National University of Agriculture
Sciences and Technologies for Sustainable Agriculture (STSA)
ISSN: 1659-5726 (Online) 1659-634X (Print) https://www.stsa.una.bj/index.php/st

VOLUME N° (ORIGINAL ARTICLE)

Rural-Rural Migration: fight or flight way to mitigate Climate Change effect in Northern Benin?

Alice Bonou[1*], Janvier Egah[2], Anna Veronika Bachan-Juris[3], Leonard Wantchekon[4,5], Gauthier Biaou[1]

Laboratoire d'Economie Rurale et de Sciences Sociales pour le Développement Durable, Université Nationale d'Agriculture, Bénin
Janvier Egah, Laboratory Society- Environment (LaSEn), University of Parakou, Bénin, email: egahjanvier@gmail.com or janvier.egah@fa-up.bj
Anna Veronika Bachan-Juris, University of Minnesota, USA, email: avb308@nyu.edu
Leonard Wantchekon, African School of Economics, Bénin and Côte d'Ivoire, University of Princenton, USA, email: lwantchekon@gmail.com
Gauthier Biaou, National University of Agriculture, Benin, email: gbiaou@yahoo.fr

ABSTRACT

Adaptation to climate change is a challenge for the agricultural sector taking into account its important place in the economy of West African countries. Agricultural sector often struggles to ensure the daily life of farmers, which sometimes forces them to migrate in search of a better economic life. This paper focuses on climate change and how it results in these complex migratory flows. Moreover, the paper offers empirical evidence on migration as a purposeful strategy for running away or fighting/coping with/adapting to evolving conditions. The study was conducted in Northern Benin, where 60 farmers were interviewed. For this purpose, descriptive statistics were used to explain farmers' perceptions of migration as a technique for income diversification. Moreover, a logistic regression model is used to investigate the factors influencing migration decisions in Northern Benin. The result indicates that Beninese farmers seek work in other farms (outside their village or community) and jobs as miners or in other small-scale trades, primarily for economic reasons. Furthermore, vulnerability to climate change, household and family characteristics are the root of economically driven migration. The recommendations involve a call for the government/NGO to come in and spread awareness that climate change is man-made and thus can be stopped. Moreover, strategies for adaptation that don't require them to move will be highlighted. Farmers need to join into agricultural cooperative and seek agricultural credit, technical assistance and NGO's or government programs on climate-smart agriculture.

Key words: Migration, Climate change, Adaptation, Agriculture, Benin

RESUME

L'adaptation au changement climatique est un défi pour l'agriculture qui occupe une place importante dans l'économie des pays d'Afrique de l'Ouest. L'agriculture peine souvent à assurer la vie quotidienne des agriculteurs, obligeant parfois ces derniers à migrer pour la recherche d'une meilleure vie économique. Cet article se focalise sur la manière dont le changement climatique entraîne des flux migratoires complexes. Il fournit également des preuves empiriques supplémentaires sur la migration en tant que stratégie d'adaptation au changement climatique. L'étude a été réalisée au Nord-Bénin où 60 agriculteurs ont été interrogés. La statistique descriptive a été utilisée pour expliquer les perceptions des agriculteurs sur la migration comme technique de diversification des revenus. Un modèle de régression logistique a également été utilisé pour étudier les déterminants de la décision migratoire au Nord-Bénin. Le résultat indique que les agriculteurs béninois cherchent du travail dans d'autres exploitations agricoles (en dehors de leur communauté), ainsi que des emplois agricoles ou dans d'autres petits métiers, pour des raisons essentiellement économiques. De plus, la vulnérabilité au changement climatique et les caractéristiques des ménages sont à l'origine des migrations économiques. Les recommandations visent à motiver les gouvernements et les ONG à intervenir et à sensibiliser le public sur le fait que le changement climatique est d'origine humaine et peut donc être stoppé. De plus, des stratégies d'adaptation ne nécessitant pas de déplacement seront mises en exergue. Les agriculteurs doivent se constituer en coopératives agricoles et rechercher des crédits agricoles, une assistance technique et des programmes d'ONG ou gouvernementaux en faveur d'une agriculture respectueuse du climat.

Mots clés : Migration, Changement Climatique, Adaptation, Agriculture, Bénin

Corresponding author: Alice BONOU FANDOHAN
Received in Aug 2021 and accepted in jan 2025
E-mail address: alice.bonou@gmail.com

1. Introduction

The relationship between migration and the environment has long been discussed in academic and policy circles (Mukherjee & Fransen, 2024; Fernández et al., 2024; Szaboova et al., 2023; Kaczan & Orgill-Meyer, 2020). The impact of climate change on migratory flows is twofold. On one hand, short-term events such as natural disasters forcefully displace large populations on national and international levels. Scientists predict that these events will cause mass displacements of thousands of "environmental refugees", a phenomenon which will dominate international relations in the 21st century (International Organization for Migration - IOM, 2019). On the other hand, slower long-term changes in the environment, such as increasing temperatures, drought, irregular rainfall seasons, rising water levels and soil erosion, will drive migratory movements within and across national borders (Zickgraf, 2016). For the latter case however, it will be more difficult to measure flows, as they will occur over longer periods of time more erratically or circularly or a pattern, as opposed to permanent mass movements (Cattaneo, 2019). This paper focuses on long term environmental change and how it results in these complex migratory flows. The discussion of the environment-migration nexus is controversial, as it is often difficult for researchers and practitioners to extract environmental factors as sole drivers of flows, as they are inextricably interwoven with other economic and social factors (Bohnenkämper et al., 2024; Bezu *et al*, 2020). In addition, low-income countries in the developing world are more vulnerable and prone to the negative effects of climate change, as they lack infrastructure and resources to rapidly address these changes (Bonou et al., 2024; Ahir et al., 2021; Coulibaly et al., 2020; Lokonon, 2019). However, in academic and policy circles, many misconceptions in the status quo scenario claim that climate change will cause large-scale international movements from rural to urban areas and from developing to more developed countries (Crawford et al., 2023; Majumdar & Weber, 2023). Governments worldwide have also perceived and approached migration from rural to urban areas as a negative phenomenon, leading to an abandoned agricultural sector and crowded cities with high unemployment rates. These governments focus on directing their respective policies to limit this type of migration which is difficult to address (Butros et al., 2021). These initial perceptions fail to consider the second type of environmental change. Long term effects, such as those listed above, have produced movements, often to neighboring countries or within the country's national borders (Tacoli, 2009). Migration is complex and is often pursued for different purposes. It can in some cases exemplify a failure to adapt to change in the physical environment, and thus becomes a coping mechanism and essential 'fight or flight' decision for agricultural laborers (Rademacher-Schulz, 2014). On the other hand, migration can be a deliberate action or adaptation strategy (*ibid*). Choosing to migrate during the dry season to work elsewhere has for decades been a strategic choice for sustaining rural livelihoods. In this case, the difference between coping and adaptation in reaction to environmental change is determined by factors such as education, income level, productivity, household size, soil degradation and the communities' realities (Rademacher-Schulz, 2014).

