Chapter 5
Climate-Induced Migration in West Africa

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Although West Africa's contribution to global climate change is very minimal, its geographical location and weak adaptive capacity makes it highly vulnerable to the effects of climate change and variability. The livelihoods of people in the dry regions of West Africa, in particular, are adversely affected by increased temperature and fluctuating rainfall patterns because they depend on rain-fed agriculture and ecosystem services. Flooding is also a common climate-induced hazard in some West African countries. However, only a few researchers have examined the nature of climate-induced migration in the sub-region. This chapter examines how migration is used as a strategy to deal with climate change and variability in West Africa. While it is difficult to separate climatic drivers from the socio-economic causes of migration, seasonal and permanent migration are increasingly used by households to deal with climate change and variability in some communities in West Africa. Floods have also caused population displacement in parts of West Africa. While human mobility occurs in response to changes in climatic variables, migration is not adequately incorporated into planned climate change adaptation strategies being implemented by governments in the sub-region. This chapter, therefore, recommends that migration should be incorporated into climate change adaptation and development policies and programs in the sub-region.

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J. K. Teye (ed.), *Migration in West Africa*, IMISCOE Research Series,
https://doi.org/10.1007/978-3-030-97322-3_5

5.1 Introduction

Climate change has, in recent years, engaged the attention of the global community, in view of its negative impacts on livelihoods and sustainable development, especially in developing countries (Afifi et al., 2014; Mbiyozo, 2020; Wilkinson et al., 2016). The emission of greenhouse gases is largely blamed for recent changes in climatic variables, especially rising temperature and fluctuating rainfall. According to the Intergovernmental Panel on Climate Change (IPCC) (2018), from 1850–1900 to 2006–2015, mean land surface air temperature has increased by 1.53 °C. Such an increasing trend of temperature is predicted to continue, especially in the foreseeable future (Foresight, 2011). While some regions of the world have experienced increased precipitation, dryland areas, especially in sub-Saharan Africa and Asia, are experiencing fluctuating and decreased precipitation (IPCC, 2018). Although sub-Saharan Africa contributes only 7.1% to global greenhouse gas emissions, its poorest and most Marginalized people are the most exposed to the harsh impacts of climate change (Rigaud et al. 2018; Mbiyozo, 2020).

While human mobility has, for centuries, been part of livelihoods in Africa (Mensah-Bonsu, 2003), it has become a major climate adaption strategy in recent years (Dreier & Sow, 2015; Teye & Owusu, 2015). There is enough evidence to suggest that migration is one of the most common and increasingly used strategies to cope with harsh climatic variations and natural disasters. Many of the environmental migrants (i.e. people who migrate in response to climate change and variability) in Africa are households whose livelihoods depend on rain-fed agriculture (Jarawura & Smith, 2015; Teye et al., 2015). Migration allows such households to modify their exposure to climatic and environmental stressors and thereby diversify their income sources when on-site adaptation is either impossible or undesirable (Bendandi & Venier, 2017). Thus, for families and communities that rely on livelihoods that are vulnerable to threats of climate change, migration forms a critical resilience strategy for diversifying income and spreading risk (Mbiyozo, 2020).

The West African sub-region has, particularly, been the focus of much of the recent academic and policy discussions on the effects of climate change on human mobility. The sub-region's location, high dependency on rain-fed agriculture, poverty and weak governance systems, make it highly vulnerable to the effects of climate change/variability (Stan turf et al., 2011; IOM, 2021). Indeed, weak adaptive capacity in the face of recurrent drought has triggered low crop yields, food insecurity, poverty, and out-migration in the dry areas of West Africa (IOM, 2021). However, although West Africa's population is considered one of the most mobile in the world (Romankiewicz & Doevenspeck, 2015), only a few researchers have examined climate-related migration in the sub-region (Van der Geest, 2011; Zickgraf et al., 2016). As a result, there is little understanding of the dynamics of climate-induced migration in West Africa and how migration is used to deal with climate change and variability (Afifi et al., 2016).

Against this background, this chapter relies on a review of the literature and recent studies to examine migration in the context of climate change and variability

in West Africa. More specifically, the chapter discusses how migration is used as a strategy to deal with the 'slow-onset' climatic processes, especially rainfall variability and drought. It also discusses how 'rapid on-set' environmental processes, especially rainstorms and flooding, cause population displacement in West Africa. The chapter is divided into four sections. The next section is devoted to the conceptualization of the relationship between climate change and migration. Section 5.3 describes the climate change situation, while Sect. 5.4 presents climate adaptation strategies in West Africa. Section 5.5 presents empirical findings on climate-induced migration in West Africa. Section 5.6 discusses climate immobility, while Sect. 5.7 presents the conclusion and policy implications of the findings.

5.2 Theoretical Perspectives on the Relationship Between Climate Change and Migration

While it is generally acknowledged that climate change induces migration, there are opposing views on the number of people who actually migrate as a result of climate/environmental change. The IOM (2007: 1) defines 'environmentally induced migrants' as 'persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad'. However, the relationship between environmental/climate change and migration is contested, with some scholars questioning the role of climate change in large-scale migration flows (Sow et al., 2014). For instance, Black (2001) argued that although climate change influences migration decision-making processes in the Sahel, it is not a major driver of migration in the region. Doevenspeck (2011), similarly, argued that environmental change is not a major cause of migration in Benin because, despite increased environmental change across the northwestern parts of the country, not all the affected households migrate. Some scholars have argued that while it is easier to attribute population mobility to 'rapid onset' climatic events (e,g. flooding, cyclones) which force people to flee, it is quite difficult to directly link large-scale migration to 'slow-onset' climatic processes, such as rising temperatures and declining rainfall (Renaud et al., 2011; Teye, 2017).

On the other hand, some scholars contend that a wave of environmental migrants may follow environmental degradation, including drought (van der Geest et al., 2010). According to Hugo (2011), environmental factors, including climate change, can be key drivers of migration, with their degree of significance being more often located along a continuum ranging from 'not being significant at all' to 'being the dominant cause of migration'. Thus, the environment can mostly be considered a 'proximate' cause of migration, making it difficult to differentiate between 'environmental migrants' and others except at the extreme/forced end of the continuum. There is, however, ample evidence to suggest that the debates about the climate/

environment-migration nexus are not so much about whether environmental factors play a role in migration but the magnitude of their influences, given that several factors combine to precipitate migration (Black et al., 2011; Zickgraf et al., 2016). Recent scholarship has shown that a number of factors, including the type of climate shock, population characteristics, institutional capacity to ameliorate the adverse effects of climate change, largely determine whether or not migration will be adopted to deal with climate change and variability (Bendandi & Venier, 2017; Renaud et al., 2011; Teye, 2017).

5.2.1 Conceptual Framework

Based on insights from the literature, the conceptual framework used for the analysis in this chapter assumes that migration is a highly personal decision based on a range of complex and often overlapping reasons involving economic, environmental, social and political factors. This makes it difficult to isolate climatic drivers and accurately forecast levels of migration due to climate change (Mbiyozo, 2020). We, however, agree with the assertion of Hummel (2016: 220) that while it is almost impossible to isolate environmental factors from the complex interplay of ecological, economic, social and political factors that shape migration decisions, it is feasible to analyze the impacts of climate change on migration by considering the motive for migration.

