in interview techniques of ethnographic and quantitative (large-scale sample surveys) approaches. First, it must be recognised that research results are shaped by the way in which questions are formulated. Interviewees often undergo an intensive ‘problem-scanning’ with respect to their migration motives, economic situation and environmental changes. Second, it is difficult to avoid general narratives on climate, the environment and migration issues. Third and most fundamentally, a causal linkage between environmental changes and migration is often taken for granted in research designs and reflected in questions that directly ask for these linkages, thus leading to a perpetuation and reification of this narrative. This is problematic, since it is the researcher rather than the respondent who hints at causal connections. Mertz et al. (2009) suggest how ‘hinting at problems’ and causal linkages can bias research results, having conducted a study in rural Senegal to analyse people’s perception of climate change and their coping and adaptation strategies by applying household questionnaires and different types of interviews. To avoid biases, they only posed climate-related questions towards the end of the interviews. Indeed, none of the respondents identified climate factors among the five main positive or challenging aspects of their village life (not even within the category of agriculture). “Only when asked directly about climate issues did the group interviews largely corroborate the impacts identified in the household interviews, and they reiterated that rainfall variability during the rainy season is of major importance” (see p. 810 in Mertz et al. 2009). This example demonstrates that suggestive interviewing considerably influences responses and should thus be avoided when seeking to grasp the relevance of climatic conditions and the environment for rural households.

Given the conceptual shortcomings, this chapter will provide evidence of the complexity of the environment-migration nexus by discussing results from a research project on migration and local assessments of climatic and environmental changes in Mali and Senegal. As the Sahelian drylands are frequently presented as hotspots of climate change impacts (Hulme 2001) and the population is seen as very likely to become displaced by environmental degradation (IOM² 2009), two study areas in Senegal and Mali have been selected in order to understand how these assumptions translate at the local level. Macro data on climate is contrasted with findings on local people's assessments of changes in climate conditions and the environment (see also West et al. 2008) and contextualised with the identified patterns, dynamics, motives and people's notion of migration. Through this process, we are not evaluating the effects of climate trends in the study areas as outcomes of global climate change; rather, we argue in favour of assessing the relevance of various trends in climate variability and the importance of its different cultural, social and political dimensions by focusing on local people's representation, perception and interpretation of climate and environmental changes. Considering the conceptual and methodical difficulties of carving out the relevance of climate and environmental factors in migration decisions, this chapter puts forward a methodological approach that attempts to avoid suggestive causality between climate, environment and migration in the research design.

Following a presentation of the study regions and the methodological approach, we offer an analysis of current climate and vegetation trends and how people assess them locally. The second empirical part provides a historically informed analysis of the contemporary migration landscape, including patterns, motives and destinations, before the chapter concludes with some conceptual and methodological reflections on this approach to grasping the local dimensions of environment, climate and migration.

5.2 Study Regions

Research is conducted in the two study areas of Linguère, Senegal, and Bandiagara, Mali (see Fig. 5.1). Both regions belong to the semi-arid Sahel-Sudan region, yet differ in their socio-economic context as well as their cultural and historical migration background. While the Linguère area is part of a traditionally important pastoral zone, the drylands of Bandiagara are mainly farmland, although crop production is important in both study regions. In Linguère, many of the pastoralist families nowadays are sedentary and practise both the cultivation of land and livestock breeding. However, our study focuses on general patterns of people's mobility rather than the specific movements of herders with their cattle. The selection of the study regions was based on the criteria of high population mobility, peculiarity of environmental change and accessibility of the regions.

²International Organization for Migration.

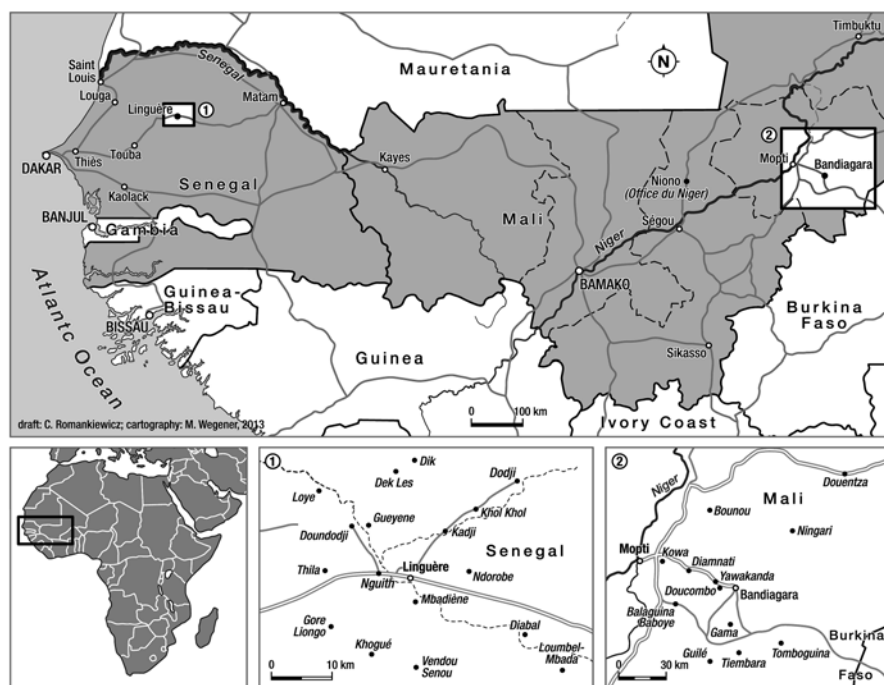


Fig. 5.1 Study regions and surveyed villages

The area around Linguère is situated in the northern part of Senegal in the region of Louga, department of Linguère (also known as the *Ferlo*) (Fig. 5.1). Around 80 % of the population lives in rural areas, with the Fulani and Wolof being the largest ethnic-linguistic groups (ANSD³ 2007). This agro-sylvo-pastoral area is sparsely populated (14 inhabitants per km² [inh./km²]), characterised by an average annual rainfall of 380 mm and dominated by open shrub and tree savanna and grasslands (Tappan et al. 2004). Economic activities concentrate on livestock breeding and crop production (mainly millet and groundnut). Relying on the most recent migration data available (ANSD 2008), Louga shows an overall migration deficit (ANSD 2007) with 18 % of Senegal's international migrants originating from this region in 2002, making it the third most important region in terms of migrant origins, after Dakar and Thiès (see p. 230 in DPS⁴ 2004).

In 2009, the Mopti region in Mali had two million inhabitants and a population density of 25 inh./km² (INSTAT⁵ 2009). Research concentrates on the Dogon plateau and the Séno plain near the town of Bandiagara, a dryland zone characterised by an annual precipitation of around 600 mm and open shrub and

³ Agence Nationale de la Statistique et de la Démographie.

⁴ Direction de la Prévision et de la Statistique.

