Climate- and Environment-Induced Intervillage Migration in Southwestern Burkina Faso, West Africa

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ABSTRACT

This study investigated key environmental factors causing intervillage migration by farmers. Therefore, it used household data from surveys, semistructured interviews, life histories, and focus group discussions in southwestern Burkina Faso, West Africa. The results showed that 1) when referring to the experienced historical weather and climate, farmers were aware of the effects of ongoing climate and environmental change; 2) soil degradation, land tenure insecurity, and lack of rainfall were major drivers of environment-induced migration; and 3) soil fertility, productivity, rainfall, and humidity, as well as land tenure security, were major pull factors. Farmers indirectly identified population pressure as a major driver of intervillage migration since it contributes to land degradation and land tenure insecurity. It is argued that migration implicitly adds to the natural climate and environmental stresses. When aiming to elaborate suitable land-use planning, the findings call for additional research that is needed to understand better the complex interrelationships between environmental drivers and permanent, environment-driven intervillage migration.

1. Introduction

Because of the devastating drought in the early 1970s in West Africa, many people died and livestock perished; in addition, environmental migration induced by climate-related impacts and the resulting environmental stress accelerated. Because of the recent and predicted climate changes and variability, issues such as environment-induced migration have become a major concern for West African governments and international donors alike once again (Werz and Conley 2012).

Environmental migration, as a result of environmental and climatic changes, is a dynamic, multifactorial phenomenon that has been the subject of an extensive and long-standing controversy (McLachlan et al. 2007) in part because of a lack of in-depth understanding of the complex relationships between variable environmental changes and migration (Jónsson 2010). Some scholars assert that current climate hazards such as heavy rainfall, drought, flooding, heat waves, delayed onset of the rainy season, a decrease in the amount of annual rainfall, a decrease in the number of rainfall events, and a lengthening of dry spells not only directly reduce crop yields and hence incomes, but also are drivers of migration by people in search of better living conditions and survival opportunities [Leighton 2012; Hagberg

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1 Environmental migration is defined as the movement of persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment, are obliged to leave their regular homes, either temporarily or permanently. They move either within their country or abroad (IOM 2014).

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2. Climate and environmental conditions and migration

The relationships between climate and environmental factors and people’s mobility are quite complex, as it seems that climate change, environment degradation, and population migration create a vicious circle (Massey et al. 2010). On the one hand, mostly in the semiarid zones of West Africa characterized by a high climate variability (Salack et al. 2016), increasing rainfall variability can reduce crop yields and consequently household incomes and thus may push families to migrate (Barbier et al. 2009). Also, rapid environmental degradation, as evidenced in land degradation, encourages people to migrate (Henry et al. 2004). On the other hand, it has been concluded that permanent migration increases population growth in the host region and consequently increases pressure on land resources, which may lead to accelerated land degradation and environmental changes in areas that were previously in balance (Ouédraogo et al. 2009). In some specific cases, the newly arrived have even been seen as culprits for irreversible land-cover change and soil degradation due to deforestation and strategies such as shifting or slash-and-burn agriculture that previously had been unknown in the host regions (Djiga 2015).

A wealth of literature on population migration confirms that environmental and climate change drive migration, although this has not been supported by studies from West Africa. Furthermore, most studies on population migration have focused on bridges between migrant remittances and development (Adarkwa 2015), rural–urban migration, changes in demographic and socioeconomic variables (local marriage rates, population, age, sex, household structure, education levels in departure areas and host zones, incomes, level of urbanization, population density, wage levels, fertility...
and mortality rates, etc.), and population mobility (Tiemoko 2004; Amankwaa et al. 2003; Adepoju 2003; OECD 2006; Beauchemin 2011). The few studies on environmental change and migration within West Africa focused on the Sudano–Guinean portion of the region (Bassett and Turner 2007), Senegal (Bleibaum 2009; Touré and Crowley 2014), and Niger (Afifi 2009). It was generally concluded that climate and environmental change can adversely impact farmers’ and herders’ incomes and push them to migrate, yet it remains unclear whether such conclusions can also be generalized to other agroecological zones in West Africa.