Following Foresight (2011) and UN Environment (2017: 7), we assume that the decision to migrate is influenced by macro-level, meso-level and micro-level determinants (see Fig. 5.1). The five broad macro-level drivers are demographic factors (e.g. population density, population structure, disease prevalence), political factors (e.g. governance/freedom, policy incentives, conflict/insecurity), economic factors (e.g. employment opportunities, income and wage, producer prices), social factors (e.g. family/kin obligation, marriage, and seeking education) and environmental factors (e.g. land productivity, habitability, food and water resources). While these macro-level factors may create a context where migration is desirable, the final decision to migrate or stay is taken by individuals based on interaction of micro-level factors (e.g. age, gender, level of education) and meso-level factors (e.g. intervening obstacles such as cost of moving). The people who migrate can further be divided into two categories, namely those who voluntarily choose to leave and those who are forcefully displaced (not shown in figure). Those who stay can also be divided into two groups, namely those who voluntarily choose to stay (immobile) and those who are unable to move (trapped) (Foresight, 2011; Schraven et al., 2020).

The interaction between and among macro-level, meso-level and micro-level factors explain why, faced with the same climate change, some people may choose to migrate while others may choose to stay. The framework will predict that people who do not have the resources to pay the cost of migration may not move even if they are affected by environmental climate change. This group is said to be trapped. Relying on the entitlement framework, Teye and Owusu (2015) argue that, when

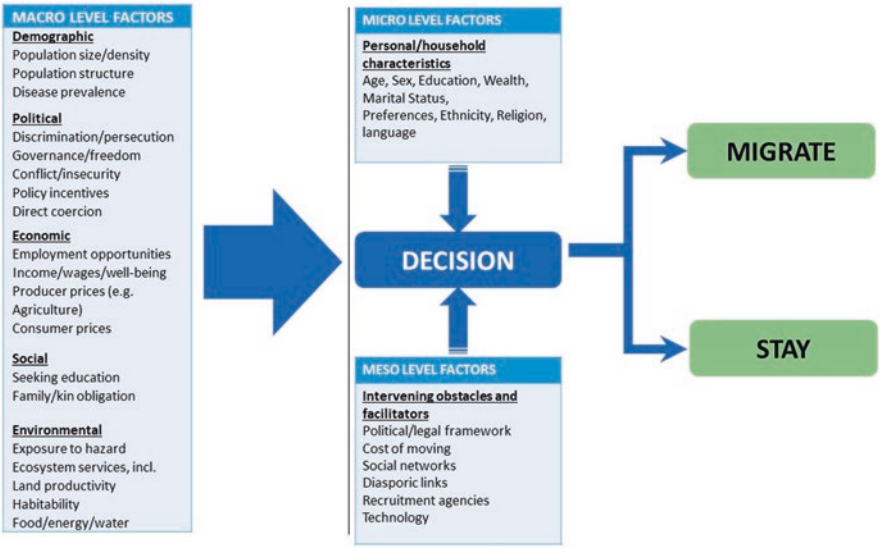

Fig. 5.1 Drivers of Migration. (Source: Adapted from Foresight Framework, 2011)

faced with slow-onset climatic processes, individual's decision to migrate or remain are shaped by their endowments (rights and resources). They argue that persons who have the resources to adopt effective in-situ adaptation strategies, such as irrigation, may not migrate in the context of climate change. However, some level of endowments will also be required to embark on migration. We further assume that the nature of climatic process or event will determine migration trends. In the case of 'rapid onset' events such as floods, significant number of people in affected communities will be forcefully displaced but some will come back after successful recovery of the affected area. In the case of 'slow on-set' events, migration will depend on characteristics of individuals and ability to overcome intervening obstacles, such as cost of migration.

5.3 Climatic Zones and Climate Change in West Africa

While the climate of West Africa is largely tropical, it varies with location even within the same country. As shown in Fig. 5.2, there are four major climatic zones, namely the Sahelian zone, Sudano-Sahelian zone, Sudanian zone and Guinean zone. The Sahelian zone, which is located in the northern part of West Africa, is the driest part of the sub-region with precipitation ranging between 250 mm and 500 mm. The Sudano-Sahelian zone is also quite dry with average annual precipitation ranging between 500 mm and 900 mm. The Sudanian zone has an average annual precipitation between 900 mm and 1100 mm, while the Guinean zone has an average annual precipitation greater than 1100 mm (Emetere, 2017).

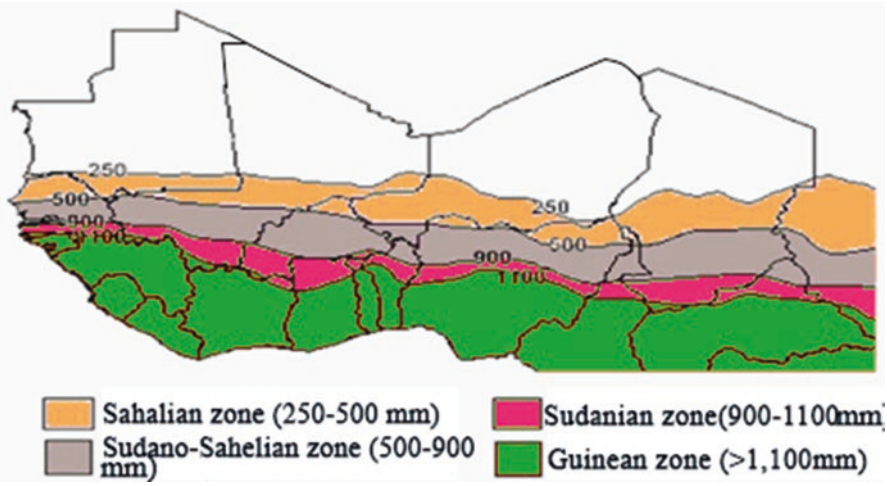

Fig. 5.2 Climatic Zones of West Africa. (Source: Adapted from Emetere, 2017)

Generalizing about climate change and variability patterns in West Africa is quite problematic because important elements, such as rainfall and temperature, vary not only across the region but also within countries. Generally speaking, however, while a recovery of rainfall across the region has been experienced (Nicholson, 2005), most of the countries in the sub-region have witnessed fluctuating or unpredictable rainfall regimes (Heinrigs, 2010; Owusu & Teye, 2014). There have been prolonged intra-seasonal dry spells (Salack et al., 2016). The Sahel region is particularly very vulnerable to climate change and its weather patterns are highly unpredictable (Heinrigs, 2010). Indeed, high rainfall variability, declining rainfall and recurrent droughts are common features of the Sahelian climate, resulting in the arid and hyper-arid climate of the region. As shown in Fig. 5.3, the Sahel region experienced severe droughts in 1973, 1984, 1990 and 2012. The frequency of droughts in the Sahel, in recent years, has exceeded those predicted by climate models (Hulme et al., 2001). Within the Sahel, the Chad Basin is, particularly, experiencing drought. Countries that are outside the Sahel have also been witnessing declining rainfall. In Ghana, for instance, rainfall amount has declined by 20% since 1960, and it is further projected to decline between 9% and 27% by 2100 (Minia, 2004). On the other hand, since the 1960s, mean annual temperature has been on the ascendancy in the West African region. The Sahel region has, particularly, been witnessing increasing temperatures than any other part of the region. Fontaine et al. (2013) showed a significant warming of 1 °C– 3 °C for the Sahel for the period 1979–2011, which roughly corresponds with the trend we have established in Fig. 5.3. Since the mid 1990's, temperatures have been above normal and increasing. Other estimates show that temperatures in the Sahel are increasing 1.5 times faster than the rest of the world (Gliessman, 2021).