In rural areas, as dry seasons become longer due to climate change, farmers engage in migration to find employment and other sources of income outside their communities, send their income home, and return to farm again during the rainy season (Kraler et al., 2011). Therefore, the link between climate and migration in the country is apparent and merits further inquiry. The fundamental question of this research is: How do long-term environmental changes influence migratory flows, particularly migration, and to what extent does this migration serve as an adaptation strategy rather than merely a survival mechanism? The link between climate and migration in Africa is established based on perceptions of individuals or using a qualitative approach (Gemenne et al., 2017; Le Corre, 2016; Bambara et al., 2013). Up to date, no research focuses on this domain in Benin. This paper attempts to fill in this gap by combining qualitative approach and quantitative approach to establish a link between migration and climate change in Benin. It highlights how choosing migration is a positive phenomenon, an adaptive strategy for a changing environment, a means for income diversification, and for reducing vulnerability in the household and farm. It also provides additional empirical evidence on migration as an adaptation strategy.

As policies are made on local studies, the following research questions are answered:

Can migration flows be attributed to the consequences of climate change in Northern Benin?

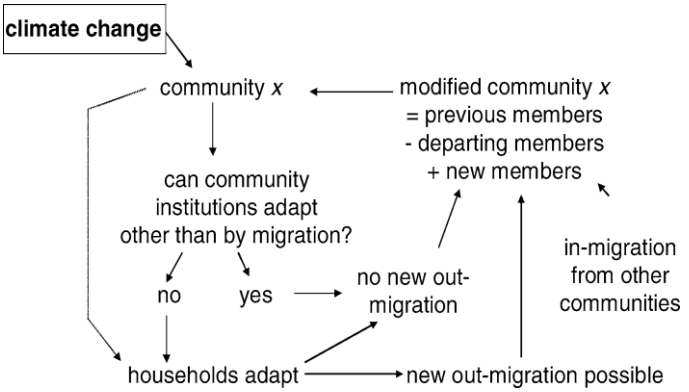
Can a connection be made between migration and environmental change in a larger context?

- Which socioeconomic characteristics of farmers influence their migration decision and why?
- Can migration be identified as an adaptation strategy to the changing climate?

The answer to all these questions allows us to uncover the complex relationship between mobility and environmental change in Benin. Without acknowledging this at government level, national authorities will continue to fail by addressing temporary migratory movements (and informal remittance flows) which take place nationally or with neighboring countries (and are thus more difficult to track in censes). By rethinking the approach to the environment-migration nexus, governments and other actors can gain a better understanding of how migration can be a positive strategy to combat climate change, food insecurity, and rural poverty. It is also crucial for the farmers to understand the difficulties by using migration as a tool to cope with climate change consequences. The phenomenon of migration in general, and as a climate adaptation strategy, has not been studied in depth, nor implicated in government policy/practice in Benin. Therefore, this case study focuses on three regions in Northern Benin and aims to identify farmers' perceptions of climate change and migration as a means for sustaining livelihoods. In this paper, we used descriptive statistics to explain farmers' perceptions of climate change and adaptation techniques, and their perceptions of migration as a technique for

income diversification. Moreover, logistic regression model is used to investigate the factors that can influence migration decisions in Northern Benin.

2. Theoretical and conceptual framework



Migration as an Adaptation to Climate Change, McLehman, (2016)

Those choosing to migrate utilize the process as a mechanism for income diversification and risk management, thus securing their livelihoods against their volatile environment (Rademacher-Schulz, 2014). Adaptive migration also compensates for the lack of employment opportunities during dry season, reduces the pressure on household food stocks, and seasonal income variability (Silchenko & Murray 2023; Demont, 2022).

Due to its climactic conditions and recent migratory statistics, Benin is an ideal case study for this type of research. The country is especially vulnerable to climate change as its agricultural sector is "rain-fed" while employing a vast majority of the rural population (Klutse et al., 2021). A recent study has reported that the primary effects of climate change nationally include endangered farmer livelihoods and food scarcity (Farooq et al., 2022; Muluneh, 2021). Reported changes in environment were cited primarily as delayed rainy seasons, increased floods, multiplication of drought and dry spells, increased strong winds and greater heat (Baudoin et al., 2014).

In regards to migration, the number of Beninese nationals migrating to other countries has rapidly increased. The IOM has recently reported over 4.4 million Beninese, over half the population, has migrated in their lifetimes (IOM, 2020) . 69% of these migrants have gone to Nigeria (Dreier & Sow, 2015). Population growth, poverty, difficult climatic conditions and dwindling natural resources justify these increased migratory flows (Ali et al., 2023; Hermans & McLeman, 2021).

3. Materials and Methods

3.1 Study area

This paper focuses on the Benin case study. The factor that makes Benin crucial for climate change research is that its economy is dependent on agriculture, which is rain-fed, and thus makes it even more vulnerable to a changing environment (Baudoin, 2015). In Benin, the northern region is chosen because it is a dryland with a stressed climatic condition that forces youth to look for alternatives (Akponikpe *et al.* 2019). It concerns the departments of Atacora, Donga and Alibori. In each department, one commune is selected with two villages.

This study was conducted in three communes: Ouaké, Boukoumbé and Banikoara (figure 1). They differ by agro-ecological zoning. Ouaké and Boukoumbé fall in the West Atacora Zone which is vulnerable to climate change (Akponikpe *et al.* 2019). The third commune, Banikoara, falls in the Cotton Zone of Northern Benin, an area that is watered by the Niger River and is influenced by the continental Alizé. This zone is less vulnerable to climate change (Akponikpe *et al.* 2019).

Another criterion that confirms this selection is the migration trend. In 2016, 23 404 individuals migrate from Atacora. In Donga, 17 142 individuals migrate while 14 485 individuals migrate from Alibori (INSAE, 2016). The three communes also differ by climate gradient based on the bioclimatic classification of Aubreville (1949). They fall into the Sudanian climate, which is characterized by a unimodal rainfall pattern. The rainy season starts approximately in May and ends in October (Fontes & Guinko, 1995).

The survey covers two communities/villages in each commune: Boukoumbé (Dikouteni and Koumago); Banikoara (Gomparou Peulh and Sampeto) and Ouaké (Kakpala and Kawado). The selection of the communities was based on the level of vulnerability to climate change.

Banikoara, located in northern Benin's cotton belt, is highly specialized in cotton production, a key agricultural sector for the national economy. Despite the presence of 21 reservoirs and 63 lowland areas designated for agriculture and fishing, managing these water resources remains a challenge due to climatic variability (Alokpaï *et al.*, 2024). Rain-fed agriculture is the dominant economic activity in Banikoara. However, climate variability has led to fluctuating yields, prompting widespread seasonal and permanent migration in search of more favorable farming conditions. Migration is thus emerging as a primary adaptation strategy against climate-induced rainfall variability and declining crop yields.

The Commune of Ouaké is located in the northwest of the Donga Department, situated between the parallels 9°23' and 9°51' North latitude and the meridians 1°20' and 1°35' East longitude. It encompasses sixty-one (61) villages and urban quarters. The Commune of Ouaké enjoys a humid Sudanese climate with two (02) seasons: a rainy season from May to October and a dry season from November to April. A hydrographic network from the Volta basin flows across this terrain, influenced by the hydrological regime of the Volta basin. This network consists of rivers and seasonal streams (Djodjo, 2018).