⁵ Institut National de la Statistique.

tree savanna. Rainfed agriculture and to a certain extent vegetable gardening are the main economic activities (MEA⁶ 2009). Dogon and to a much lesser extent Fulani are the predominant ethno-linguistic groups. In the early-1990s, the region's migration deficit for both international and internal movements was among the highest in the country (Bocquier and Diarra 1999). Data from a 2005 survey reveal that 61 % of the interviewed households in the Mopti region mentioned one or more migrating members (WFP⁷ 2006), thus indicating a long tradition of labour migration (Sieveking and Fauser 2009). Besides migration to Bamako (31 %) and other African countries (28 %), rural areas and villages (23 %) are also important destinations for migrants from the Mopti region (WFP 2006; Merabet and Gendreau 2007).

5.3 Methodological Approach

Given the flaws of the different approaches described above, we developed a multi-method and multi-level research design without asking respondents explicit questions about the linkages between environment, climate and migration, let alone asking directly whether climatic and environmental changes cause migration. As already pointed out, such direct questions by researchers tend to trigger answers that refer to master narratives of environmental migration and provide the respondents the opportunity to avoid elaborating on the subtle and complex social and political undercurrents that relate to migration. Moreover, we attempted to separate research on climate and vegetation trends from the migration issues by conducting the respective fieldwork at different times. During the conversations, we tried to avoid making direct causal links between environmental and climatic factors and migration motives, allowing only the people themselves to establish such potential links.

While the identification of the study areas essentially followed the idea of ecological inference (high emigration rates and noticeable trends in vegetation cover of a certain area), ethnography helped to identify migration dynamics and motives, as well as grasping assessments of climatic and environmental changes at the local level. Our fieldwork could be best described as a multi-sited ethnography (see p. 106 in Marcus 1995) following migration networks to multiple places in the area of origin and the target regions of migration, which of course have to be understood as potential places of departure for new migration. This approach is motivated by the aim to avoid the sedentary bias inherent in migration research in Africa (see also Verne and Doevenspeck 2012). We conceptualise movement “as constitutive for economic, social and political relations” (see p. 43 in Urry 2007) and mobility as an integral part of human life and not as a problem *per se*, regardless of the place where this life is lived (see also Sheller and Urry 2006; Büscher and Urry 2009).

⁶ *Ministère de l'Environnement et de l'Assainissement.*

⁷ *World Food Programme.*

We conducted fieldwork during 9 months in 2011 and 2012 and used semi-structured and narrative interviews to understand the village's history, directions and amplitudes of and motives for migration, as well as local meanings of these movements. Additionally, we collected biographies of migrants and identified migration networks. On this basis, contacts with migrating family members at various places were established by telephone or via the internet, leading to interviews in Bamako and Dakar, as well as France and Spain. Working with migrants from the study area at their current residence offered valuable insights into migration networks, given that speaking to migrants outside the social structure of their home village seems to produce less biased and more explicit statements regarding their migration decisions. We used also interviews for the study of the assessment of changes in climate and environmental conditions, addressing both the state of and perceived changes of temperature, rainfall and wind, soil fertility, woody cover, biodiversity, capacities of pasture and crop yields (see Mertz et al. 2010; Roncoli 2006). We conducted the respective interviews with the same people who had already provided insights into migration, or, in case we were unable to encounter them again, referred to members of the same household or family from the same village. Village elders provided valuable information regarding pre-drought conditions and long-term changes in natural resource and farm-management. Additionally, we conducted transect walks and site visits with individual villagers in the surroundings of settlements. Attention was paid to people's interpretations and explanations of already mentioned and visible changes in vegetation cover, the availability and exploitation of woody resources, soil fertility, crop yields and degradation phenomena. Accordingly, we took these impressions and information into account in later interviews in the respective villages. With the help of a village questionnaire, elders identified trends in the tree species composition of the past 50 years (see for example Gonzalez 2001).

5.4 Changes in Climate and Environment: Local Representations of "Facts"

While the Sahelian region has always been characterised by high climate variability, there is much uncertainty in climate trends and forecasts produced by the different climate models on smaller spatial levels for the West African Sahel (Boko et al. 2007; Kandji et al. 2006; Hulme 2001). When looking at environmental changes in terms of vegetation trends, it may be considered that not only climate (rainfall in particular) but also human factors contribute to long-term changes in the natural environment (Herrmann et al. 2005). Nevertheless, what is experienced, assessed and communicated by the population is the variability of weather and changes in vegetation cover at the local level. Depending on the available data, we operationalise climate as temperature and rainfall (cf. Gbetibouo 2009; Mengistu 2011) and examine the environment through the indicators of woody vegetation coverage and diversity, which can be considered as important measures of environmental

degradation (cf. p. 73 in Bilsborrow 2002; p. 113 f. in Massey et al. 2010).⁸ In the following section, data on temperature, precipitation and vegetation change in the study regions are contrasted with local people's assessments and explanations. Following Hulme (2008), climate can only be understood and must be re-examined as a manifestation of both nature and culture, which implies that

its physical dimensions are allowed to be interpreted by their cultural meanings [...] [and] that discourses about global climate change have to be re-invented as discourses about local weather and about the relationships between weather and local physical objects and cultural practices (ibid. p. 6).

5.4.1 Temperature

According to data collected from meteorological stations, an increase in the mean annual temperature can be observed for the western Sahel⁹ since the 1960s (see Fig. 5.2). Boko et al. (2007) state that there is a rising number of warm spells and a decrease in extremely cold days for the period 1961–2000 in West Africa. Peaks in high mean annual temperatures in the past two decades have been registered for

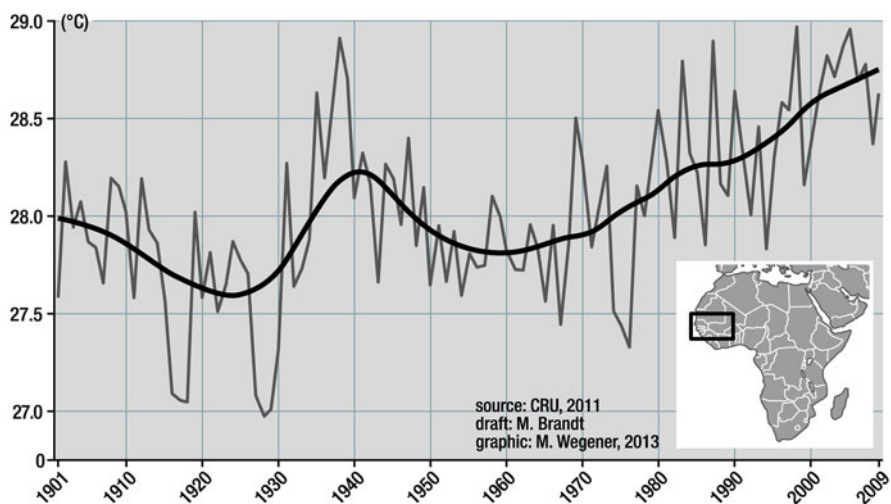


Fig. 5.2 Average annual temperature in Western Sahel (1901–2009) (CRU (Climate Research Unit), data after Mitchell and Jones (2005))

⁸The development of soil fertility has been considered in ethnographic research yet is not explicitly integrated here because there are no ‘hard’ data on soil quality that could be compared with people’s statements.