The outflux areas of internal and permanent migration in Burkina Faso have in the past been regions with highly degraded croplands that were located mainly in the north of the country, the Sahelian zone, and on the central plateau. The people migrated primarily to the less degraded areas in the country such as the Hauts-Bassins, Boucle du Mouhoun, Cascades, and south-central, southwestern, and eastern regions. Henry et al. (2003) used a generalized linear modeling approach to analyze the factors that cause interprovincial migration in Burkina Faso and concluded that household migration was strongly influenced by biophysical changes in the environment as well as demographic and socioeconomic factors. However, these studies focused on large-scale (national, regional, or interprovincial) often north–south-oriented migration. Furthermore, Henry et al. (2004) based their conclusions on quantitative and secondary data as they had no access to data from the migrants themselves. Also, prior to large-scale migration, south–south and permanent intervillage migration has often taken place but is also hardly reported because of the absence of in-depth insight into households’ complex decision-making and mobility.

In general, it is widely thought that the southern regions of Burkina experience favorable rainfall conditions and have a reputation of being the country’s breadbasket. This does not, however, exclude the fact that some villages may have nevertheless felt the impact of climate change (Sanfo et al. 2017). Since the southern region represents the upper limit and the highest potential and security for food production in the country, understanding of farmers’ perceptions and the notions and reflections on migration of the present populations or even ongoing migration are important to know for further land-use planning.

The main objectives of this study were therefore to 1) assess farmers’ awareness and perception of climate hazards and environmental changes and 2) identify the major push and pull factors of environmental migration and support the adaptation of land-use planning policies.

3. Materials and method

a. Study area

Data were collected in the southwestern region of Burkina Faso (Fig. 1), which is typified by a generally rugged landscape made up of a succession of hills. The overall topography includes multiple ridges, which form a group of hills with an average altitude of 534 m MSL. Agriculture is the main subsistence activity for about 88% of the total population (about 620 000 in 2005; IOM 2014). The region is located between the 700- and 1100-mm isohyets. The rains usually start in April–June (AMJ) and end in September–October (SO). The length of the growing season varies from 70 days in the northern areas to about 100 days in the more southern regions. Rainfall shows high inter- and intra-annual variability (Figs. 2, 3). The area is subject to severe dry spells during the rainy season (Figs. 4, 5) that may cause low, modest, or severe harm depending on if, when, and for how long these spells occur (Barron et al. 2003).

Most farming is subsistence-oriented, dominated by manual labor with handmade tools, and plows are rarely used. The use of chemical fertilizers is restricted to cotton production because the cotton company distributes inputs such as fertilizers, seed, and pesticides on credit to be repaid immediately at the end of the cotton harvest. Fallowing is becoming rare, and SWC techniques are unknown.

The annual population growth rate amounted to 2.2% between 1995 and 2006, but in 2012 it was estimated to be close to 3%, implying a doubling of the population every 20 years (INSD 2013; IOM 2014). Population density is around 70 inhabitants per square kilometer, which is below the population density in some regions of the country but higher than the average population density country-wide (50 inhabitants per square kilometer).

b. Data collection

The present study focused on 12 villages (Fig. 1). The villages were selected for their proximity to functioning meteorological stations in the region that enabled the comparison of farmers’ perceptions with monitored standard meteorological information.

Prior to the field surveys, an official briefing session was held with the head of the Provincial Department of Agriculture (Direction Provincial de Agriculture) in the region, during which the purpose of the survey was explained and assistance was requested for setting up meetings with farmers and identifying contact persons in each community.

Household data, originating from various sources, were acquired in different steps. In the first step, farmers’ awareness of climate change impacts was mapped in the
12 villages selected. Two complementary approaches, household questionnaires, and focus group discussions (FGDs) were used to acquire farm household data from May to June 2014. The farm household surveys aimed at collecting primary data on farmers’ perception of climate change risks or hazards and of impacts as well as data on the impacts of climate change on farmland productivity and farm households’ risk management strategies.

The surveys were conducted by 10 graduate students from the University of Ouagadougou after they had been trained on the topics of the survey: household education and consumption, employment, perception of climate risk or hazards, climate impacts on farmland productivity, and risk management strategies. In each of the 12 villages, a total of about 13 farm households were selected with the boundary condition that the farmer must have had more than 20 years’ farming experience (i.e., long enough to have experienced the effects of climate change on farmlands). Overall, 158 households were interviewed.