The Commune of Boukoumbé is located in the Atakora Department, in the north-west of Benin. Boukoumbé is situated 54 kilometers from Natitingou, the departmental capital, and approximately 600 kilometers from Cotonou. Boukoumbé has 13,608 households, with a predominantly young population. The elderly population (aged over 60) is very small, with a rate of 5.82% (Agbanou, 2018).

Although Ouaké and Boukoumbé belong to different agroecological zones, they face similar climate-induced challenges. Their unique geographical and climatic characteristics shape local agricultural practices and drive adaptive strategies developed by communities to mitigate climate-related risks. Examining these communes provides valuable insights into the localized impacts of climate change and the adaptive responses implemented to safeguard food security and community well-being.

3.2. Data collection and questionnaire designing

Three-stage sampling method was used. The primary sampling units are three communes purposively selected in North Benin. The secondary sampling units are six communities purposively selected. The tertiary sampling units are 60 farmers with 10 farmers randomly selected from each community. They were interviewed by two enumerators who are agricultural economists using the semi-structured questionnaires. The interviews were performed in the local languages (for this, interpreters were hired), while the questionnaire was in French. Data collection was done from 28th August to 4th September, 2017. Data collected are the socioeconomic characteristics (age, sex, decision maker, education background, household size, experience, farm size, ethnicity, agriculture as the main source of income), farmer perceptions of migration (origins, destination and patterns) and the drivers of migration decision.

3.3 Data Analysis

The tables, graphs, and descriptive parameters (mean, standard deviation, and frequencies) are used to analyse socioeconomic characteristics and farmers' perceptions of climate change and adaptation techniques. Subsequently, descriptive statistics were used to explain farmers' perceptions of migration as a technique for income diversification. In addition, descriptive statistics allowed us to demonstrate the realities of migratory movements, the sending of remittances, and migrant return to their communities of origin.

To assess the drivers of the decision to migrate, socioeconomic and demographic characteristics, and location variable are analysed using a logistic regression. The dependent variable was the migration decision (fjob), and the independent variables included age (age), experience working in agriculture (expe), household-head level of education (instruc), size of land cultivated (sup), household size (hhsize), number of males (nmhh) and females (nwhh) in the household, department of origin (depart), whether they receive government or NGO assistance or agricultural credit (acret), and whether agriculture is their only source of income (agrev). In addition, we added variables to explain farmer's perception of climate change, specifically the extent to which they recognized climate change as a threat to their livelihood (apc_lab) and whether they thought adaptation was possible (mcc).

As the dependent variable (fjob) is binary, the logistic regression gives us the probability or decision whether the head of household migrates or not. Therefore, the migration decision can take the following values: fjob = 1 if the head household answers 'Yes' for migration and fjob = 0 if the head household answers 'No'. The general equation of logistic regression model specification is given as follows:

$$P_i = prob(y_i = 1) = \frac{1}{1 + e^{-\alpha_i X_i}}$$

- α_i is the coefficient of the ith characteristic;
- X_i represents the independent variables which are the i^{th} characteristic of the household

4. Results

4.1. Socioeconomic characteristics of farmers.

From the sample pool, the vast majority of farmers interviewed were male (95%) and considered themselves to be the primary household decision makers (93%). They identified with different ethnic groups, primarily as Otammari (36%) and Lokpa (31%). The average age of interviewed farmers was 44 years, with the majority aged from 24 to 60 years. The majority of farmers had no formal education (56%), followed by those who possessed a primary level (21%) and secondary level of formal schooling (21%). The average number of individuals living in a single household was 11. The result shows 25 years as average number of years of experience in agriculture and with most farmers in the 15-40 years' bracket (Table 1).

Regarding farming, the average farm size is 5.63 ha. Also, almost all farmers (97%) employed family members as the main workforce for the farm instead of hiring laborers. Over half of the farmers interviewed (52%) relied on agriculture as their primary source of income. Only a minor percentage of farmers (35%) claimed to belong to an agricultural association in their community. Lastly, only a small minority of farmers (7%) claimed they had ever been assisted in their activities by the government, NGOs, or other organizations (Table 1).

4.2. Farmer perceptions of climate change and adaptation

4.2.1. Climate change causes & farmer recognition/appreciation

Among the respondents, the majority of farmers (52%) perceived that the climate had changed most significantly in the last 1 to 5 years compared to observations made a decade ago. Secondly, over third (35%) of farmers perceived the climate to have changed the most significantly in the past 6-15 years (Table 2). Most interviewed farmers believed "supernatural forces" were the primary cause of climate change (48%). Sample responses included the "will of God", "God's anger against humanity", and the "divine plan". The concept of climate change being related to supernatural forces is an important issue. That means that people are helpless in the face of it. This shows the need to spread awareness that climate change is man-made and thus can be stopped. Around a third of farmers interviewed (29%) believed natural phenomena were the primary causes of climate change, these included

"changing natural processes", "animal migration". On the contrary, man-made causes included deforestation (18%), such as burning of grasses and trees and neglecting fallow. The last-mentioned cause was the misuse or overuse of pesticides and chemicals (2.5%) and disrespect for nature in general (Table 2).

4.2.2. Climate change effects

Currently, as an effect of these environmental changes, several farmers (63%) noted experiencing meager and unproductive harvests, due to the proliferation of new harmful weeds and insects that damaged crops. Less than a third of farmers (30%) specified soil degradation as a major effect, and attributed soil poorness and infertility to strong winds and torrential rains, flooding, erosion, as well as lack of access to high-quality (and affordable) organic fertilizers (Table 2).

Most respondents (62%) expressed fear of upcoming famine and future food scarcity and inability to produce sufficiently to feed their families when asked about how future environmental change could affect their farms. One farmer lamented: "*hunger will kill me and my family*", and another claimed, "*We will not be able to harvest anymore. We will die out of hunger*". Many others alluded to similar "*end of the world*" situations related to famine and food scarcity. Other farmers expressed that climate change would make their land unproductive in the future. A small number of farmers (12%), explicitly mentioned abandoning agriculture as their primary income-generating activity if the environmental change were to worsen. It is sorrowful to note here that a certain degree of fatality can be read from farmers' responses, which sheds interesting insights on the degree to which adaptation to climate change is even possible/and or accepted by local populations of Northern Benin (Table 2).

4.2.3. Climate change adaptation & information

When asked whether it was possible or necessary to adapt to environmental changes caused by the changing climate, exactly 50% of respondents agreed that adaptation to climate change was possible and necessary while the others disagreed. Of those who agreed, the primary adaptation technique suggested by most of the respondents (80%) was reforestation (Table 2). One farmer claimed it was crucial to promote the following techniques: reforestation, planting trees, organizing prayers, raising awareness of the need to respect natural laws. Another farmer emphasized that farmers should respect nature, not cut trees anarchically, and respect the sacred forests. Some farmers (11%) also claimed they needed more information and advice regarding environmental change and strategies for adaptation. Finally, one farmer claimed, "*NGO and government can give us more insights into how to mitigate these changes*".

Moreover, data were collected on the sources of climate change information by the farmers. Most of the farmers (72%) claimed to inform themselves on climate change and environmental issues on the radio. Other listed sources including learning from friends (15%), the television (10%) and personal observation (3%). (Table 2).