⁹Data from *Climate Research Unit* (CRU) 2011 (see Mitchell and Jones 2005). Here, temperatures changes are considered for the Western Sahel and not on the level of the study regions, since available temperature data has been interpolated for larger areas between meteorological stations, and because temperature trends do not show significant differences within the region.

1998 and 2005. Beyond rainfall, rising average temperatures essentially account for reduced soil moisture and tree cover changes (Gonzalez et al. 2012). By determining physiological processes, changes and extremes of temperature may negatively affect crop and livestock production (Stabinsky 2011).

Villagers in both study areas expressed diverse opinions on temperature trends, providing a variety of interpretations. In contrast to the findings from five West African countries of Maddison (2007), stating that significant numbers of farmers perceived increasing temperatures, most of the elders in our study areas agreed that it used to be hotter in the past.¹⁰ A couple of interviewees in Senegal independently recalled a phenomenon in the 1960s when birds, paralysed by the heat and unable to fly, came towards their houses and even into their rooms in search of cooling. Today, some said that suffering from the cold is worse than before, while others claimed that the ‘coldness improved’ and that it is getting warmer. Only a few people could not identify a general trend in temperature change, suggesting instead that hotter and colder years or periods have always alternated.¹¹ People’s assessment of temperature change is clearly influenced by their personal experience of seasonal heat waves or cold waves; moreover, even the availability of warm clothing and a blanket can have an impact on a person’s views. In general, interpretations of temperature variations were directly or indirectly related to rainfall: the more it rained in the past rainy season, the less intense the heat, people explained. Leaf growth, cloudiness, wind direction and the existence of seasonal water bodies were said to affect the intensity of the heat during the dry season. It also seems that the perceived severity of high temperatures in the past has been reduced by the increased availability of water sources such as boreholes, wells, artificial waterholes and dams, compared to the period before the 1970s drought.

Interestingly, few of the interviewees perceived the rise in temperatures that has actually been recorded for the region, with most of them reporting decreasing temperatures. Given that abundant rainfall was said to reduce the heat, one potential explanation could be that the increasing amounts of precipitation in recent years (see next section) have significantly influenced this perception. Similarly, Roncoli et al. (2003) report on the influence of the intensity and duration of rainfall on farmers’ perceptions of dry season temperatures in Burkina Faso. Accordingly, narrations of rising temperatures evidently coincide with perceived decreasing precipitation (cf. Maddison 2007).

5.4.2 *Precipitation*

The Linguère region is clearly drier than Bandiagara, as reflected by a difference in annual rainfall of up to 200 mm (Fig. 5.3). While both study regions experienced several severe droughts during the twentieth century, the 1970s and 1980s droughts

¹⁰ Various interviews in Kadji, Khogué (Senegal) and Kowa, Doucombo (Mali), February–April 2011.

¹¹ Interviews in Loumbel Mbada (Senegal) and Yawakanda (Mali), March–April 2011.

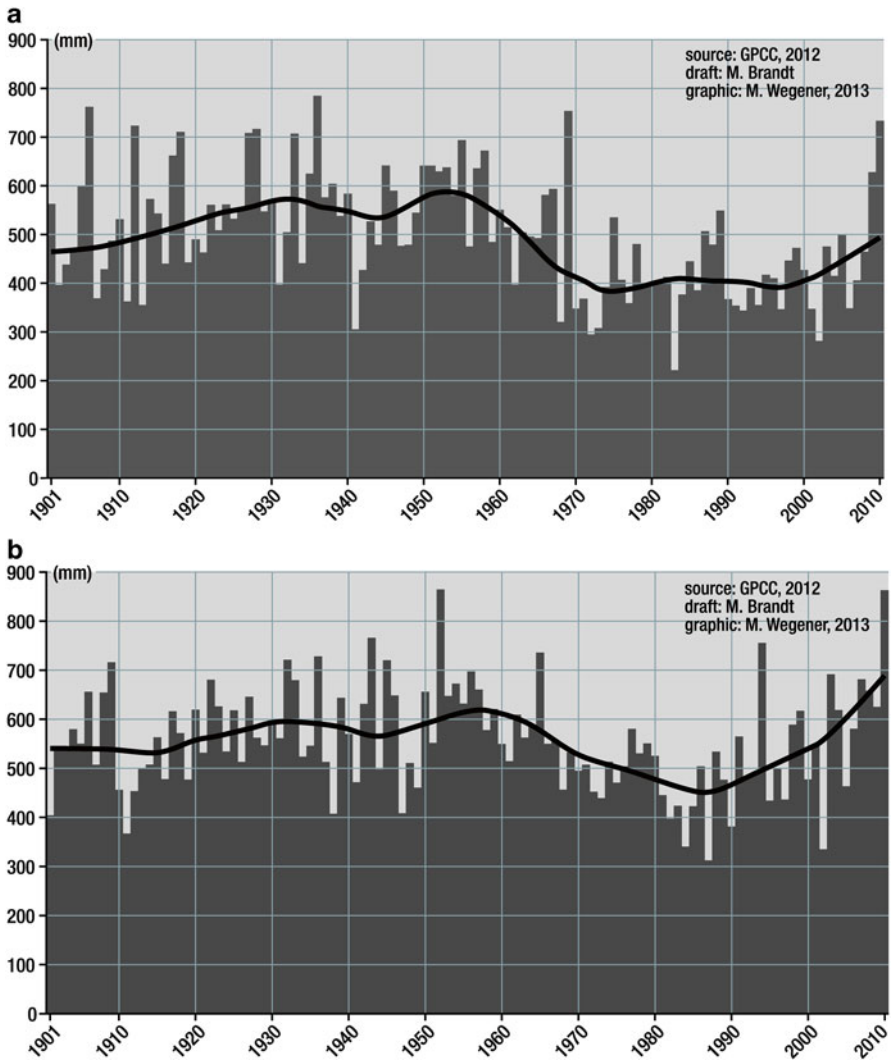


Fig. 5.3 Average annual precipitation in Linguère (**a**) and Bandiagara (**b**) (1901–2010) (GPCC (Global Precipitation Climatology Centre), data after Schneider et al. (2014)). The precipitation diagrams are given for the study areas of Linguère and Bandiagara, marked in Fig. 5.1)

coincided with a long-lasting drop in the annual precipitation level. In Linguère, for example, this rainfall decline was almost 30 %. While rising precipitation has been recorded for the past two decades in Bandiagara, almost reaching pre-drought levels, Linguère’s rainfall has shown a slight increase since 1998. In 2009 and 2010, Bandiagara and Linguère had very abundant rains that locally even reached record

values.¹² Nevertheless, the apparent gain in mean values goes in hand with the increased variability and unpredictability of rainfall (cf. MEA 2009). In 2011, annual precipitation in both study areas did not exceed average amounts.¹³

The interviewed village elders confirmed that rainfall today is lower compared to the period prior to the drought in the 1970s. Generally, people seem to have a good memory of the severe droughts in the 1970s and 1980s. However, it must be noted that there are differences between villages within the same study area, and respondents did not feel equally affected. In both study regions, the informants indicated an upward trend in precipitation in the past 5 years, describing the rainfalls of 2009 and 2010 as the most abundant for a long time. Accordingly, rainfall in 2011 was clearly evaluated as being low. However, assessments of the harvests during the past years do not reveal a uniform picture. In both Linguère and Bandiagara, some villages apparently benefitted from good and very good harvests in 2009 and 2010, with people reporting increased numbers of young people reengaged in agriculture. In other places, most people stressed that the distribution of rainfall was of much greater importance¹⁴ than its total annual amount. Missing breaks between rainfalls, floods after heavy rains, persisting moisture on the fields and delayed, altogether lacking or too little rainfall during certain periods of plant growth mean that the harvest in 2010 was even lower than in 2011 for some households.