The FGDs were conducted in parallel with the household surveys to collect detailed qualitative information on local indicators of climate change, climate variability, climate risks for agriculture, local strategies to adapt to climate change, and the remediation policy to reduce food scarcity. On average, each discussion group was composed of about 26 farmers selected by the farmers’ associations in the communities. A total of 307 farmers from 12 villages participated in the 12 FGDs in addition to the 158 surveyed heads of households. Therefore, a total of 465 farmers participated.

In the second step, from 23 to 29 March 2015, information was collected on agricultural practices and on the climatic and environmental factors that triggered farmers to migrate. These data were acquired through guided interviews in the same 12 villages with the same sample of farmers. Particular attention was paid to villages with few native inhabitants (the Pougoulis) and located in the least populated zones of the region with good cropland and lowland assets (fertility, humidity). Autochthonous and migrant farmers as well as resource persons and knowledgeable informants (program and project leaders, heads of administration) were interviewed. The open-ended questions allowed for constructive
discussions. All interviews covered a broad range of topics, including agriculture practices and related risks, both in the host and departure zones, key environmental changes, comparative land availability and degradation (in both the host and departure areas), deforestation, and the migration process.

In the third and final step, historical climate data on rainfall, dry spells, temperatures, and wind speed (1970–2010) were collected from the Burkina meteorological services in the region. Rainfall anomalies were computed using the World Meteorological Organization (WMO) climatological reference data (1981–2010). The findings were then analyzed not only to (i) compare farmers’ perception of climate and environmental risks with historical meteorological data, but also to (ii) correlate climate- and environment-induced migration as a result of climate and environmental impact factors and other socioeconomic indicators. Mean values, standard deviations, and frequency distributions where applicable are presented.
4. Results and discussion

a. Farmers’ perception and awareness of climate hazards and environmental change

Farmers in the study region mentioned different environmental and climate changes they had perceived over several decades. For instance, 31% of the interviewees considered dry spells to be the most important and most frequently occurring climate-related risk affecting crop production and productivity (Table 1). About 25% emphasized strong winds as the next most serious climate-related risk affecting crops and yields. A lack of rain was mentioned by 17%, while flooding was mentioned by only 12%, high temperatures by 10% of the sample, and dust and low temperatures ranked sixth and seventh, respectively. These findings resemble those of other studies on farmers’ perceptions of climate hazards not only in the Sahel (e.g., Mertz et al. 2009), but also in other semiarid regions such as in Ethiopia’s Nile basin (Deressa et al. 2008) and central Tanzania (Slegers 2008).

The historical meteorological data revealed an increase in maximum and minimum temperatures (Fig. 6) and in wind speed (Fig. 7), thereby confirming farmers’ perceptions. However, the perceived decrease in rainfall was only partially confirmed by the historical records, whereas farmers’ perceptions matched the trend of annual
dry spells (Fig. 8). Further analyses showed that in-season rainfall distribution and especially the intra-seasonal dry spells as well as the changes in the onset and end of the rainy season did corroborate farmers’ perceptions. When analyzing the historical rainfall data (1991 to 2010), a decrease in the onset of the rainy season and an increase in long dry spells (Fig. 9) matched closely. Although rainfall in July–September (JAS) and SO did not corroborate farmers’ perceptions (Figs. 10, 11), when the onset and end of the rainy season is followed by a long dry spell (Figs. 9, 11) total crop failures can occur (Mahé et al. 2010). Notably, according to farmers, yield levels are used to assess whether rainfall changes have occurred. This means that, according to farmers, even if days with good rainfall occurred within the rainy season and even if the total rainfall measured was above average, they can be deemed to be poor by farmers in the event that yields were low. Therefore, farmers’ perceptions of climate change are based more on the impact of weather and climate on individual farmers’ livelihoods, that is, social and economic impacts (Slegers 2008), than on the absolute values of weather and climate parameters. This decision path is very similar to the findings of previous studies in Burkina Faso underlining that the occurrence of dry spells damage yields. Hence, it has therefore been argued that farmers perceive low yields to be the true cause of their household food insecurity and vulnerability throughout the year (González et al. 2011; Maddison et al. 2007; Hassan 2010).