4.2.4. Perceptions of migration among smallholder farmers

In this section, the analysis of the origins, destinations and patterns are carried out. From the sample pool, a majority of respondents (67%) claimed they personally knew an individual from their own families who had migrated to find a job outside of the village. Therefore, we can assume that migration or mobility of farmers has been generally recognized as a contemporary phenomenon in the study area.

Most of the respondents from the Atacora region (75%) and from the Donga region (95%) claimed someone had migrated from their families. On the contrary, less than half (42%) of respondents from the Alibori region claimed someone from their families had migrated (See Figure 2).

As the data shows, most of farmers interviewed claimed they knew an individual who had migrated to Nigeria (40%), to another area of Benin (37%), to Togo (13%), while only 5% mentioned Niger (Figure 3).

Regarding the patterns of migration, most farmers who migrate in rural Benin employ themselves in agriculture (manual labor) in other rural areas (79%) (Figure 4 a). Therefore, this migration pattern can be predominantly characterized as rural-rural. From the literature, rural-rural migrants are predominantly employed in agriculture, farming, and manual labor. In addition, a small minority (9%) found jobs in mining and other sectors (13%) including commerce and other trades such as masonry, carpentry, and welding (Figure 4a). It is also important to recognize the frequency of migrants return home. From the respondent pool, 41% of respondents claimed migrants usually returned on an annual basis. About a third of farmers (28%) have claimed migrants returned on a biannual or seasonal basis, leaving during the dry season and returning for the rainy season. A quarter (24%) claimed they returned only occasionally, for special events or to visit their families and only 7% claimed they never returned (Figure 4b).

4.3. Drivers of migration decision

The logit results highlight migration decision of a member of the household is determined by six variables (Table 3). There are: Department of the origin of the migrant (depart), Experience working in agriculture (expe), Size of household (hhsize), Number of males in the household (Nmhh), Number of females in the household (nwhh), and Age of the head of household (age). The first three variables negatively influence the decision to migrate, whereas the rest of the variables positively influence the decision.

The variable "Department of the origin of the migrant (depart)" was negatively significant. Migrants from Atacora and Donga departments were more likely to migrate and knew more farmers that migrated from their own families than those from the Alibori department. This can be explained due to various factors. Environmental and ecological divergences, as discussed in the study area section, partially explain

these differences. Another significant variable was the number of years of farming experience. It negatively affects the desire or decision to migrate.

Thus, the more established a farmer is, the lower the probability is for him to leave the household to find work elsewhere. Subsequently, the larger his household size is, the lower the probability for a farmer to migrate. This finding is converse in the literature.

When coming to the three others variables, we have the number of females and males in the household, which are positively significant. The higher the number of females in the household, the higher the probability that the head of the household or other male would migrate. In addition, a higher number of males in the household also increases the probability that one of them will migrate. Finally, the age of the head of household was also positively significant with the decision of a member of the family to migrate. Age is a key indicator for a household head to motivate the members of the family to migrate, as the age of the head of household will increase, the probability that he or a member of the household will migrate increases. Older farmers might have encouraged younger ones to migrate in their place. Then, they may refuse to migrate as they had worked in agriculture all their life and considered migration for labor as primarily outside the agricultural sector. Therefore, young male farmers are much more willing to consider migration than older ones (Kumar & Bhagat, 2017).

5. Discussion

5.1. Socioeconomic Causes

From the data, it is apparent that Beninese farmers seek work in other farms (outside their village or community), as well as jobs as miners or in other small-scale trades, primarily for economic reasons. Specifically, household and family characteristics are the root causes of economically-driven migration. As explained in the logit model, the number of males and females in a household is linked and highly significant in determining the migration decision. According to Jha et al. (2017) farmers seeking outside employment are more likely to do so if they support larger families with more females, as females in these regions often work in the household and rarely leave to pursue work elsewhere. In addition, when families have more males there is a larger chance that at least one of the males migrate to support the family from the outside (Egah et al., 2023). As men are more likely to migrate than females, households with more males have a higher probability of having at least one migrant. However, the variable household size negatively determines the decision to migrate. This result is also controversial in the literature (Tcha, 1995). Household size significantly influences migration patterns. Generally, larger households are more likely to migrate in search of economic opportunities and to diversify their income sources. Conversely, smaller households may be more likely to migrate with all family members, seeking a more cohesive family structure. Additionally, the marginal gain from migration can increase with larger household sizes, particularly when parents prioritize their children's well-being (Tcha, 1995).

Lastly, families with larger households are likely to have at least one migrant than smaller households. This also confirms the new economics of labor migration theory that migration is more of a household decision than an individual one (Esteve et al., 2024; Egah et al., 2023; de Haas et al., 2019).

Regarding the patterns of migration, most farmers who migrate in rural Benin employ themselves in agriculture (manual labor) in other rural areas (79%). Therefore, this migration pattern can be predominantly characterized as rural-rural. In addition, a small minority (9%) found jobs in mining and other sectors (13%), including commerce and other trades such as masonry, carpentry, and welding. These activities are conducted in urban and semi-urban areas as Natitingou and Parakou, and smaller towns, including Kerou in Northern Benin as well as Savi in Eastern Nigeria. 65 % of the migrants do not return home on a biannual or seasonal basis. They stay outside their communities for more than one year or a random basis. Is this sustainable? The head of a family migrating all the time every year is not a long-term solution. In the long run, the negative consequences outweigh the positive ones. Szaboova (2023) highlights the drawbacks of migration, such as loss of population in migration source areas, climate risk in migration destination, and material and non-material flows and economic synergies between source and destination. A long-term solution is either to invest in other techniques, such as organic fertilizer or better seeds, to fight climate change. They could also diversify their income by taking other jobs in their village or community during the dry season. This shows the need for government/NGO assistance to help farmers identify these sectors or major crops they should produce to be more competitive. Developing sensitization campaigns to inform farmers about climate change and strategies for adaptation that don’t require them to move.

Considering the theory of rural migration as a strategy for income diversification, past studies, such as Dreier and Sow (2015) and Egah et al. (2023), found that farmers in rural areas migrated to work in farms or other sectors to make a steady income flow and remit these funds to their families back home. Therefore, the awareness of income diversification as an adaptation strategy is prevalent. From the data, most farmers did not migrate with the initial thought that working elsewhere and sending money home could protect them in times of financial difficulty. Similarly, it is important to note that almost half of the respondents (48%) claimed to have another existing income source outside of agriculture and thus already engaged in income diversification. Some farmers do not send their remittances home. Considering this fact, farmers are engaged in it without needing to migrate. Thus, in this specific case study, income diversification cannot be secluded as a primary driver for rural-rural migration. In addition, according to respondents, only 50% of migrants sent home remittances while the others did not. This result was not predicted, as migrants

usually send home at least some of their savings. However, it is important to note that migrants work on farms for at least the harvest period and thus it takes time for them to accumulate income which they could bring home in person rather than send it.

The lack of remittances could also be explained by the family being able to sustain itself with the food stock (subsistence farming) or from other existing income sources. If migrants fail to send home remittances, they can still stabilize the household by bringing back income in person upon return home. Thus, migration can stabilize the household financial situation and act as a safety net in case of outside shocks or events.