While the remarkable increase in precipitation over the past few years was confirmed in both Bandiagara and Linguère, the local people assessed its impacts within the study areas very differently. Moreover, the interviewees also mentioned other factors determining yields, such as the access to seeds, pesticides and fertiliser, as well as their appropriate application, generally decreasing soil fertility and lack of agricultural land, equipment and labour force.¹⁵ These first results show that the total amount of precipitation can only reflect a modest indicator of a 'good' rainy season and does not necessarily translate into better harvests and increasing food security for everyone. Moreover, it is essential to consider the cultural dimension of people's representation of climate (Hulme 2008; Peterson and Broad 2009). Therefore, Roncoli argues "an inquiry into the cultural meaning that underlies farmers' understandings of climate, both its ordinary and abnormal manifestations, is a necessary first step in climate application studies" (2006, p. 84). Important aspects that can deepen insights into assessments of climate include examining local terminologies and calendars for the different seasons (Orlove et al. 2004), or the exploration of local classifications and types of rainfall (Roncoli et al. 2002). Our respondents in both countries highlighted the impact of the timing and distribution of rainfall, which shows that "unlike scientists, these farmers think about rainfall as a process rather than as a quantity" (see p. 84 in

¹²For example, more than 720 mm for Linguère in 2010 (interview at meteorological station in Linguère, March 2011).

¹³Satellite data from *Tropical Rainfall Measuring Mission (TRMM)* (see Huffman et al. 2007).

¹⁴Interviews in e.g. Kadji in Senegal, Yawakanda and Kowa in Mali, 2011 and 2012.

¹⁵Various interviews in Kadji, Khogué (Senegal) and Doucombo, Yawakanda, Tiembara, Bamako (Mali), 2011 and 2012.

Roncoli 2006). Given that a multitude of factors besides rainfall have an effect on yields, it is clear that climate can only be of limited explanatory power with respect to people's vulnerability (Mertz et al. 2009).

5.4.3 *Vegetation*

Since the mid-1980s, remote sensing has detected a greening trend in large parts of the African Sahel, contesting the notion of widespread degradation (Anyamba and Tucker 2005; Olsson et al. 2005). Moreover, rainfall seems to be only one of the important causative factors for this recovery from the great droughts (Herrmann et al. 2005). While the data on local vegetation changes available for our two study sites does not provide conclusive explanations regarding the contribution of climate factors, it does provide an idea of general regional vegetation and land use trends over the past 50 years.

Linguère is located in the transitional zone of three ecological regions with different soil and vegetation characteristics (see Tappan et al. 2004). Depending on the soil type (e.g. deep sandy soils or shallow loamy and gravelly soils over laterite), there are considerable local differences in the agricultural potential as well as the mortality of woody plants (*ibid.*; see also Vincke et al. 2010). Generally, the trends indicate a significant expansion of cropping land and a moderate loss of woody cover since 1965, but a relative stability since 1983. In Bandiagara, two major zones can be distinguished, with the Dogon plateau characterised by rocky soils and the Séno plain by deep sandy soils. Significant losses of tree cover have been detected in the region during the past 40 years, albeit with considerable divergence in different areas (MEA 2009). Another study focusing particularly on Bandiagara describes the enormous encroachment of rain-fed agriculture and associated disappearance of natural woodlands for the same period, yet highlighting the recent success of governmental and villagers' efforts to preserve woody plants within agricultural lands (Yossi and Diakité 2008).

Regarding long-term changes in vegetation cover, local populations in both study areas report a tremendous decrease of woodlands since the beginning of the 1970s. For example, elders in Mali told us about dense forests during the time of their childhood. The interviewees related the disappearance of tree cover to the persistent water scarcity during the great droughts on the one hand, and extensive deforestation during that period to compensate for harvest losses by selling wood on the other.¹⁶ A major change observed by the people is a decrease in the diversity of tree species: "Today you have to walk long distances to find certain medical plants and trees, some of them have completely disappeared."¹⁷ Trees within agricultural fields are preserved by the villagers themselves and appear to be crucial for them: "Where there are more trees, there is also more rainfall. Everyone wants to have trees on his

¹⁶Various interviews in Khogué, Loumbel Mbada (Senegal) and Kowa, Yawakanda, Doucombo, Diamnati, Tiembara (Mali), 2011 and 2012.

¹⁷Informants in Kowa, Tiembara (Mali), 2011 and 2012.

fields, because it increases soil fertility and one gets a better harvest.”¹⁸ In both countries, people evaluated soil fertility as having decreased during the past 50 years, which they do not associate with a deficiency of trees but rather with shortened or even no fallow periods as a result of insufficient cultivable land.

These local assessments of vegetation change in the study areas reveal that, despite the enormous decline of woodlands since the great droughts and increasing preservation efforts being confirmed by the local populations, there seems to be a discrepancy in the evaluation of recent vegetation trends, attesting a general greening and relative stability of woody plants. Interestingly, none of the interviewees highlighted a stability or increase of trees in the study regions; rather, they emphasised the lack of trees, high population pressure on woody plants, as well as official restrictions and penalties related to woodcutting. This is in line with the findings of Mertz et al. (2009, p. 810) in Senegal, where people perceive a degradation of vegetation and do not relate it to climate but mainly to abusive use and population growth. Even if the woody vegetation is recovering in our study regions, cutting firewood is restricted to certain areas, requires a costly official permission and therefore remains a source of conflict and concern to many people, which thus might influence their personal assessment of vegetation trends.

In this section we have discussed contemporary tendencies regarding climate conditions and vegetation trends in the two study areas, providing interpretations of these trends by the local population. Even though detailed information on smaller spatial scales is not available yet, data from meteorological observation¹⁹ and field research in the region generally point to positive trends towards more precipitation and a relative stability of vegetation cover (Tappan et al. 2004; Yossi and Diakité 2008). While people’s observations of the past profound changes in rainfall and vegetation correspond to recorded data, their assessments of current trends do not draw a uniform picture and seem to be influenced by the diverse impacts these trends may have. People interpret and feel affected by the changes very differently, and name a variety of non-climate factors on which their food security and livelihoods depend. Harvest output is a result of an interplay of parameters that goes beyond rainfall and the diversification of income generating activities essentially contributes to people’s livelihoods. It is clear that annual temperature, annual rainfall or overall vegetation cover are not adequate and sufficient parameters for making judgments with regard to the impact of climate on people’s lives on a local level.