The changes in climatic variables in West Africa are believed to be higher than that of global warming (Ezeife, 2014). The most concrete expression of climate

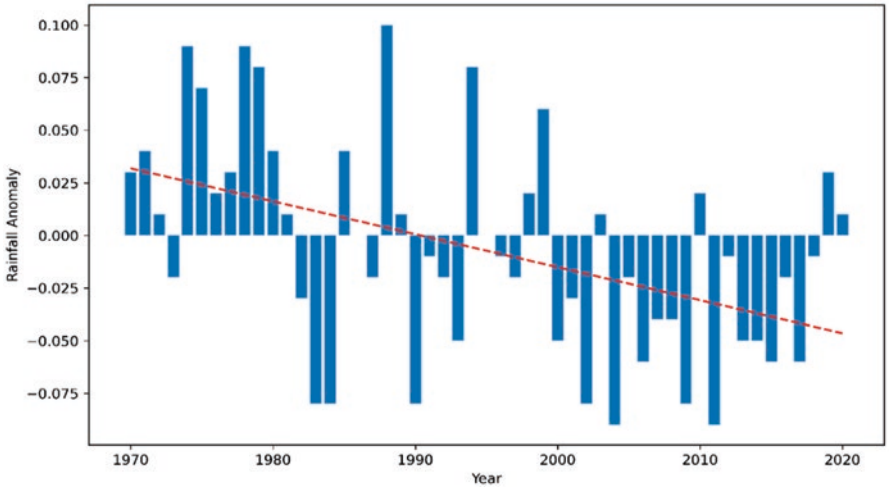

Fig. 5.3 Annual rainfall anomalies accumulated over the Sahel region of Africa from 1970 to 2020 (Line equation y = −0.001567x + (3.119750). (Source: Authors' construct based on data from the Climate Change Institute)

change in the sub-region, namely droughts, strong winds, floods, and heat waves, have impacted over 28 million people in the sub-region in 2010–2014 (Dreier & Sow, 2015; Zickgraf et al., 2016). Since 2000, high temperatures and drought, especially in the arid areas, have affected the livelihoods of millions of people who directly depend on natural resources (Gemenne et al., 2014). With the direct dependance of majority of its population on ecological resources for livelihoods, as well as decades of massive population growth, high level of poverty, food insecurity and chronic instability, predicted impacts of climate change could be dramatic for the Sahel (UNEP, 2011).

A livelihood security analysis, conducted by the United Nations Environment Programme identified 19 "climate hotspots" seriously affected by climate change (UNEP, 2011). These hotspots, which are located in Niger, Burkina Faso, northern and coastal Ghana, northern Togo, Benin, and Nigeria, have significantly decimated livelihood security and exacerbated vulnerability among local populations (UNEP, 2011, Zickgraf et al., 2016). The effects of climate change in the sub-region include water shortage, crop failure and food insecurity (Mora et al., 2013; Sissoko et al., 2011). During our recent studies in the northern savannah zone of Ghana, farmers reported how unreliable rainfall is causing crop failure, food insecurity and water stress, as highlighted in the statement below by a farmer in the Wa West district of Ghana:

> For some years now, unreliable rainfall has affected crop production in this community. Last year, we experienced serious crop failure as a result of unreliable rainfall. Many of us do not have adequate food to feed our families because of the poor harvest last year. Some of our streams also dried up and women have to travel long distances looking for water.

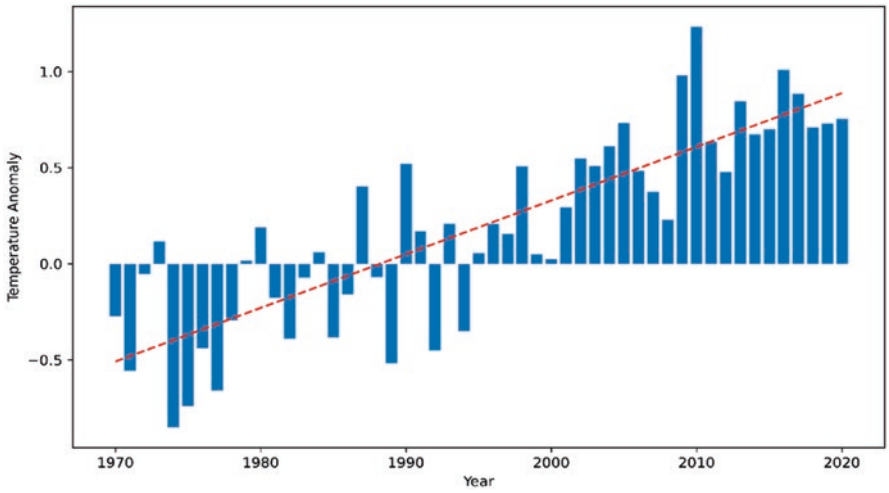

Fig. 5.4 Annual temperature anomalies averaged over the Sahel region of Africa from 1970–2020 (data from the Climate Change Institute). Line equation y = 0.027924x + (−55.519093). (Source: Authors' construct based on data from the Climate Change Institute)

Consistent with the statement above, high rainfall variability and early cessation have caused increased food insecurity in Sahelian countries such as Burkina Faso, Mali and Senegal. Additionally, as a result of climate change/variability, coastal areas in the West African sub-region (i.e. from Mauritania to Nigeria) experience sea-level rise (Shukla et al., 2019), which sometimes trigger floods and erosion (Stringer et al., 2011). The IPCC (2012) attributes recent noticeable upsurge in natural disasters in West Africa to global warming. Rising temperatures, decreased rainfall, and sea-level rise are expected to continue to tremendously impact communities in West Africa (Bendandi & Venier, 2017) (Fig. 5.4).

5.4 Climate Change Adaptation Strategies in West Africa

According to Afriyie et al. (2018), adaptation to climate change involves modifications to natural, societal, and economic structures in response to real or anticipated climatic inducements and their influences, which minimizes damage or exploits valuable prospects. In the literature, two fundamental forms of adaptation to climate change have been identified, and these are autonomous and planned adaptations (Bawakyillenuo et al., 2016). Whereas autonomous adaptation entails strategies independently adopted by households or individuals (usually farmers) to deal with climate change and variability, planned adaptation encompasses deliberate public agency strategies intended to reduce losses and or exploit benefits associated with climate change. Some of the documented in-situ climate adaptation strategies

adopted by farmers in West Africa include the cultivation of improved crop varieties; changing the planting date; irrigation; off farm-economic activities; and new knowledge about early warning systems (Bawakyillenuo et al., 2016: Afriyie et al., 2018). In West Africa, many of these strategies are autonomously adapted by farmers.