The lack of labor in rural areas is another socioeconomic driver behind rural-rural migration flows. Sociocultural barriers also prevent locals from earning a wage for labor on farms in their communities. Considering that almost all farmers (97%) utilize family members for the primary labor force on their farm, it is not commonplace in these communities for farmers to find jobs working outside of their families' farm. Therefore, one could infer those farmers migrate to other communities to look for income-generating jobs, since getting paid for their labor by their families is not an option, and looking for jobs in their communities is not socially accepted. A study on migration and income diversification in Burkina Faso found that there is "cultural barrier" between offering labor for a wage in one's community, as it can be a "sign of inability to sustain production on one's own fields" (Wouterse & Taylor, 2008). In this sense, when local labor options are unavailable due to economic and sociocultural reasons, farmers must leave to look for jobs. Lastly, the majority of farmers interviewed worked independently. A very small number of respondents (7%) currently or in the past has been assisted by NGOs, the government, or other organizations in their agricultural activities. In addition, only 18% of those farmers currently use agricultural credit.

5.2. Environmental Causes

Analysing why individuals would potentially migrate due to environmental factors, it is crucial to first examine the role of geographic location. The department was one of the most significant variables in determining the migration decision. Migrants from Atacora and Donga departments were more likely to migrate and knew more farmers who migrated from their families than those from the Alibori department. As we know, West Atacora Zone and Donga are more vulnerable to climate change, while Alibori is less affected (Akponikpe *et al.* 2019). Then the deduction is that the decision to migrate is more likely to be high in regions vulnerable to climate change rather than the other one (Kaczan & Orgill-Meyer, 2020; Neumann & Hermans, 2017). It is also important to consider the frequency of migrant return. Usually, migrants (41%) claimed to return on an annual basis, 28% claimed migrants returned on a biannual or seasonal basis, and 24% claimed they returned only occasionally. It means that 65% stay outside during the rainy season. If season change was the major push factor, a larger percentage of migrants would be expected to return on a seasonal basis. According to a past study on rural-rural migration in Benin, Dreier and Sow (2015) found Bialaba farmers from Northern Benin migrated during dry seasons to work elsewhere and remitted money upon returning to farm at home during the rainy season. In this case, the same pattern cannot be identified because less migrants returned on a seasonal basis (28%). The conclusion is that environmental changes are the primary drivers of this movement instead of seasonal change. The high vulnerability of farmers to climate change in Atacora and Donga departments is related to high exposure, high sensitivity and less adaptation capacity to climate change (Akponikpe *et al.* 2019). This vulnerability forces them to migrate the whole year, abandoning their unproductive land.

Lastly, can migration in this case be singled out as an adaptation technique? The data show that when asked whether farmers could adapt to climate or environmental changes in the future, half of them responded positively and the other half negatively. Of those who believed climate change was caused by human activity (33%), almost all (90%) felt that it was necessary to adapt to and mitigate climate change. Of those who believed climate change was caused by natural phenomena (45%), only a third felt that it was necessary to adapt to and mitigate climate change. Lastly, of those who believed supernatural forces caused climate change (Bonou, 2023), the majority (77%) felt it was not possible nor necessary to adapt to or mitigate climate change. It is crucial here to draw the connection between the belief that climate change is man-made and the willingness or desire to adapt. When asked about methods of adaptation, the technique suggested by farmers was reforestation (80%), while other farmers (11%) claimed they needed more information and advice regarding environmental change and strategies for adaptation. Thus, migration was not explicitly referred to as an adaptation technique in the face of the changing climate. This result is in line with Fernández's (2024) finding: "Households do not identify environmental pressures as the main cause of migration". Rather, it is a flight way to mitigate climate change effects. It is important to note here that many of the socioeconomic causes can also be attributed to environmental change and, as such, should not be regarded as isolated drivers/causes. This aligns with Fernández's (2024) finding in Bangladesh and Ghana, who said Climate shocks affecting economic security are key drivers of migration. The recommendations are to give a reason for government/NGO to come in and spread awareness that climate change is man-made and thus can be stopped. Moreover, strategies for adaptation that don't require them to move will be highlighted (Mukherjee & Fransen 2024). They need to join into agricultural cooperatives and seek agricultural credit, technical assistance, and NGO or government programs on climate-smart agriculture.

Future research may investigate rural-urban migration flows and impact on the agricultural sector, such as that of zemidjan drivers in Benin who

often travel from rural areas (due to unproductive land or for other reasons) to work as moto taxis in the cities.

Conclusion

This study investigated how climate change influences migration decisions in the studied communes. Of all the factors influencing the willingness to migrate, it is found that the main reason remains economic (job search and well-being). Although the size of the household is found to be a paramount factor, the decision to migrate is motivated by the search for a better life in targeted regions or countries. It should be noted that these migrations are temporary, while others are permanent or long-lasting. These depend on the perceptions of community members on the current and future impact of climate change on agriculture. Succinctly, the farmers of these communities see in migration a way to diversify their income on the one hand and, on the other hand, a means of securing their backs in the face of the versatility of agricultural harvests due to climate change, which most farmers attribute to "supernatural forces". The study sheds some light on the originality of the climate-spurred migration of farmers in northern Benin by lifting the veil on their primary motivation which remains besides the youth of the candidates, the willingness to satisfy their needs and endow themselves with a more or less bright future. Nevertheless, the migration was not explicitly referred to as an adaptation/coping technique in the face of the changing climate. Rather, it is a flight, a way to mitigate climate change effect on agriculture. The drivers of migration in Northern Benin are climate change and socioeconomic reasons. Most of the socioeconomic causes can also be attributed to environmental change. As such, they should not be regarded as isolated drivers/causes.

Acknowledgements

We acknowledge BIARI (Brown University), which has founded this research. We want to thank BIARI ALUMNI RESEARCH TEAM 2016-17. We also thank ASE research assistants: Komivi Badohoun, Yannick Ngongang Mbunang, Roger Kpadonou, and Ségolène Eyebiyi. Finally, we thank the enumerators: Ken Kounouewa and Morel Kogbevi, and the farmers who participated in this survey.

References

Agbanou, B. T. (2018). Dynamique de l'occupation du sol dans le secteur Natitingou-Boukoumbé (nord-ouest bénin) : De l'analyse diachronique à une modélisation prospective [Phdthesis, Université Toulouse le Mirail - Toulouse II ; Université d'Abomey-Calavi (Bénin)]. https://theses.hal.science/tel-02476241

Ahir, H., Garbers, H., Coppo, M., Melina, M. G., Narita, M. F., Unsal, M. F. D., Malta, V., Tang, X., Gurara, D., Zanna, L.-F., Venable, L. G., Kpodar, M. K. R., & Papageorgiou, M. C. (2021). Macroeconomic Research in Low-income Countries : Advances Made in Five Key Areas Through a DFID-IMF Collaboration. International Monetary Fund, 59p.

Akponikpe P.B.I., Tovihoudji P., Lokonon B., Kpadonou E., Amegnaglo J., Segnon A. C., Yegbemey R., Hounsou M., Wabi M., Totin E**.,** Fandohan-Bonou A., Dossa E., Ahoyo N., Laourou D., Aho N., (2019). Etude de Vulnérabilité aux changements climatiques du Secteur Agriculture au Bénin. Report produced under the project "Projet d'Appui Scientifique aux processus de Plans Nationaux d'Adaptation dans les pays francophones les moins avancés d'Afrique subsaharienne", Climate Analytics gGmbH, Berlin.