5.5 Hoe and Mobile Phone: Local Migration Dynamics

The high mobility of people in the study areas has a long tradition and must be regarded in the historical context of West African migration dynamics (see de Haas 2007; Merabet and Gendreau 2007). Contemporary migration patterns in West

¹⁸ Interviews in Kowa, Diamnati (Mali), 2011 and 2012.

¹⁹ Data from *Global Precipitation Climatology Centre (GPCC)*.

Africa are shaped by colonial influence. The introduction of taxes and the high labour demand in coffee, cacao and groundnut plantations, mines or for large infrastructural projects have led to the development of a rural-rural and rural-urban circular labour migration pattern that is mainly directed from landlocked countries such as Niger, Burkina Faso and Mali towards the coastal regions of Senegal, Ivory Coast, Ghana and Nigeria (Bakewell and de Haas 2007). Fast-growing urban centres and especially harbour towns such as Accra, Lagos, Abidjan, Lomé, Dakar and Cotonou have emerged as important economic points of attraction for job-seeking migrants. Environmental and climatic conditions have always contributed to shaping the causal, temporal and spatial dimensions of human migration in the region. For example, a north-south rainfall gradient implies that regions in the south generally have more favourable conditions for crop production, thus supporting a north-south-directed agricultural and labour migration. Moreover, annual transhumant movements performed by Fulani pastoralists or the dry-season migration practised by sedentary, agriculturalist rural households are well-known migration strategies of adaptation to the effects of seasonality of rainfall and periodic droughts characteristic to the West African Sahel (see p. 451 in McLeman and Hunter 2010).

5.5.1 *Migration in Bandiagara*

Our results confirm that Bamako and the Ivory Coast are primary destinations for migrants from Bandiagara; moreover, apart from a few exceptions, international migration beyond Africa seems to be of lesser importance. Bamako has become an increasingly important destination thanks to rising job opportunities,²⁰ particularly in the informal sector.²¹ Much migration from Bandiagara appears to be temporary and circular, both within Mali and abroad. In most of the villages, a tendency towards the longer absence (temporary) or intensified emigration (permanent) of young people, especially to Bamako, is associated with an increasing literacy rate and the lack of institutions of higher education or relevant employment opportunities.²² As with many other ethnic groups in West Africa, migration as a “rite de passage” to adulthood is also an integral part of the Dogon people’s culture in Bandiagara, whereby virtually all young men temporarily leave their village to “go on adventure” (Dougnon 2007; see p. 62 in Doevenspeck 2005): “It’s the chat. If you didn’t travel, you have nothing to tell. [...] Besides, you feel less annoyed because you have experienced many things.”²³ Usually, who is allowed to migrate and for how long is negotiated within the household, in order to keep at least a mini-

²⁰ Especially due to the growth of the construction, telecommunications, service and petty trade sectors (Kilroy 2008; OECD 2008).

²¹ Various interviews with migrants in Bamako in 2011 and 2012 showed that they are self-employed or engaged in informal economic activities.

²² Various Interviews in Doucombo, Yawakanda, Kowa and Bamako in 2011 and 2012.

²³ Interview in Kowa, April 2011.

num of manpower at home. Young people repeatedly mentioned the lack of income opportunities in their rural home as a migration motive. For many interviewees, paying taxes, purchasing animals or farming equipment, a mobile phone or a motorbike are important objectives that can be realised through migration.²⁴

The only connection between environmental and climatic factors and migration that the people established themselves was through describing an increase of seasonal labour migrants as one of their strategies to compensate for insufficient harvests caused by 'bad' rainfall (see Sect. 5.4.2). However, as Findley (1994) has shown for the drought from 1983 to 1985, short-distance, temporary migration as a response to variations in the rainfall regime of the region is not new. Even though dry-season migration is still more important, the seasonal circular movements seem to take on increasingly heterogeneous temporary patterns, with people commuting at all times of the year.²⁵ Depending on the individual situation, they may return to the home village for less than 3 months per year, or stay away for several years and only pay short visits to the village for family events or whenever important community affairs have to be settled.²⁶ Interviewees reported that migrants' remittances play an important role regarding food security, especially for poorer households, since yields are insufficient to supply the families throughout the year. However, interviews in Bandiagara revealed that harvests crucially depend on a multitude of other factors in addition to rain, including the specific location of fields, crop diversification and the degree of mechanisation. At this point, it is important to note that temporary migration is only one of various income generating activities mentioned, along with petty trade, vegetable gardening, selling animals, wild fruits and plant leaves as animal feed, or selling wood and charcoal. In a sense, all these activities can be regarded as adaptation strategies both to climate variability and economic hardship.

5.5.2 *Migration in Linguère*

Results show that mobility patterns in the area of Linguère are principally characterised by internal migration towards the cities and international migration towards Europe. By far the most prominent destination among the urban centres is Dakar. Even though repetitive temporary movements persist at present, young people nowadays seek to settle down permanently in the city. The most frequently cited motives for migrating to the urban centre were the same as in Bandiagara, namely education and proper employment and income opportunities.²⁷ One interviewee explained that

²⁴ Various interviews in Nianangali, Kowa, Yawakanda, Doucombo, Balaguina Baboye, Bamako, 2011 and 2012.

²⁵ One reason is that there is less competition between migrants for work in Bamako during the rainy season (interviews in Bamako in 2012).

²⁶ Interviews in Kowa, Diamnati, Tiembara and Bamako in 2011 and 2012.

²⁷ Interviews in Khogué, Kadji, Linguère town, Nguith, March 2011 and Dakar, February 2012.

anyone who finds a permanent job in town does not return to the village easily. A further reason is surely that movements from Linguère to the cities have persisted since colonial times, thus strengthening migration networks over a long period, which again perpetuates migration to this day.²⁸ Elders with their own migration experience emphasised the ‘bright-light effect’ of the big city: “Those people who are doing agriculture and think that agriculture is good and sufficient don’t know anything and haven’t seen the big cities. [...] They haven’t seen much in their life.”²⁹ Although people in Linguère critically evaluate the emigration of young people by hinting at the subsequent increased workload on the farms for their elders, they also appreciate the importance of education and the positive effects of young people’s migrations, as well as the importance of remittances, with typical statements including: “If you abandon school, you abandon your family”³⁰ or “Someone who lives in the city and sends money is closer to the family than someone who stays at home without means.”³¹

Interviewees also made statements concerning environmental and climatic aspects in connection with migration. For instance, one migrant from Nguith in Dakar said that the formerly seasonal migration from his village to Dakar began to take on a permanent character following the onset of the droughts at the beginning of the 1970s, owing to decreasing yields. The community’s specialisation in basket making in Dakar permitted them to become increasingly independent from harvest output in the village. The chiefs of the villages of Kadji and Khogué specified that some young people were returning to their villages and becoming reengaged in farming at the time of the investigation, due to the particularly abundant rainfalls in 2009 and 2010.³² Even though the detailed circumstances remain unknown, it can certainly be assumed that they did not have a permanent and rewarding income in Dakar and might have returned to the capital in 2011. Another farmer from Linguère, when first interviewed in 2011, emphasised his profitable engagement in agriculture. In 2012, he was encountered in Dakar, explaining that he had decided to abandon the last cropping period following a bad onset of rainfall in 2011. Thanks to family contacts and his migration experience in Dakar, he had secured work assisting a cousin in his mobile phone shop. Such examples highlight that fluctuations in the amount and timing of rainfall are contributing factors in decisions for temporary internal movements, which are less regarded as a problem but rather a usual mode of living in a very mobile and multi-local social environment under variable climatic conditions. However, our data indicate that migration to Europe does not seem to have a causal relation to climate or environmental factors (cf. Jónsson 2010).