The main reason why autonomous adaptation strategies are more pervasive in West Africa is the inability of governments to design and implement planned adaptation strategies (Gbetibouo, 2009; Teye et al., 2015). However, the rate of adoption of the autonomous climate change adaptation strategies is also very low, due to financial and technical constraints (Afriyie et al., 2018). For instance, while irrigation is one of the most effective strategies for dealing with declining and fluctuating rainfall regimes being experienced in West Africa (Bawakyillenuo et al., 2016), one European Union-funded study conducted in the very dry Upper West region of Ghana in 2019 indicates that only 0.8% of the over 2000 households surveyed used irrigation to deal with climate change and variability. The recent study shows that in some of the communities that clearly need irrigation for farming, unavailability of dams is a main barrier to adoption of irrigation. The lack of infrastructure for irrigation is a common challenge in various arid and semi-arid regions of all the various West African countries, including Nigeria, Mali, Niger. Our recent studies in Ghana indicate that, in the absence of dams in communities that are facing challenges of climate change, some farmers use diesel pumps to pump water from rivers, small streams or ponds to water crops. Some farmers also rely on small dug-outs with canals to cultivate crops. Farmers in our recent studies explained that both the use of pumps and construction of dug-outs are quite expensive and far beyond the economic resources of many households (see also Teye & Owusu, 2015). There are gendered dynamics of adoption of adaptation strategies induced by disparities in exposure, vulnerability, access to resources, capabilities and prospects, with existing peculiar communal conditions, forces and characteristics important for successful adaptation (Afriyie et al., 2018; Parsons, 2019). A research by Teye and Owusu (2015) in the dry coastal savannah zone of Ghana, for instance, showed that female farmers generally lack the endowments (e.g. financial resources, access to land) to adopt some of the effective climate change adaptation strategies, such as irrigation.

Recognizing the challenges faced by farmers in their efforts to adopt climate adaptation strategies, some West African governments and development partners have been designing and implementing a few planned adaptation schemes in some countries, including Nigeria, Ghana, Mali, Niger, and Burkina Faso. In Ghana, for instance, planned climate change adaptation strategies have been outlined by the National Climate Change Policy (NCCP) (Ministry of Environment, Science, Technology and Innovation, 2012). The planned climate change adaptation strategies being implemented by the government of Ghana and its development partners include the introduction of improved crop varieties with short gestation periods, provision/rehabilitation of irrigation facilities in communities experiencing climate change, and training of farmers in off-farms income generation activities (see Teye & Owusu, 2015). The government of Ghana has recently completed the *National Climate-Smart Agriculture and Food Security Action Plan of Ghana (2016–2020),*

which provides a comprehensive framework for developing climate-smart agriculture in Ghana (Essegbey et al., 2015). In addition to the governments programmes, planned adaptation programmes are also implemented by international agencies in various communities in the dry regions of West Africa. For instance, UNDP has, since 2016, been implementing an Adaptation Fund Project, which aims to increase resilience to climate change in northern, Upper East and Upper West regions of Ghana through the management of water resources and diversification of livelihoods. The European Union has also been funding the 'Resilience Against Climate Change in Ghana project', which aims to enhance infrastructure and technical knowledge for irrigation and other strategies needed to deal with declining rainfall and increasing temperature.

In situations where the in-situ adaptation strategies described above are unfeasible and or undesirable, migration is 'autonomously' used to deal with the effects of climate change. It is in light of this that some scholars such as Gemenne et al., (2014) and Zickgraf et al. (2016) have noted that climate change manifestations, such as drought, desertification, intense heat and winds, floods and rising sea level, significantly influence mobility patterns from and within West Africa. However, many of the West African governments do not see migration as an effective climate adaptation strategy. Consequently, planned migration has not been comprehensively incorporated into National Adaptation Program of Action (NAPAs). In fact, some governments even characterize migration as a maladaptation (Sward & Codjoe, 2012; Teye, 2017).

5.5 Evidence of Climate-Induced Migration in West Africa

There is enough evidence to suggest that, although it is difficult to isolate the role of climate change from other drivers of migration, both rapid- and slow-onset climatic processes have contributed to migration in many parts of West Africa. This section begins with an assessment of migration in response to rapid-onset climatic events in West Africa. This is followed by an analysis of the effects of slow on-set processes, namely drought and rainfall variability, on migration.

5.5.1 Effects of Rapid On-Set Climatic Events on Migration and Displacement

In West Africa, rainstorms and floods are the most common rapid-onset climatic events that drive people away from their usual places of residence. Floods are caused by interaction of climatic factors (e.g sea level rise and heavy rains) and human factors (e.g poor drainage systems and building structures in water ways).

Ironically, while drought is a serious developmental challenge in West Africa, ***flooding caused by heavy rainfall*** also continues to cause forced migration and displacement in the sub-region. Since the 1970s, drought events have been alternating with years of flooding (Schraven et al., 2020). The recent years of heavy rainfall (2007, 2009 and 2012) witnessed devastating cases of both flash and riverine floods which resulted in the loss of lives and property as well as displacement (Nka et al., 2015; Schraven et al., 2020). According to Schraven et al. (2020), the floods recorded in 2007 affected more than 500,000 in the 11 West African countries, namely Mauritania, Mali, Niger, Burkina Faso, Senegal, Côte d'Ivoire, Gambia, Liberia, Sierra Leone, Togo, and Ghana. The rainfall-induced floods in 2009 also affected a total of 600,000 people in Burkina Faso, Ghana, Niger, Senegal, and Sierra Leone (Zickgraf et al., 2016), while the floods in 2012 caused serious damage to property and resulted in forced displacement in Nigeria, Niger, Senegal, Ghana. More specifically, the 2012 floods affected about 260,000 people in Ghana, 35,000 in Burkina Faso and 20,389 in Togo (Schraven et al., 2020). In 2015, heavy rains caused serious flooding which led to the loss of lives, destruction of houses and displacement in West African countries of Togo, Benin and Ghana (Davies, 2015). Apart from floods caused by heavy rainfall, ***floods caused by sea-level rise and associated coastal erosion*** also leads to forced displacement in several West African coastal towns and villages, including, Dakar, Lagos, Lomé, Accra, Tema (Fagotto, 2016). Many of the West African countries continue to experience periodic flooding and displacement largely as a result of heavy rainfall and sea-level rise.

In **Ghana**, rainfall induced flooding has been causing displacement and forced migration in several parts of the country. The 2007 floods, for instance, caused serious damage to farmlands, livestock and houses in northern Ghana. The flooding in northern Ghana has now become an annual problem. Each year, the flooding situation is worsened by the spillage of water from the Bagre dam in Burkina Faso. As support provided by the government during these periods are inadequate, some of the affected persons tend to adopt both short and long-term migration to deal with the flooding. On the other hand, although government agencies sometimes issue early warning to communities about the possibility of flooding, many households are unable to move to safer areas because of lack of financial resources and social capital to do so. Further, as a result of lack of social support and social networks, some of the affected households who move initially tend to return to the flood prone areas, even when it was not safe to do so. An interview with an assembly member in northern Ghana clearly captures this:

> We need water to cultivate crops during the dry season…… [but] we are also sometimes affected by serious flooding during the rainy season…. When we get to the rainy season, the government sometimes gives warning that heavy rainfall may cause flooding. We [assembly members] also inform people about this but many of them don't have any place to go… Even when people are evacuated from the lowlands experiencing serious floods, they return there shortly because that is where they have their farming lands. So unless the government is able to build houses for people living in flood prone areas, merely giving early warning to poor farmers to move to safer places does not solve the problem.