Ali, S. H., Kniveton, D., & Djalante, R. (2023). Human Migration and Natural Resources : Global Assessment of an adaptive complex system, United Nations Environment Programme Report, 166p. https://pure.iiasa.ac.at/id/eprint/19135/

Alokpaï, N., Djibrila, R. Y., Tchekli, T. G. R., Sambieni, E., & Mongbo, R. L. (2024). Pour une paix durable entre agriculteurs et eleveurs au Benin : Lessons tirées de la gouvernance des infrastructures et ressources agropastorales dans la Commune de Banikoara. *International Journal of Innovation and Applied Studies, 44(1)*, 60-76. http://www.ijias.issr-journals.org/

Aubréville, A., & Chevalier, A. (1949). Climats, forêts et désertification de l'Afrique tropicale/par A. Aubréville; préface de Aug. Chevalier. Société d'éditions Géographiques, Maritimes et Coloniales. https://lccn.loc.gov/50000067

Bambara, D., Bilgo, A., Hien, E., Masse, D., Thiombiano, A., & Hien, V. (2013). Perceptions paysannes des changements climatiques et leurs conséquences socio environnementales à Tougou et Donsin, climats sahélien et sahélo-soudanien du Burkina Faso. *Bulletin de la Recherche Agronomique du Bénin*, *74*(1), 8-16.

Baudoin, M.-A., Sanchez, A. C., & Fandohan, B. (2014). Small scale farmers' vulnerability to climatic changes in southern Benin : The importance of farmers' perceptions of existing institutions. Mitigation and Adaptation Strategies for Global Change, 19(8), 1195-1207. https://doi.org/10.1007/s11027-013-9468-9

Bezu S, Demissie T, Abebaw D, Mungai C, Samuel S, Radeny M, Huyer S, Solomon D. (2020). Climate change, agriculture and international migration nexus: African youth perspective. CCAFS Working Paper no. 324. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), 57p.

Bohnenkämper, R., Fußeder, C., Emmanouilidis, G., Emmert, C., Haberger, M., Hartmann, N., Hohlfeldt, L., Jäckel, F., Körber, J., Listl, J., Ostendorp, F., Pantaleon Osuna, A., Steinmetzer, L., Thurl, L., Ungruhe, C., Wagener, J., & Wehner, S. (2024). Socio-economic development and migration in rural Ghana : Report from field research in Amedzofe, Volta Region. https://doi.org/10.15475/mitrawa.upa3

Bonou, A., Egah, J., Aihounton, G. B. D., & Bloor, M. (2024). Impact of floods on rice production in West Africa: Micro-evidence from Benin. *Sustainable Environment*, 10(1). https://doi.org/10.1080/27658511.2024.2356396

Bonou, A., Lokonon, B. O., Singbo, A. G., & Egah, J. (2023). Socio-demographic determinants of farmers' beliefs about climate change cause in the Sudanian zone of Benin. *Annales de l'Université de Parakou-Série Sciences Naturelles et Agronomie*, *13*(1), 31-42.

Butros, D., Gyberg, V. B., & Kaijser, A. (2021). Solidarity Versus Security : Exploring Perspectives on Climate Induced Migration in UN and EU Policy. Environmental Communication, 15(6), 842-856. https://doi.org/10.1080/17524032.2021.1920446

Cattaneo, C., Beine, M., Fröhlich, C. J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M.Schraven, B. (2019). Human migration in the era of climate change. Review of Environmental Economics and Policy, 13(2), 189-206.

Crawford, N. J. W., Michael, K., & Mikulewicz, M. (2023). Climate Justice in the Majority World : Vulnerability, Resistance, and Diverse Knowledges. Taylor & Francis. DOI:10.4324/9781003214021.

Coulibaly, T., Islam, M., Managi, S. (2020). The impacts of climate change and natural disasters on agriculture in African countries. *Economics of Disasters and Climate Change*, 1-18.

de Haas, H., Czaika, M., Flahaux, M.-L., Mahendra, E., Natter, K., Vezzoli, S., & Villares-Varela, M. (2019). International Migration : Trends, Determinants, and Policy Effects. P*opulation and Development Review, 45(4), 885-922*. https://doi.org/10.1111/padr.12291

Demont, T. (2022). Coping with shocks : How Self-Help Groups impact food security and seasonal migration. *World Development,* 155, 105892. https://www.sciencedirect.com/science/article/pii/S0305750X22000821

Djodjo, G. E. (2018). Entrepreneuriat agricole au Bénin: étude économique de la production du riz de bas-fonds à Ouaké. *Repères et Perspectives Economiques*, *2*(1). https://doi.org/10.34874/IMIST.PRSM/RPE/11340

Dreier, V., & Sow, P. (2015). Bialaba Migrants from the Northern of Benin to Nigeria, in Search of Productive Land—Insights for Living with Climate Change. Sustainability, 7(3). https://doi.org/10.3390/su7033175

Egah J., Bonou A., Baco M. N., Moumouni I. M., Kestemont M-P. (2023): Les migrations agricoles participent-elles à la conservation de l'agrobiodiversité? Cas de l'igname au Nord-Bénin, Afrique de l'Ouest. *Cah. Agric. 2023, 32, 18.* https://doi.org/10.1051/cagri/2023011.

Esteve, A., Pohl, M., Becca, F., Fang, H., Galeano, J., García-Román, J., Reher, D., Trias-Prats, R., & Turu, A. (2024). A global perspective on household size and composition, 1970–2020. *Genus, 80(1), 2.* https://doi.org/10.1186/s41118-024-00211-6

Farooq, M. S., Uzair, M., Raza, A., Habib, M., Xu, Y., Yousuf, M., Yang, S. H., & Ramzan Khan, M. (2022). Uncovering the Research Gaps to Alleviate the Negative Impacts of Climate Change on Food Security: A Review. *Frontiers in Plant Science, 13.* https://doi.org/10.3389/fpls.2022.927535

Fernández, S., Arce, G., García-Alaminos, Á., Cazcarro, I., & Arto, I. (2024). Climate change as a veiled driver of migration in Bangladesh and Ghana. *Science of the total environment*, *922*, 171210.

Fontès, J., & Guinko, S. (1995). *Carte de la végétation et de l'occupation du sol du Burkina Faso*.

Gemenne, F. (2017). The refugees of the Anthropocene. In: *Research handbook on climate change, migration and the law* (pp. 394-404). Edward Elgar Publishing. https://doi.org/10.4337/9781785366598.00025

Hermans, K., & McLeman, R. (2021). Climate change, drought, land degradation and migration : Exploring the linkages. *Current opinion in environmental sustainability, 50,* 236-244. https://www.sciencedirect.com/science/article/pii/S1877343521000701

INSAE. (2016). *Recensement Général de la Population et de l'Habitation (RGPH4). Résultats Définitifs*. INSAE : Cotonou, Bénin ; 209.