b. Climate factors and migration

When asked to list climatic factors affecting their decision to migrate, farmers did not point to a clear cause-and-effect relationship between climate change and migration. However, they referred first to the lack of rainfall, dry spells, droughts, and parasites such as Striga as common climate and pest factors that reduce crop yields and household incomes. The absence of a clear relationship between climate-related drivers of migration may at first glance seem surprising. For instance, the increasing presence of Striga, as mentioned by farmers, may be a consequence of climate change and therefore be perceived as such, but it is not seen as a direct driver of migration. Following these explanations, the increasing presence of Striga was classified as an environmental change. Obviously, some farmers spoke only in general terms about climate conditions when referring to rainfall, temperature, wind, and dry spells.

About 28% of the respondents perceived a change in climate, as evidenced by less rain and humidity and more dry spells per year. Among these, about 10% emphasized that the host zones for migration are wetter, while 14% blamed the lack of rainfall in the source zones. About 5% mentioned dry spells as a key push factor in intervillage migration. According to 24% of the respondents, erratic rainfall and the lack of humidity has a severe impact on crop yields and hence on household livelihoods. Because rainfall is perceived as becoming more erratic, these respondents had chosen to migrate to areas where rainfall is adequate and ensures more stable and higher yields.

Some comments indicated that farmers justify their mobility as caused by rainfall, which is seen as the key factor in crop production. Some farmers referred to humidity and rainfall as climatic pull factors of environmental migration, and the lack of rainfall and humidity and increased dry spells as push factors of migration. Although rainfall, humidity, and dry spells were mentioned by farmers as driving their migration, some respondents spoke about climate conditions only in very general terms. During the interviews, it became clear that the phrase “climate conditions” covers variables such as temperature, wind, rainfall, and so on that may have a negative impact on crop yields, but it was low yields per se that motivated farmers to leave their present zones. The respondents clearly stated that the effects of weather cause migration rather than the weather per se.

Table 1. Changes in climate factors observed and ranked by the farmers.

<table>
<thead>
<tr>
<th>Climate factors</th>
<th>Trend, ranking and number of respondents (%)</th>
<th>% of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry spells/drought</td>
<td>Decreased (+) 1 31</td>
<td></td>
</tr>
<tr>
<td>Wind load</td>
<td>Decreased (+) 2 25</td>
<td></td>
</tr>
<tr>
<td>Rainfall</td>
<td>Increased (+) 3 17</td>
<td></td>
</tr>
<tr>
<td>Flood</td>
<td>Increased (+) 4 12</td>
<td></td>
</tr>
<tr>
<td>High temperatures</td>
<td>Increased (+) 5 10</td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td>Increased (+) 6 5.3</td>
<td></td>
</tr>
<tr>
<td>Low temperatures</td>
<td>Increased (+) 7 5.3</td>
<td></td>
</tr>
</tbody>
</table>

Source: Household surveys (May–June 2014 and March 2015)
living conditions, as has also been postulated earlier for regions in Africa but hardly quantified (IPCC 2007; Warner et al. 2012; Werz and Conley 2012; Djiga 2015).

c. Environment factors as drivers of migration

According to the interviewees, three environmental indicators are key to describing the impact of environmental change and hence migration: deforestation, land degradation, and soil productivity decline. While good and productive agricultural lands are considered to be pull factors in the host zone, deforestation and land degradation are major push factors in the source region. Almost 90% of the interviewees considered good productive land to be the main pull factor of environment-related migration. In addition, 74% reported that soils had become infertile in their own villages, compared to the soil fertility in the host zone. All migrant farmers emphasized that cropland in their new homes was more suitable than in their home villages. These statements by migrants were confirmed by native farmers. Moreover, several key informants in the region, including host zone natives, confirmed that soil fertility used to be the most important pull factor in population migration. They emphasize a general consensus on the link between deforestation, land degradation, farmland productivity, crop yields, and the farmers’ decision to migrate (West et al. 2008; Barbier et al. 2009). These observations are typical not only for southwestern Burkina

![Interannual evolution of maximum and minimum temperatures over one site in the study area (Boromo). Trends are shown in red (maximum temperatures) and blue (minimum temperatures). The temperatures shown here are the maxima of the maximum temperatures (and the maxima of the minimum temperatures) over the sites.](image-url)
Faso but also for other regions (Suhrke 1993; IOM 2014; Bilsborrow 2002).