²⁸ This became evident by considering the large and still increasing community of migrants from Nguith in Dakar, April 2011, February 2012.

²⁹ Chef de village in Khogué and Kadji, March 2011.

³⁰ Interview with wife of chef de village in Khogué, March 2011.

³¹ Informant in Khogué, March 2011.

³² Interview with chef de village in Khogué, March 2011.

The contemporary migration landscape is still largely shaped by historically established patterns, with most population movements taking place within the country or region. A common, albeit not new phenomenon in both societies is the trend towards increasing emigration to the cities, and capitals in particular, which people do not primarily associate with climate and environmental factors. Dry-season migration is a well-known and important strategy of adaptation to the annual variability of climatic conditions of the region. However, there are also increasingly complex and ambiguous temporal patterns of circular migration. As shown by the remarks made in some of the interviews, the variability of precipitation (for instance, the drought of the 1970s or the varying patterns of rainfall in recent years) affects migration dynamics to a certain extent. Moreover, it also became evident that in this case migration is not the only adaptation strategy and that there can be enormous differences in the migration dynamics of different villages. The motives behind migration decisions are very complex and multi-layered, even if some respondents directly mentioned aspects of rainfall trends when explaining migration decisions.

5.6 Bringing People and Places Back in: Local Insights in Climate, Environment and Migration

In this chapter, we have adopted a local perspective to explore the relationship between climate, environment and migration in two regions of Mali and Senegal where population mobility is high and processes of environmental degradation are said to increase people's vulnerability. We have shown that seasonal and temporary migration patterns in Bandiagara and Linguère have been traditionally adapted to climatic conditions, long before the international debate on the consequences of global climate change started. Migration in this sense is a well-established strategy to adapt to seasonality and variability of rainfall (Findley 1994; de Haan et al. 2002), but likewise must be regarded as an adaptation to processes of economic, social and cultural change. This places the focus of this volume's discussion on the multiple dimensions of local contexts in which climatic and environmental change and population movements occur. Empirically, two preliminary conclusions can be drawn from our results. Local climate variability continues to impact migration, especially the magnitude of seasonal movements, although it seems that the same climate trends do not result in the same migration responses. For example, increased rainfall in 2009 and 2010 contributed to the return of migrants to Linguère, whereas by contrast, negative impacts of the higher rainfall on harvests have played a part in increased numbers of seasonal migrants in Bandiagara. However, it is evident that the contemporary migration landscape is very much shaped by historically established mobility patterns and networks. In this respect, education and income opportunities in urban centres, 'going on an adventure' and returning to the village with a mobile phone or a motorbike for prestige reasons reflect widespread migration motives. The destination and length of migration heavily depend on the migrant's assets, thus rendering migration a

socially differentiated and selective process that does not provide a homogeneous image of patterns, destinations, objectives and motives.

Complex migration patterns are embedded in an environment that, when looking at quantitative representations of rainfall and vegetation trends on a larger scale, seems to be undergoing continuous recovery from the effects of the great Sahelian droughts of the past century. However, by considering the cultural dimension of climate, people's assessments show that the timing and distribution of rainfall, or even the number of trees in the field, may be more essential than increasing mean annual precipitation. People in different places feel differently affected by recent changes in climate conditions, further stating that climate is only one of many factors that affect their livelihoods.

It must be recalled that the conceptual constraints in approaching the complexity of the environment-migration nexus imply methodological difficulties. During research, it became evident that a clear distinction between cognitive perception and people's own assessment of climate and environmental parameters is hardly possible. The answers provided by the respondents are highly biased by the impacts of climate and vegetation changes on their individual situation. Cultural aspects, experiences and concerns all impact local assessments of climate and environment (see also Roncoli 2006). Therefore, this chapter proposes an approach that conceptually and methodically separates the two research topics of migration and climate/environment. Separate research on local interpretations of climate and environmental changes allows us to deepen our comprehension of their cultural meanings and relevance for people's daily lives, rather than targeting climate variability and environmental degradation as a problem *per se* that requires migration as an answer. This approach is complemented by the inclusion of migrants at their current place of residence abroad, in an attempt to grasp mobility as a normality, a routinised practice of everyday life, as opposed to considering it as a mere coping strategy, a reaction to a concrete threat in the area of origin.

In this respect, the present study contributes to the current debate on climate and environment as drivers of migration in the West African Sahel by presenting both a local representation of migration and a local assessment of climate and environment. Considering the local level empirically and contrasting climate trends and environmental changes in the study regions with assessments by local people allows comparison with similar approaches (see Mertz et al. 2009; West et al. 2008; Maddison 2007). The multi-sited approach of presenting local people's views on migration from the study areas can provide information concerning migration motives and helps to show that contemporary mobility must not be regarded predominantly as an adaptation strategy in the face of environmental or climate stress. Given this complex framework of mobility and local assessment of climate and vegetation trends in the study areas, it becomes evident that, as discussed above, concepts adopting a disentangled view on climate as the main driver of population movements are misleading. Rather, it is important to develop a deeper understanding of local meanings of environmental change and migration in the context of multiple social, political and economic processes of change in order to understand if, how and to what extent certain climate and vegetation trends play a role for what kind of migration.