IOM. (2019). World Migration Report 2020. United Nations. https://doi.org/10.18356/b1710e30-en

IOM. (2020). World Migration Report 2024. https://publications.iom.int/books/world-migration-report-2024

Jha, C. K., Gupta, V., Chattopadhyay, U., & Sreeraman, B. A. (2017). Migration as adaptation strategy to cope with climate

change : A study of farmers' migration in rural India. *International Journal of Climate Change Strategies and Management, 10(1),* 121-141. https://doi.org/10.1108/IJCCSM-03-2017-0059

Kaczan, D. J., & Orgill-Meyer, J. (2020). The impact of climate change on migration: a synthesis of recent empirical insights. *Climatic Change*, *158*(3), 281-300. https://doi.org/10.1007/s10584-019-02560-0

Klutse, N. A. B., Owusu, K., Nkrumah, F., & Anang, O. A. (2021). Projected rainfall changes and their implications for rainfed agriculture in northern Ghana. *Weather, 76(10)*, 340-347. https://doi.org/10.1002/wea.4015

Kraler, A., Kofman, E., Kohli, M., & Schmoll, C. (2011). Gender, generations and the family in international migration. *Amsterdam University Press.* https://library.oapen.org/handle/20.500.12657/34532

Kumar, N., & Bhagat, R. B. (2017). Interaction between migration and development: A study of income and workforce diversification in rural Bihar. *Environment and Urbanization ASIA*, *8*(1), 120-136. https://doi.org/10.1177/0975425316683869

Le Corre, M. R. V. (2016). Influence du climat, de la disponibilité des ressources et de la taille des populations sur la phénologie et les patrons de migration du caribou migrateur," Rangifer tarandus". Philosophiæ doctor (Ph. D.) -- Université Laval, 2016, 144 pages.

Lokonon, B. O. K. (2019). Farmers' vulnerability to climate shocks : Insights from the Niger basin of Benin. *Climate and Development, 11(7),* 585-596. https://doi.org/10.1080/17565529.2018.1511403

Majumdar, R., & Weber, E. U. (2023). Multilevel intergroup conflict at the core of climate (in)justice : Psychological challenges and ways forward. *WIREs Climate Change, 14(5),* e836. https://doi.org/10.1002/wcc.836

McLeman, R., Schade, J., & Faist, T. (Eds.). (2016). *Environmental migration and social inequality* (Vol. 61). New York: Springer International Publishing. 240p.

Mukherjee, M., & Fransen, S. (2024). Exploring migration decision-making and agricultural adaptation in the context of climate change: A systematic review. *World Development*, 179, 106600.

Muluneh, M. G. (2021). Impact of climate change on biodiversity and food security : A global perspective—a review article. *Agriculture & Food Security, 10(1)*, 36. https://doi.org/10.1186/s40066-021-00318-5

Neumann, K., & Hermans, F. (2017). What drives human migration in Sahelian Countries? A meta-analysis. *Population, Space and Place*, *23*(1), e1962.

Rademacher-Schulz, C. (2014). The making of the social order–migration, resource and power conflicts in the Moroccan Draa Valley. Erdkunde 68(3), 173-183. https://www.jstor.org/stable/24365230

Silchenko, D., & Murray, U. (2023). Migration and climate change–the role of social protection. *Climate Risk Management, 39,* 100472. https://www.sciencedirect.com/science/article/pii/S2212096322000791

Szaboova, L., Adger, W. N., de Campos, R. S., Maharjan, A., Sakdapolrak, P., Sterly, H., ... & Abu, M. (2023). Evaluating migration as successful adaptation to climate change: Trade-offs in well-being, equity, and sustainability. *One Earth*, *6*(6), 620-631. https://doi.org/10.1016/j.oneear.2023.05.009

Tacoli, C. (2009). Crisis or adaptation? Migration and climate change in a context of high mobility. *Environment and Urbanization, 21(2),* 513-525. https://doi.org/10.1177/0956247809342182

Tcha, M. (1995). Altruism, household size and migration. *Economics letters*, *49*(4), 441-445.

Wouterse, F., & Taylor, J. E. (2008). Migration and income diversification: Evidence from burkina faso. *World Development*, *36*(4), 625-640.

Zickgraf, C., Vigil Diaz Telenti, S., De Longueville, F., Ozer, P., & Gemenne, F. (2016). The impact of vulnerability and resilience to environmental changes on mobility patterns in West Africa. KNOMAD WORKING PAPER 14 , 31p. **https://hdl.handle.net/2268/193650**