Periodic flooding, caused by heavy rains, has also been responsible for displacing people from some parts of the Volta, Greater Accra, and Central regions of Ghana. In April 2013, for instance, flooding caused by heavy rainfall destroyed property and farmlands in Agona East district in the Central region, affecting more than 1000 people. A majority of the affected people temporary migrated to nearby safer areas (Teye, 2017). In June 2015, the coastal regions, especially Accra and Central region, experienced heavy rainfall which led to loss of lives, destruction of some settlements and displacement in Accra.

In addition to flooding induced by heavy rainfall, some coastal regions of Ghana also experience flooding caused by sea-level rise. For instance, Keta, a fishing community in the Volta region of Ghana has been experiencing a sea-level rise of about 3 mm per year (Boatemaa et al., 2013). The coastline erosion associated with the sea-level rise has led to a 2.66 mm annual loss of the coastline (Schraven et al., 2020). In addition to implementation of the Keta sea defence project to reclaim land from the advancing shoreline, the government of Ghana has implemented a limited resettlement program which led to the relocation of a small number of households that were affected by the sea erosion. The sea water flooding and associated coastal erosion is responsible for internal migration in the Keta Municipal area (Hillmann & Ziegelmayer, 2016). Coastal flooding is also threatening the Senegalese, Togolese, Sierra Leonean, and Gambian coasts (UNESCO, 2012), with many port cities at risk of sea-level rise and displacements (Zickgraf et al., 2016).

Togo has also been experiencing increased rainfall-induced flooding which result in loss of lives, property and displacement. For instance, the 2007 torrential rain and floods led to loss of lives and the displacement of 13,764 persons especially in settlements close to the Mono River basin (Ntajal et al., 2016). Similarly, heavy rainfall in the northern part of the country, in 2017, resulted in flooding of villages bordering the Mono catchment and displaced 3612 people (Schraven et al., 2020). The floods, in June 2015, affected households in Lome and led to the displacement of 5000 persons (Davies, 2015). Togo's coastal communities, such as the former capital city, Aneho, and dozens of surrounding villages, are also experiencing flooding caused by sea-level rise and associated erosion. The erosion which is currently eating away between 6 and 10 meters of coastal land each year has destroyed houses close to the sea and caused forced displacement (The New Humanitarian, 13th November, 2015).

Similar to the Ghanaian and Togolese situations, flooding induced by heavy rainfall periodically displaces people in **Nigeria**. The 2012 devastating floods, for instance, displaced over 6.1 million people (Zickgraf et al., 2016). In 2020, flooding killed 68 people and affected 35 states, 320 local government areas and over 129,000 people. Many of the affected persons have been forced to move from their homes (Ankara News, 2020). Key informants explained that while flooding, in Nigeria, causes short-term movement, some of the affected households also adopt long-term migration from flood prone communities.

Senegal has also witnessed periodic rainfall-induced flooding which forces people to migrate from the northern part of the country. In 2009, thousands of people were forced to flee their homes in villages in northern Senegal due to flooding

caused by heavy rains. Some of the affected households did not return after the recovery of the impacted communities. Other households were also assisted by the Senegalese government to resettle in safer areas (Schraven et al., 2020). In 2020, heavy rains caused flooding in 11 regions, resulting in the forced displacement of about 3285 people in the suburbs of Dakar and the department of Thiès (IFRC, 2020). Senegal also experiences serious coastal flooding caused by very strong sea waves. The serious flooding and coastal erosion have led to the forced displacement and migration of several households from the affected coastal communities.

Rainfall-induced flooding has also been responsible for population mobility in **Côte d'Ivoire**. In June 2018, for instance, heavy rains caused the flooding of some suburbs of the city of Abidjan. As many houses were submerged, 18 lives were lost and many people were forcibly displaced. Some people were forced to relocate to other suburbs (Schraven et al., 2020). Similarly, in October 2019, heavy rainfall resulted in flooding in six cities, namely Abidjan, Aboisso, Grand Bassam, Ayamé, and Man. About 12,900 persons were affected by the flooding which also caused 12 deaths. More than 612 people were made homeless and relocated to safer areas (IFRC, 2020). Sea-level rise and coastal erosion have also been responsible for displacement in coastal communities in the country. For instance, according to a report by Coulibaly (2019), the village of Lahou-Kpanda, which is located about 140 km southwest of the Ivorian capital Abidjan, is gradually sinking. In fact, its prison, hospital and school have already been subsumed by the waters. The advancing shoreline has forced some villagers to migrate from the village. The report noted that some villagers have even exhumed the bodies of relatives and moved them to other areas, for fear of their graves being lost to the sea, as captured in the statement below:

> Today we live in anguish. What will happen tomorrow if no one comes to the help of the village? We will disappear…..In Africa, our parents, our ancestors are very important to us and to see them scattered in the sea is heartbreaking and every day that God brings to us we are haunted. (Daniel Loha, village elder, quoted by Coulibaly, 2019).

Benin has also occasionally experienced flooding associated with torrential rainfall. Flooding recorded in the country in 2010 led to the death of 43 persons and affected 360,000 persons. In 2010, more than 150, 000 were displaced (Ferris & Stark, 2012). Benin has also experienced rising sea-level and erosion which cause displacement, especially in Cotonou and its surrounding coastal communities (Dossou & Gléhouenou-Dossou, 2007). Floods are also the most common hazards in the **Gambia**. In October 2020, for instance, about 32,952 people were affected by floods in the Gambia, with 13,751 of them being internally displaced (Tamba, 2020). **Sierra Leone** has also been experiencing flooding caused by heavy rainfall in recent years. On 1st August 2019, for instance, rainfall-induced floods and landslides in Freetown affected livelihoods of about 5381 people in Freetown. Some of these people were forcibly displaced while others migrated for short distances (IFRC, 2020).

Mali and **Burkina Faso**, which lie in dry zone, also occasionally experience flash floods which cause forced migration. For instance, in Mali, floods in 2010 and

2013 caused the destruction of property and forced displacement in Bamako. According to Floodlist News of 12 August 2020, the serious flooding recorded in July and August 2020 affected more than 13,200 people. About 5400 of the affected persons were internally displaced. The worst affected regions are Gao, Mopti, Ségou and Sikasso. Similarly, in 2017, floods which were accompanied by strong winds caused the displacement of about 30,862 people in the 12 of the 13 regions in Burkina Faso (Schraven et al., 2020).

It is important to state that while people displaced by floods and rainstorms could be said to be *environmental emergency migrants* who return to their usual places of residence once the affected areas recover physically and economically, there is evidence that some of the people affected by flooding do not return to their original homes. Most of the people displaced by flooding in West Africa tend to migrate over short distances within the same region.

Consistent with the predictions of our conceptual framework, key informants believe that increased incidence of flooding and displacements in West Africa are not only caused by climatic factors but rather an interaction of climatic factors (e.g rainfall), weak system of urban planning, and poverty, as highlighted in the statement by a Nigerian researcher during an interview in 2021:

> In Nigeria it is true that climate change is causing population movements. Although people talk a lot about drought, flooding also causes forced displacement…. Flooding in Nigeria is caused by a combination of heavy rainfall and poor planning of our settlements…... And when there is flooding, the state agencies do not promptly assist people to move from affected areas. So even if there is warning about more flooding, some poor people cannot move because they have no where to go.