References

- Adamo, S. B. (2008, August 18–29). *Addressing environmentally induced population displacements: A delicate task*. Background paper for the population-environment research network cyberseminar “environmentally induced population displacements”. www.populationenvironmentresearch.org. Accessed 25 Nov 2013.
- Ammassari, S., & Black, R. (2001). *Harnessing the potential of migration and return to promote development—Applying concepts to West Africa* (IOM migration research series, 5). Geneva: International Organisation for Migration (IOM).
- ANSD. (2007). *Situation Economique et Sociale de la Région de Louga. Année 2006*. Louga: Service Régional de la Statistique et de la Démographie de Louga. http://www.ansd.sn/publications/annuelles/SES_Region/SES_Louga_2006.pdf. Accessed 25 Nov 2013.
- ANSD. (2008, June). *RGPH III – Résultats Définitifs du Troisième Recensement Général de la Population et de l'Habitat (RGPH III) – (2002)*. Rapport National de Présentation. Agence Nationale de la Statistique et de la Démographie, Ministère de l'Economie et des Finances. http://www.ansd.sn/publications/rapports_enquetes_etudes/enquetes/RGPH3_RAP_NAT.pdf. Accessed 25 Nov 2013.
- Anyamba, A., & Tucker, C. J. (2005). Analysis of Sahelian vegetation dynamics using NOAA-AVHRR NDVI data from 1981–2003. *Journal of Arid Environments*, 63, 596–614.
- Bakewell, O., & de Haas, H. (2007). African migrations: Continuities, discontinuities and recent transformations. In P. Chabal, U. Engel, & L. de Haan (Eds.), *African alternatives* (pp. 95–118). Leiden: Brill.
- Bates, D. C. (2002). Environmental refugees? Classifying human migrations caused by environmental change. *Population and Environment*, 23(5), 465–477.
- Bilsborrow, R. E. (2002). Migration, population change, and the rural environment. *Environmental Change and Security Project Report*, 8, 69–94.
- Black, R. (2001). Environmental refugees: Myth or reality? *New issues in refugee research* (Working Paper No. 34). Geneva: UNHCR.
- Bocquier, P., & Diarra, T. (1999). Migration internes et internationales. In P. Bocquier & T. Diarra (Eds.), *Population et Société au Mali* (pp. 63–74). Paris: L'Harmattan.
- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., & Yanda, P. (2007). Africa. In IPCC [M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson] (Eds.), *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change* (pp. 433–467). Cambridge: Cambridge University Press.
- Büscher, M., & Urry, J. (2009). Mobile methods and the empirical. *European Journal of Social Theory*, 12(1), 99–116.
- Castles, S. (2002). Environmental change and forced migration: Making sense of the debate. *New issues in refugee research* (Working Paper No. 70). Geneva: UNHCR.
- Castles, S. (2011). Concluding remarks on the climate change-migration nexus. In É. Piguet, A. Pécout, & P. de Guchtenaire (Eds.), *Migration and climate change* (pp. 415–427). Paris/Cambridge: Cambridge University Press – Editions de l'UNESCO.
- De Haan, A., Brock, K., & Coulibaly, N. (2002). Migration, livelihoods and institutions: Contrasting patterns of migration in Mali. *Journal of Development Studies*, 5, 37–58.
- De Haas, H. (2007). *The myth of invasion—Irregular migration from West Africa to the Maghreb and the European Union* (Research report). Oxford: International Migration Institute, University of Oxford.
- Doevenspeck, M. (2005). *Migration im ländlichen Benin—Sozialgeographische Untersuchungen an einer afrikanischen Frontier* (Freiburger Studien zur Geographischen Entwicklungsforschung, 30). Saarbrücken: Verlag für Entwicklungspolitik.
- Doevenspeck, M. (2011). The thin line between choice and flight: Environment and migration in rural Benin. *International Migration*, 49(1), 50–68.
- Dougnon, I. (2007). *Travail de Blanc, travail de Noir—La migration des paysans dogon vers l'Office du Niger et au Ghana (1910–1980)*. Paris/Amsterdam: Karthala/Sephis.

- DPS. (2004). *Rapport de synthèse de la deuxième enquête Sénégalaise auprès des ménages (ESAM-II)*. Direction de la Prévision et de la Statistique (DPS), Ministère de l'Economie et des Finances. http://www.ansd.sn/publications/rapports_enquetes_etudes/enquetes/ESAM_2.pdf. Accessed 25 Nov 2013.
- El-Hinnawi, E. (1985). *Environmental refugees*. Nairobi: United Nations Environmental Programme.
- Findley, S. E. (1994). Does drought increase migration? A study of migration from rural Mali during the 1983–85 drought. *International Migration Review*, 28(3), 539–553.
- Gbetibouo, G. A. (2009). *Understanding farmers' perceptions and adaptations to climate change and variability, the case of the Limpopo Basin, South Africa*. Washington/Addis Ababa/New Delhi: International Food Policy Research Institute (IFPRI), Environment and Production Technology Division.
- Gonzalez, P. (2001). Desertification and a shift of forest species in the West African Sahel. *Climate Research*, 17, 217–228.
- Gonzalez, P., Tucker, C. J., & Sy, H. (2012). Tree density and species decline in the African Sahel attributable to climate. *Journal of Arid Environments*, 78, 55–64.
- Henry, S., Boyle, P., & Lambin, E. F. (2003). Modelling inter-provincial migration in Burkina Faso, West Africa: The role of socio- demographic and environmental factors. *Applied Geography*, 23, 115–136.
- Herrmann, S. M., Anyamba, A., & Tucker, C. J. (2005). Recent trends in vegetation dynamics in the African Sahel and their relationship to climate. *Global Environmental Change*, 15, 394–404.
- Huffman, G. J., Adler, R. F., Bolvin, D. T., Gu, G., Nelkin, E. J., Bowman, K. P., Hong, Y., Stocker, E. F., & Wolff, D. B. (2007). The TRMM multisatellite precipitation analysis (TMPA): Quasi-global, multiyear, combined-sensor precipitation estimates at fine scales. *Journal of Hydrometeorology*, 8, 38–55.
- Hulme, M. (2001). Climatic perspectives on Sahelian desiccation: 1973–1998. *Global Environmental Change*, 11, 19–29.
- Hulme, M. (2008). Geographical work at the boundaries of climate change. *Transactions of the Institute of British Geographers*, 33(1), 5–11.
- INSTAT. (2009). *4ème Recensement Général de la Population et de l'Habitat du Mali – R.G.P.H. 2009 – Résultats Provisoires*. Bamako: Institut National de la Statistique – INSTAT, Bureau Central du Recensement – BCR.
- IOM. (2009). *Climate change, environmental degradation and migration: Addressing vulnerabilities and harnessing opportunities*. Geneva: International Organization for Migration (IOM) and Permanent Mission of Greece.
- Jónsson, G. (2010). *The environmental factor in migration dynamics—A review of African case studies* (Working Paper 21). Oxford: International Migration Institute, University of Oxford.
- Kandji, S. T., Verchot, L., & Mackensen, J. (2006). *Climate change and variability in the Sahel region: Impacts and adaptation strategies in the agricultural sector*. Gigiri/Nairobi: Word Agroforestry Centre (ICRAF)/United Nations Environment Programme (UNEP).
- Kilroy, A. (2008). *How does the spatial configuration of a rapidly-growing city impact on urban insecurity? A case study of Bamako, Mali*. Cambridge, MA: Massachusetts Institute of Technology (MIT), Department of Urban Studies and Planning.
- Kniveton, D., Schmidt-Verkerk, K., Smith, C., & Black, R. (2008). *Climate change and migration: Improving methodologies to estimate flows* (IOM migration research series, 33). Geneva: International Organization for Migration (IOM).
- Maddison, D. (2007). *The perception of and adaptation to climate change in Africa* (Policy Research Working Papers, 4308). Washington, DC: The World Bank.
- Marcus, G. E. (1995). Ethnography in/of the world system: The emergence of multi-sited ethnography. *Annual Review of Anthropology*, 24, 95–117.
- Massey, D. S., Axinn, W. G., & Ghimire, D. J. (2010). Environmental change and out-migration: Evidence from Nepal. *Population and Environment*, 32(2), 109–136.
- McLeman, R., & Hunter, L. M. (2010). Migration in the context of vulnerability and adaptation to climate change: Insights from analogues. *Climate Change*, 1, 450–461.