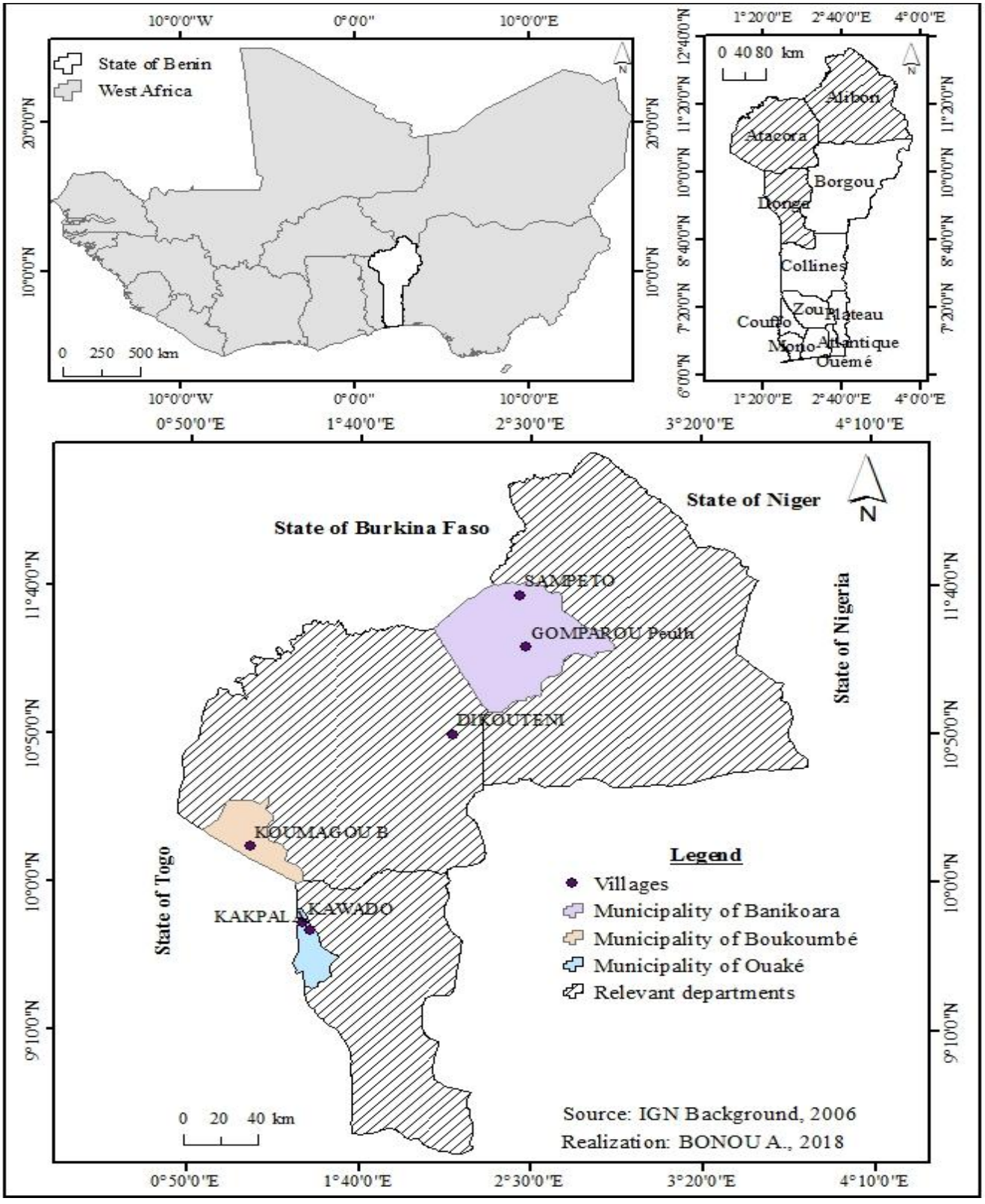


Figure 1: *Study AreaSource: Bonou, A. 2018*

Table 1: Variables and descriptive statistics

Qualitative variables		
Variable names	**Modalities**	**Frequencies (%)**
Sex	Man	95
	Female	5
	Total	100
Education	None	56.67
	Primary	21.67
	Secondary	21.67
	Total	100
Ethnicity	Otammari	36
	Gando	13
	Lokpa	31
	Bariba	10
	Others	10
	Total	100
Agriculture as the main source of income	Yes	51.67
	No	48.33
	Total	100
Quantitative variables		
Variables names	**Mean**	**Std. Dev.**
Household size	11.18	7.29
Experience	24.82	14.37
Farm size	5.63	5.93

Source: Data collected, 2017

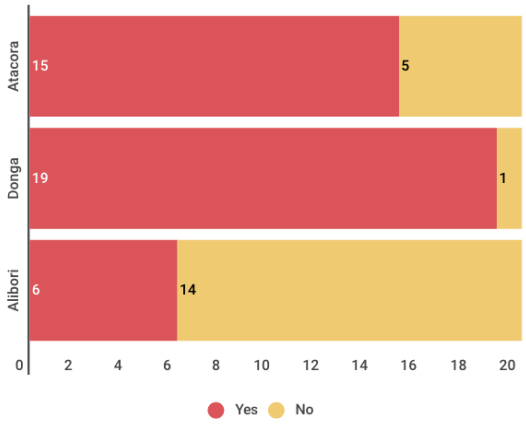
Table 2 : Farmers' perceptions of climate change and adaptation techniques

Variables names	**Modalities**	**Frequencies (%)**
Perception of climate change	last 1 to 5 years	52
	last 6 to 15 years	35
	last 15 to 30 years	13
Primary cause of climate change	supernatural forces	48
	natural phenomena	29
	man-made : deforestation	18
	misuse or overuse of pesticides and chemicals	2.5
	Don't know	2.5
Current major impacts of climate change on farm	meager and unproductive harvests	63
	soil degradation	30
	Other	7
Future impacts of environmental change	famine and future food scarcity	62
	land unproductive in the future	17
	abandoning agriculture	12
	Don't know/ Other	9
Climate change adaptation techniques	Reforestation	80
	need more information and advice	11
	abandon chemical fertilizers	2
	Don't know	7
Source of information regarding climate change	Radio	72
	Friends	15
	TV	10
	personal Observation	3

Source: Data collected, 2017

(a)

Figure 2: Number of migrants by department



Migrant destination	Frequency	Percentage
Nigeria	16	40%
Benin (Parakou, central region, etc).	15	37%
Togo	5	13%
Niger	2	5%
Did not know anyone who migrated/No	1	3%
Other country - unspecified	1	3%
Total	40	100

Figure 4: Migrant sectors of employment (a) and rate of migrant return (b)

(b)

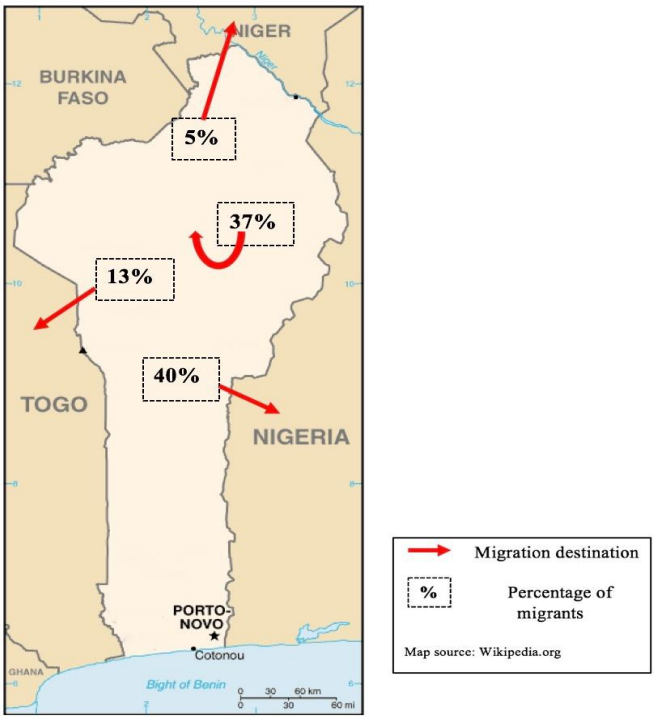


Figure 3: Map of migrant destinations

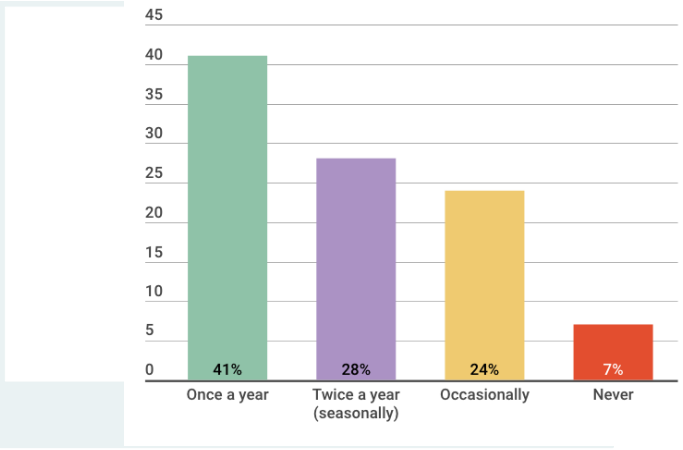


Table 3: Logistic regression results

Variables	Coefficient
Experience working in agriculture (expe)	**-0.077*** (0.044)
Number of males (Nmhh)	**2.406**** (1.205)
Number of females (nwhh)	**2.626**** (1.263)
Possibility t	-1.294 (0.868)
o adaptation (mcc)	
Age (age)	**0.128**** (0.06)
Recognizing climate change as a threat to their livelihood (apc_lab)	-1.875 (1.361)
Size of household (hhsize)	**-2.461**** (1.227)
Size of land cultivated (sup)	-0.028 (0.082)
Department of origin (depart)	**-1.195*** (0.686)
Government or NGO assistance or agricultural credit (acret)	-0.578 (1.262)
Household-head level of education (instruc)	1.051 (0.69)
Agriculture like their only source of revenue (agrev)	0 (0)
Constant	-1.063 (2.815)
Observations	60
Pseudo R^2	0.361
LR chi2 (9)	16.13**
Standard errors are in parentheses	
***** p<0.01, ** p<0.05, * p<0.1**	

Source: data collected, 2017