Although good cropland was emphasized by all as the key pull factor, the underlying reasons differed and were sometimes linked to land use. For instance, some comments emphasized the relationship between land fertility and trees. Farmers described the process of land fertilization through trees and thus emphasized the role played by tree leaves for improving soil fertility. Other comments addressed in particular the link between higher yields and soil fertility, underlining that the search for fertile farmland dominates farmers’ decisions to migrate in an attempt to increase yields/production to feed their families. On the other hand, some comments concerning land fertility as a pull factor in migration were not backed by in-depth reflections and links.

About 26% of the farmers pointed out that out-migration is closely linked to the ongoing deforestation in their villages since deforestation and soil degradation render agriculture less profitable. Ultimately, this drives migration with the objective of finding more suitable cropland. It is noteworthy that the causes of deforestation and land degradation were not specified directly, but farmers stated in general that local rules and culture are not respected anymore. Furthermore, 7% of the respondents mentioned the lack of trees as the prime driver for their migration. Hence, they underlined the abundance of trees in the host zones, which, according to these respondents, would facilitate the formation of clouds and in turn trigger atmospheric cooling and useful rainfall.

Trees directly provide medicines and facilitate traditional practices as well, as evidenced by farmers mentioning spiritual aspects when emphasizing that it is not culturally desirable to cut down trees. It was explained that it may become dangerous when the spirits are annoyed since this could bring harm to a community (in the form of strong winds and less rain during the rainy season or unwanted rain storms during the harvest season). This spiritual incentive also drove some people to migrate.

The impact of climate change sometimes was linked to environmental changes such as the extinction of species (plants, insects, birds) in the source regions of out-migrating farmers. For instance, the increasing presence of Striga, a harmful parasitic plant that destroys crops including sorghum (Sorghum bicolor), millet (Pennisetum glaucum), corn (Zea mays), rice (Oryza sativa), and sugar cane (Saccharum officinarum), was reported. However, only 2% of the farmers surveyed reported that their own migration was directly linked to the increasing emergence of Striga on their cropland. Migrant farmers also mentioned Striga destroying crops in the past even if they had never seen it or encountered it on their own cropland. Nevertheless, they all agreed that nowadays, Striga has become a genuine threat to their crops. This perception is obviously corroborated by scientific opinions. For instance, Scholes (2008) investigated the relationship between the occurrence of Striga and grain yields in sub-Saharan Africa and highlighted the negative impact of the parasite on crop yields and suggested using naturally resistant relatives as a countermeasure for cropland infected with Striga. Most of the interviewees stressed the need for better management of the environment and for judicious land-use practices to improve their households’ livelihoods. But as soon as farmers experienced a drop in yields, they invested less in farmland management and hence were
trapped in the vicious circle leading to lower productivity and lower harvests and hence reduced interest in maintenance. The typical final solution for a farm family is then to migrate, sometimes permanently.

d. Other socioeconomic indicators of internal migration

The open-ended questions left room for discussion and self-explanations during which farmers mentioned that migration is an outcome of other socioeconomic variables as well. They pointed in particular to demographic pressure, land availability, and land tenure insecurity. These factors also drive migration, especially when combined with population growth in the source zone. About 91% of the farmers indicated that population pressure leads to land degradation and hence to cropland scarcity and insecurity. Among them, 53% emphasized that land availability is a main driver of population migration, while 14% pointed to land tenure insecurity. Other socioeconomic indicators, including family reunification, were mentioned by 17% of the farmers. However, above all, the lack of income has lead farmers to migrate. Different statements made by the farmers highlighted the cause-and-effect relationship between population growth, population pressure, land availability, and land tenure insecurity, which has also been mentioned before in other regions (Gemenne et al. 2014; Sall et al. 2011; Jónsson 2010). Furthermore, such studies reported that migration is the outcome not only of climate and environmental changes, but also of socioeconomic factors.