As highlighted in the statement above, there are situations whereby some of the people affected by flooding are unable to move due to lack of endowments.

5.5.2 *Effects of Slow On-Set Environmental Processes on Migration*

Given that environmental stress produced by slow-onset climatic processes are gradual, migration in response to such changes tend to be voluntary (Hugo, 1996). As slow on-set climatic factors interact with several socio-economic, demographic, and political factors to shape migration, it is quite challenging to analyze their effects on migration decisions of people (Black et al., 2011; Foresight, 2011). Notwithstanding this methodological challenge, several researchers have reported cases whereby drought and rainfall variability have contributed to out-migration in West Africa.

Research has shown that as a result of weak adaptive capacity to effectively adopt in-situ climate adaptation strategies, such as irrigation and cultivation of high yielding and short-cycle crop varieties, rainfall variability and drought have been seriously affecting the production of climate sensitive staples including maize,

millet and sorghum especially in the Sudano- and Guinean-Sahelian areas of countries such as Niger, Senegal, Mali, Burkina Faso, Nigeria, Northern Togo and Benin (Schraven et al., 2020; Sultan et al., 2013). As a way of dealing with such climate-induced crop failures, food insecurity, and poverty, people in dry areas of West Africa have, historically, been migrating seasonally to other rural areas with more favorable climatic conditions and or to urban areas in the same country or nearby countries. As a result of increased rainfall variability, seasonal migration, which helps farmers to deal with lack of employment opportunities and food scarcity during the dry season (Romankiewicz & Doevenspeck, 2015), has increased in many of the countries in West Africa (Afifi et al., 2014; Teye & Owusu, 2015). Permanent migration is also gradually increasing, due to worsening rainfall variability (Obour et al., 2017). In some cases, households send some of their members permanently to urban areas or areas with more favorable climate for work so that the migrants can send food and financial remittances back home to assist households left behind deal with food insecurity brought about by drought.

A number of country-level case studies have recently documented cases of climate-related human mobility in West Africa (Jarawura, 2013; Awumbila et al., 2015, 2019; Teye & Owusu, 2015). West African communities in the Sahel, which covers northern Senegal, southern Mauritania, central Mali, northern Burkina Faso, Niger, and north of Nigeria particularly, experience drought-induced migration. The severe droughts recorded in West Africa in 1969–1974, for instance, resulted in mass migration from the Sahel region to areas with more favorable climate. Similarly, in 2010, about ten million people were affected by drought-induced hunger across West Africa, leading to mass migration from Sahelian countries such as Niger, Mali, Burkina Faso and Mauritania (Schraven et al., 2020). Studies have also shown that although transhumance of Fulani herdsmen from the Sahel to more favorable ecological regions has existed for centuries, the phenomenon has increased as a result of climate change (Teye, 2017; Tonah, 2000). Farming households are more likely to migrate due to climate change than non-farming households. For instance, using data from the Nigeria General Household Survey and the Ghana Living Standard Survey, Cattaneo and Massetti (2015) found that although climate change did not significantly impact the propensity for non-farm households to migrate, there was a relationship between dry season temperature at 23 °C and the tendency for farm households to migrate.

One of the most seriously affected areas in the Sahel is the Chad Basin (covering parts of **Niger and Nigeria** in West Africa and Chad and Cameroun in Central Africa). The Chad basin has since the early 1970s been marked by long period drought and rainfall variability, leading to crop failure, loss of livestock, water scarcity and migration (Schraven et al., 2020). The surface area of Lake Chad has shrunk from 25,000 square kilometers in the 1960s to about 2500 km^2. As a result of climate change, various resource users (e.g. farmers and herders) compete for resources, especially water. This has worsened farmer-herder tensions and interstate conflicts on the use of transboundary water resources (Williams, 2019). The combined effects of drought and conflicts lead to mass movement of people from parts of Niger and Nigeria as well as Chad and Cameroun which are located in

Central Africa. In a study by Afifi (2011), a return migrant explained how drought forced him to migrate from the Niger part of the Chad Basin as follows:

> My family and I were farmers. Then the famine of 2005 took place. I used to have five cars for transportation, and I made my living from this. Due to the famine, I had to sell one car after the other till only one was left. I gave it to my son to work on it and left for Libya to earn money" (Quoted in Afifi, 2011, p. e114).

In a survey by IOM in 2021 in the Chad Basin, about 7% of forcibly displaced Nigerians and 3% Nigeriens cited reasons directly linked to climate change to explain their movement. The percentage of respondents attributing migration to climate change appears lower because, as Afifi noted in his study in Niger, most respondents tend to link their migration to poverty but climate change emerges as a cause of poverty only during follow-up interviews:

> Most of the interviewees referred to economic factors, such as poverty and unemployment, as reasons for moving from one village / region to the other, or even moving abroad. However, when tracing the root causes for migration, results indicated that almost all of them have been influenced by environmental problems in their decision to migrate (Quoted by Afifi, 2011, p. e113).

After probing whether at any point in time environmental problems affected people's decision to move, 90% of the interviewed migrants in Afifi's study in 2011 had a positive answer. Similar findings have been reported elsewhere in West Africa where a significant number of survey respondents did not originally mention climate change as the cause of their migration. The respondents in those studies generally attributed migration to poverty and food security. However, when the researchers probed further the causes of such poverty and food security which influenced migration decisions, many respondents linked those challenges to climate change (See Awumbila et al., 2014).

Migration has also been historically used to adapt to rainfall variability in **Mali and Senegal**. Indeed, drawing on an interdisciplinary study in Mali and Senegal, Romankiewicz and Doevenspeck (2015) reported that temporary migration was one of several income generating activities being used as adaptation strategies to climate variability and economic hardship. Similarly, van der Land and Hummel (2013) observed in their study of Bandiagara in Mali and Linguère in Senegal that migration tends to constitute a key livelihood and climate adaptive strategy, especially for those with lower education. The researchers asserted that while increased rainfall resulted in the return of migrants to Linguère in Mali, its adverse effect on harvest increased the number of seasonal migrants in Bandiagara. Hummel (2016) further observed from a study of climate change and migration nexus in Mali and Senegal that 39% of respondents mentioned temporary migration during the dry season as a coping strategy. She noted that, although the manifold motive of migration cannot be reduced to climate change, there are indications that migration is an adaptive strategy for individuals and households coping with negative impacts of climate change. Hummel (2016) further demonstrated that in addition to other coping strategies, migration is adaptive strategy employed by individuals and households in both

Mali and Senegal to diversify income and minimize the effect of rainfall variability and associated crop failures.

In **Burkina Faso**, a majority of households and individuals have, historically, been adopting migration to deal with crop failure and food insecurity brought about by high inter-annual and seasonal rainfall variability (Schraven et al., 2020). An analysis of inter-provincial migrations revealed that although people were more likely to attribute migration to socio-demographic variables than climate change, climate-induced migration was pervasive (Henry et al., 2003). A recent study in Burkina Faso revealed that farmers generally perceived migration as a strategy for coping with increased temperature, wind speed and decreased rainfall in the last two to three decades (Sanfo et al., 2017). A significant proportion of respondents mentioned dry spells and drought as push factors of migration.