- McLeman, R., & Smit, B. (2006). Migration as an adaptation to climate change. *Climatic Change*, 76(1–2), 31–53.
- MEA. (2009). *Evaluation intégrée des écosystèmes: cas de la région de Mopti au Mali*. Ministère de l'Environnement et de l'Assainissement (MEA), Direction Nationale de la Conservation de la Nature (DNCA). <http://www.environnement.gov.ml/uploads/IPE/IPE%20Mali%202011/mopti.pdf>. Accessed 25 Nov 2013.
- Mengistu, D. K. (2011). Farmers' perception and knowledge of climate change and their coping strategies to the related hazards: Case study from Adiha, Central Tigray, Ethiopia. *Agricultural Sciences*, 2(2), 138–145.
- Merabet, O., & Gendreau, F. (2007). *Les Questions Migratoires au Mali. Valeurs, Sens et Contresens. Version Finale*. Paris: Civipool Conseil & Transtec Project Management.
- Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. *Environmental Management*, 43, 804–816.
- Mertz, O., Mbow, C., Nielsen, J. Ø., Maiga, A., Diallo, D., Reenberg, A., Diouf, A., Barbier, B., Moussa, I. B., Zorom, M., Ouattara, I., & Dabi, D. (2010). Climate factors play a limited role for past adaptation strategies in West Africa. *Ecology and Society*, 15(4), 25.
- Meze-Hausken, E. (2000). Migration caused by climate change: How vulnerable are people in dryland areas? A case study in Northern Ethiopia. *Mitigation and Adaptation Strategies for Global Change*, 5(4), 379–406.
- Mitchell, T. D., & Jones, P. D. (2005). An improved method of constructing a database of monthly climate observations and associated high-resolution grids. *International Journal of Climatology*, 25, 693–712.
- Mortreux, C., & Barnett, J. (2009). Climate change, migration and adaptation in Funafuti, Tuvalu. *Global Environmental Change*, 19(1), 105–112.
- OECD. (2008). Mali. In African Development Bank (AfDB) & Organisation for Economic Co-operation and Development (OECD) (Eds.), *African economic outlook 2008 – Country statistics* (pp. 415–428). <http://www.oecd.org/dataoecd/13/9/40578262.pdf>. Accessed 27 Nov 2013.
- Olsson, L., Eklundh, L., & Ardo, J. (2005). A recent greening of the Sahel—Trends, patterns and potential causes. *Journal of Arid Environments*, 63, 556–566.
- Orlove, B. S., Broad, K., & Petty, A. M. (2004). Factors that influence the use of climate forecasts: Evidence from the 1997/98 El Niño event in Peru. *Bulletin of the American Meteorological Society*, 85, 1–9.
- Peterson, N., & Broad, K. (2009). Climate and weather discourse in anthropology: From determinism to uncertain futures. In S. A. Crate & M. Nuttal (Eds.), *Anthropology and climate change—From encounters to actions* (pp. 70–86). Walnut Creek: Left Coast Press.
- Piguet, E. (2008). Climate and migration: A synthesis. In T. Afifi & J. Jäger (Eds.), *Environment, forced migration & social vulnerability* (pp. 73–86). Berlin/Heidelberg: Springer.
- Piguet, E. (2010). Linking climate change, environmental degradation, and migration: A methodological overview. *Wiley Interdisciplinary Reviews: Climate Change*, 1(4), 517–524.
- Piguet, E., Pécout, A., & De Guchteneire, P. (Eds.). (2011). *Migration and climate change*. Paris/London: Cambridge University Press – Editions de l'UNESCO.
- Renaud, F., Bogardi, J. J., Dun, O., & Warner, K. (2007). *Control, adapt or flee. How to face environmental migration?* (InterSecTions No. 5). Bonn: UNU-EHS.
- Roncoli, C. (2006). Ethnographic and participatory approaches to research on farmers' responses to climate predictions. *Climate Research*, 33, 81–99.
- Roncoli, C., Ingram, K., & Kirshen, P. (2002). Reading the rains: Local knowledge and rainfall forecasting among farmers of Burkina Faso. *Society and Natural Resources*, 15, 411–430.
- Roncoli, C., Ingram, K., Kirshen, P., & Jost, C. (2003). Meteorological meanings: Understandings of seasonal rainfall forecasts by farmers of Burkina Faso. In S. Strauss & B. S. Orlove (Eds.), *Weather, climate and culture* (pp. 181–202). New York: Berg.
- Schneider, U., Becker, A., Finger, P., Meyer-Christoffer, A., Ziese, M., & Rudolf, B. (2014). GPCC's new land surface precipitation climatology based on quality-controlled in situ data and its role in quantifying the global water cycle. *Theoretical and Applied Climatology*, 115, 15–40.

- Sheller, M., & Urry, J. (2006). The new mobilities paradigm. *Environment and Planning A*, 38, 207–226.
- Sieveling, N., & Fauser, M. (2009). *Migrationsdynamiken und Entwicklung in Westafrika: Untersuchungen zur entwicklungspolitischen Bedeutung von Migration in und aus Ghana und Mali. Bericht für das Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (COMCAD Arbeitspapiere – Working papers, 68)*. Bielefeld: Centre on Migration, Citizenship and Development (COMCAD).
- Stabinsky, D. (2011). *Climate change impacts on agriculture in Africa and the UNFCCC negotiations: Policy implications of recent scientific findings* (Working paper). United Nations Economic Commission for Africa and African Climate Policy Centre. <http://climate-justice.info/wp-content/uploads/2011/12/Climate-and-agriculture-AGN-paper.pdf>. Accessed 25 Nov 2013.
- Tappan, G. G., Sall, M., Wood, E. C., & Cushing, M. (2004). Ecoregions and land cover trends in Senegal. *Journal of Arid Environments*, 59, 427–462.
- Urry, J. (2007). *Mobilities*. Cambridge: Polity Press.
- Van der Geest, K., Vrieling, A., & Dietz, T. (2010). Migration and environment in Ghana: A cross-district analysis of human mobility and vegetation dynamics. *Environment and Urbanization*, 22(1), 107–124.
- Verne, J., & Doevenspeck, M. (2012). Bitte da bleiben! Sedentarismus als Konstante in der Migrationsforschung. In M. Steinbrink & M. Geiger (Eds.), *Migration und Entwicklung aus geographischer Perspektive* (pp. 61–94). Osnabrück: IMIS.
- Vincke, C., Diedhiou, I., & Grouzis, M. (2010). Long term dynamics and structure of woody vegetation in the Ferlo (Senegal). *Journal of Arid Environments*, 74(2), 268–276.
- West, C. T., Roncoli, C., & Ouattara, F. (2008). Local perceptions and regional climate trends on the Central Plateau of Burkina Faso. *Land Degradation and Development*, 19, 289–304.
- WFP. (2006). *Mali. Analyse de la Sécurité Alimentaire et de la Vulnérabilité. Strengthening Emergency Needs Assessment Capacity (SENAC)*. Bamako: World Food Programme & UNICEF.
- Yossi, H., & Diakité, C. H. (2008). *Dynamique de l'occupation du sol et de la végétation en zone guinéenne nord et soudanienne du Mali: Etude de cas dans les régions de Sikasso et de Mopti*. Bamako: Etude Sahel.