**FIG. 8.** annual rainfall anomalies and dry spells over the study area. Rainfall anomalies were computed using 1981–2010 as climatology; the trend over time series is shown in blue. For dry spells, the annual maximum of dry spells was considered; trends are shown in blue (for the 1970–2010 period) and red (for 1990–2010).
The relationship between population growth and land-cover change is the subject of continuing controversy (e.g., Myers 1997; Wibowo and Byron 1999; Bremner et al. 2010). While some (e.g., Amelung and Diehl 1992; Mather and Needle 2000) consider population growth to be the primary cause of deforestation and land-cover change, others (e.g., Geist and Lambin 2002; Lambin et al. 2001) have argued that population growth should be seen as one driver among other important drivers. Boserup (1965), using a technological approach, argued that population growth and pressure lead to technological advances and social and economic imperatives to innovate, develop new technologies, and increase the productivity of land and natural resources. Although the current findings cannot be compared directly to these earlier findings, several statements made by interviewed farmers are likely to be corroborated by the theories and studies showing that population growth and pressure lead to land degradation (Malthus 1798).

This situation is likely to be confirmed in the study region as population pressure greatly affects land availability and soil fertility, whereas the expected intensification techniques and technologies are yet to come.

5. Summary and conclusions

The main objective of this study was to investigate the complex relationships between climate and environmental
change and the resulting population migration in southwestern Burkina Faso. Individual interviews with selected households, life histories, and focus group discussions in 12 villages along with climate and weather data available for the region made it possible to describe farmers’ perceptions of climate change and compare them with historical weather and climate data. In a second step, native and migrant farmers, program and project leaders, and heads of administration were targeted to disentangle the complex relationships between household migration, environmental factors, and climate variables.

Our findings revealed that smallholder farmers’ awareness of the impacts of climate change is mainly based on their own perceptions. Generally, the farmers interviewed perceived temperatures and wind speed to have increased and rainfall to have decreased over the last two to three decades. These changes were mostly corroborated by historical climate data for temperature and wind speed, but not always confirmed for rainfall.

For some farmers, migration appears to be a strategy to cope with these changes. Climate conditions in general and specifically dry spells and drought are push factors to migrate, whereas rainfall and humidity are pull factors deciding where to migrate to. Some perceptions of farmers were difficult to comprehend. For instance, the emergence of the crop parasites such as Striga was regarded as a climate factor even though the emergence of Striga is a consequence of climate

![Seasonal rainfall anomalies and dry spells during the height of the monsoon (July–September) over the study area. Rainfall anomalies were computed using 1981–2010 as climatology. For dry spells, the annual maximum of dry spells was considered. Trends are indicated in blue (for the 1970–2010 period) and red (for 1990–2010).](http://journals.ametsoc.org/doi/pdf/10.1175/WCAS-D-16-0065.1)
change and should thus be better classified as an environmental change.

Migrants reported a positive association between push factors for migration such as land degradation and deforestation. Consequently, good farmlands were perceived as the main environmental pull factors of farm household migration. In addition, farm family migration is driven by socioeconomic factors as well. Population pressure and family reunification, for instance, were emphasized.

Agriculture is the main economic activity in the study region in Burkina Faso. It is therefore important to design policies that address adaptation and land-use planning to reduce environmental degradation and migration that put too much pressure on farmland resources, ultimately leading to land degradation in the host zones. The majority of the households interviewed recognized that the host zones will probably face land availability challenges and will no longer be able to offer suitable farmland to new migrants. This perception among farmers corroborated the assertion made by Ouédraogo et al. (2009) underlining that the problem of rural migration needs to be prioritized and if necessary managed before it has irreversible impacts on the environment. Policymakers and development actors thus need better understanding of the complex links between climate and environmental changes, household livelihoods, and migration decisions.

When designing and implementing land-use planning
projects, the focus should therefore not be on purely technical aspects alone but also on social and economic dimensions such as smallholder farmers’ awareness, perceptions, and decisions.

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