Rainfall variability also causes migration from northern **Benin**. For instance, a study of Bialaba migrants from Northern Benin to Nigeria revealed that a significant proportion of interviewees mentioned environmental factors, in the form of irregular rainfall, increased temperature, occurrence of strong destructive winds, and poor soils as drivers of emigration to Nigeria and other West African countries, such as Ghana and Ivory Coast, which have more favorable climatic conditions and soils (Dreier & Sow, 2015). A respondent in their study explained the economic importance of such climate-induced migration in the following words:

> There are many people who emigrate. There are still more people who migrate in the dry season to work abroad and return afterwards. They go abroad to do agricultural work and return with motorcycles and building material. My children also went abroad, that's why I have a zinc roof on my house. Many go to Nigeria at the moment. The Ivory Coast is a bit too far, but there are also people who go there. In recent years, many more people have gone to Nigeria in search of a better life, because the rain was not sufficient here (Quoted by Dreier & Sow, 2015, p. 3188).

The above statement shows that in some cases, climate induced migration contributes to improved welfare of household members left behind. Some studies have also shown that while three quarters of the reasons for migration mentioned by respondents in northwest Benin were related to environmental conditions for agricultural production, only half of the respondents directly linked their migration to environmental changes (Doevenspeck, 2011; Dreier & Sow, 2015).

Rainfall variability also causes migration in the northern and coastal Savannah zones of **Ghana**. For instance, Rademacher-Schulz et al. (2014) found that, in the Nadowli District of the Upper West Region of Ghana, a common livelihood strategy used by households with low capacity for economic diversification is dry-season migration to more suitable farming and mining areas. Although people from the Northern Savannah zone have, historically, migrated seasonally to the forest zone of Ghana in search of alternative livelihoods during the dry season (Jarawura, 2013; Van der Geest, 2011), human mobility has increased in scope and duration of absence as a result of a combination of climate change, population growth, improved transportation, social media and the role of social networks. About 24% of households in our recent study have at least one member who has migrated *seasonally* to urban areas.

Although relative to seasonal migration, permanent migration is not a very common strategy for dealing with climate change in many West African countries (Dreier & Sow, 2015; Jarawura, 2013), our recent studies in Ghana shows that increasing number of seasonal migrants are now staying permanently at their destinations as highlighted in the following statement by a farmer in the Upper West region of Ghana:

> At first people used go to the Brong area to farm during the dry season, and then come back here during the wet season to farm here. However, as there is now longer period of dry season, some people don't come back but rather stay there permanently.

The statement above clearly supports the findings of Obour et al. (2017) in the forest zone of Ghana where it was established that climate change is increasing the proportion of north-south migrants that stay permanently in the forest zone.

Despite the overwhelming evidence on how drought and rainfall variability cause migration, some researchers have argued that climate change is not a major driver of migration in some West African settlements. For instance, notwithstanding the peculiar patterns of migration in the Sahel, Black (2001) argued that it is logically flawed to conceptualize climate change as the primary driver of forced displacement, even if it features prominently in the decision-making process of migrants. Similarly, while van der Geest (2011) attributed the decision of people living in northern Ghana to migrate to southern Ghana to a combination of poor agro-ecological conditions at home and easy access to fertile lands in the more humid destination area, he still concluded that migration from northern Ghana is driven more by other socio-economic factors rather than climate change. His assertion is based on his analysis of data which indicated that, during the period of serious drought in the early 1980s, migration flows from the dry northern savannah zone did not increase significantly. Advancing similar arguments from a study of the Frafra of Northern Ghana and the Biali in Northern Benin, Sow, Adaawen and Scheffran (2014) concluded that mobility was used as a livelihood strategy when it could improve livelihood security, and that environmental factors (including climate change) may not be the most dominant drivers of migration.

Recent scholarship has shown, however, that wider socio-economic and political contexts may explain why climate change may not be a significant driver of migration in a few dry areas. Some researchers have argued, for instance, that the low level of out-migration from the dry northern Savanah zone of Ghana, during the period of serious drought in the 1980s, could be explained by the fact that the drought negatively affected both the northern savannah and popular destinations in southern Ghana. Further, as a result of the economic challenges and political instability in Ghana during the drought period in 1980, migration to southern was not appealing to people in northern Ghana (Jarawura & Smith, 2015). Additionally, political instability and poor economic conditions in southern Ghana did not make the place attractive to potential migrants. Migration flows from the dry zone to southern Ghana, however, increased in the 1990s when Ghana started witnessing political stability and southern Ghana became relatively more developed than northern Ghana (Gravesen et al., 2020).

5.6 Climate Immobility in West Africa

While the empirical findings presented in this paper clearly shows that several people have been moving from their usual places of residence in West Africa, in response to climate change and variability, there is enough evidence to suggest that some of the affected persons remain in the communities affected by both rapid on-set and slow on-set climatic events. For instance, as Doevenspeck (2011) noted, despite increased environmental/climate change across northwestern Benin, not all the affected households migrate. We have also demonstrated earlier that some households affected by flooding in Ghana and Nigeria are unable to move from affected regions because of the lack of endowments to embark on migration. While these situations of *immobility* have been neglected by researchers in many West African countries, there is a growing interest in understanding why some people do not migrate even when their livelihoods are seriously affected by climate change in the region (Walker, 2021).

In recent years, various terms, such as 'immobile people' 'stayers', 'left behind' and 'trapped populations' have been used to describe the persons who do not migrate from areas seriously affected by environmental/climate change (Carling, 2002; Mata-Codesal, 2018). Our analysis shows that the situation whereby people do not migrate from areas experiencing environmental stress fall under the two processes, namely *involuntary immobility* (i.e. the situation whereby vulnerable people are aspiring to escape environmental stress but lack the endowments to do so) and *voluntary immobility* (the situation whereby people choose to remain despite the risks posed by environmental stress) (see Foresight, 2011; Walker, 2021).

There is enough evidence to show that a number of vulnerable persons who want to escape environmental stress actually lack the resources to do so. These persons, who can be referred to as 'trapped populations' (see Black et al., 2011; Foresight, 2011) are usually the very poor, aged, and women who lack both financial and social capital to migrate from communities affected by serious flooding, erosion associated with sea-level rise and or drought. The case of 82 year old madam Ataala demonstrates this situation. She is a very poor woman whose one-bedroom house is located close to the sea at Keta, one of the Ghanaian villages experiencing sea-level rise, flooding and erosion. She explained how she is trapped in the following words:

> I know where I stay is very dangerous and the water can, one day, wash both me and my house away. Some of the people who were living here have moved to other villages or higher grounds in Keta. I want to leave but where am I going to? I am very poor and even struggle to feed myself so I cannot buy another land to build a house in any community.

Some of the officials interviewed as key informants in West African countries such as Sierra Leone, Nigeria, and Ghana explained that each year, annual flooding affect a lot of people because they lack the resources to leave their houses built in flood prone area, as highlighted in the statement below by an official in Sierra Leone.

> Early warning systems are ineffective for preventing casualties associated with flooding because people in flood prone areas know about the risks and some have expressed the desire to leave but they are constrained by lack of resources.

There is also evidence that during periods of extreme drought, some of the people who desire to migrate are unable to do so because they lack the resources and social networks. Some of the climate-induced migrants from Niger in the Chad Basin who were recently interviewed in Ghana reported that they left behind aged family members who could not migrate because of their ages. It also came out in some of our interviews that very poor households who lack resources and networks to migrate are trapped in areas facing serious climatic stress. In some communities in West Africa, such as northern Ghana, women are more likely to be among the immobile populations not only because of lack of resources but also because patriarchal norms generally do not encourage female migration.

There are also cases whereby people voluntarily decide to remain in areas affected by climate change because of spiritual attachment to the land. In the Keta area of Ghana, for instance, some of the individuals affected by sea-level rise and flooding reported that they would not want to migrate from these communities because their relatives (usually fathers and mothers) graves are in those communities, and they are spiritually attached to the land.

5.7 Conclusion

The discussion in this paper clearly shows that while it is difficult to provide figures on the number of people that are driven from their usual places of residence by climate change and variability (Foresight, 2011; Teye, 2017), there is enough evidence to conclude that flooding, rainfall variability and drought are contributing to increased migration flows and forced displacement in many of the countries in West Africa. Although the West African region is generally experiencing rainfall variability, episodes of torrential rainfall has been causing devastating flash and riverine floods (Schraven et al., 2020), which result in massive population mobility in almost all the countries in the sub-region. Additionally, coastal flooding and associated erosion caused by increasing sea-level rise have also been responsible for forced migration and displacement of people living in coastal settlements in countries such as Senegal, Gambia, Côte d'Ivoire. Sierra Leone, Ghana, and Togo.

Flooding tends to produce short-term 'environmental emergency migrants' (see Renaud et al., 2011) who usually return to their places of origin once the affected places have recovered. In view of lack of endowments to permanently migrate from places affected by these rapid-onset climatic events (i.e. rainstorms and floods) and strong spiritual attachment to the land, only a few of the households displaced by flooding have migrated permanently from the affected areas. Many of the households who have migrated from areas experiencing serious flooding are those with financial and or social capital to do so. It is only in a few cases, such as in northern Senegal and Keta in Ghana, where governments have assisted a small proportion of poor households affected by flooding to relocate to safer lands.

The analysis further shows that while it is particularly difficult to separate climatic drivers from social, political, economic and demographic factors shaping

migration decision in areas affected by slow on-set climatic processes (Foresight, 2011), migration is a common strategy being adopted by households and individuals in dry areas to deal with the effects of drought and rainfall variability. We have demonstrated that in order to deal with climate-induced crop failure, food insecurity, water scarcity and poverty, many individuals and households in dry rural communities of countries, such as Mali, Niger, Burkina Faso, Ghana, and Benin, tend to adopt seasonal migration to rural areas with better ecological conditions to continue with their agricultural activities or to urban areas to engage in non-farm activities. In some cases, households have sent some of their members permanently to urban areas or other rural areas for work. Such migrants then send remittances back home to assist households left behind deal with food insecurity and poverty. We have demonstrated that although seasonal migration is more pervasive than permanent migration, many of the seasonal migrants are now staying longer at the destinations as rainfall variability continues to worsen.

Our assessment indicates that contrary to the general media narratives which suggest that climate change may be contributing to irregular migration towards Europe, many climate-induced migrants actually migrate over short distances to nearby rural communities where they can undertake their farming activities. A few can also undertake stepwise migration to urban areas. Interviews show that as a result of lack of financial resources and social networks, many of the climate-induced migrants cannot directly migrate to Europe and other developed countries. This explains why countries such as Niger and Burkina Faso, which are worst affected by climate change, are not among the top 10 countries of origin of irregular migrants arriving in Europe (IOM, 2020).

Despite the fact that some people migrate either temporary or permanently to deal with both rapid and slow on-set climatic events in West Africa, there are cases where some affected people stay behind. While policy makers tend to assume that people who do not migrate from places facing climatic stress have successfully adopted in-situ adaptation strategies (Teye, 2017), our analysis show that there are many cases where people are facing serious climate-induced challenges (e.g food insecurity and poverty) but are unable to migrate because they lack financial and social capital to do so. Consistent with the findings of Walker (2021), we have demonstrated that inequalities related to age, gender, and economic status interact with cultural norms to shape immobility. Women, the elderly, and poor people are more likely to be part of these 'trapped populations' that lack endowments to undertake migration.

While facilitation of migration will help to improve the wellbeing of such trapped populations, only a few National Adaptation Programs of Action (NAPAs) consider planned migration as a strategy to deal with climate change. This is because in view of their inability to plan for urban growth and provide infrastructure and services for the urban poor, policy prescriptions by West African governments focus on discouraging people from moving from rural to urban areas. In some West African countries, some NGOs have even provided financial incentives for young girls and boys who arrived in urban areas to go back to the rural areas. Although evidence suggests that a majority of climate-induced migrants move to rural areas to undertake

farming activities, governments are still reluctant to encourage out-migration from rural area facing climate change. In some countries, the governments and development partners even characterize climate-induced migration as 'maladaptation' (Sward & Codjoe, 2012; Teye, 2017). In view of these findings, policy makers in West Africa should be encouraged to incorporate planned migration into climate change adaptation programs.

References

Afifi, T. (2011). Economic or environmental migration? The push factors in Niger. *International Migration, 49*(S1), e95–e124. https://doi.org/10.1111/j.1468-2435.2010.00644.x

Afifi, T., Liwenga, E., & Kwezi, L. (2014). Rainfall-induced crop failure, food insecurity and out-migration in Same-Kilimanjaro, Tanzania. *Climate and Development, 6*(1), 53–60.

Afifi, T., Milan, A., Etzold, B., Schraven, B., Rademacher-Schulz, C., Sakdapolrak, P., & Warner, K. (2016). Human mobility in response to rainfall variability: Opportunities for migration as a successful adaptation strategy in eight case studies. *Migration and Development, 5*(2), 254–274.

Afriyie, K., Ganle, J. K., & Santos, E. (2018). 'The floods came and we lost everything': Weather extremes and households' asset vulnerability and adaptation in rural Ghana. *Climate and Development, 10*(3), 259–274. https://doi.org/10.1080/17565529.2017.1291403

Ankara News. (2020). *Nigeria: 2020 flooding killed 68, impacted some 129,000*. News of 07/12/2020. https://www.aa.com.tr/en/africa/nigeria-2020-flooding-killed-68-impacted-some-129-000/2068745

Awumbila, M., Owusu, G., & Teye, J. K. (2014). Can rural-urban migration into slums reduce poverty? Evidence from Ghana. *Migrating out of Poverty (MOP) Working Paper 13*. University of Sussex. [migratingoutofpoverty.dfid.gov.uk].

Awumbila, M., Deshingkar, P., Kandilige, L., Teye, J. K., & Setrana, M. (2019). Please, thank you and sorry – Brokering migration and constructing identities for domestic work in Ghana. *Journal of Ethnic and Migration Studies., 45*(14), 2655–2671. https://doi.org/10.1080/1369183X.2018.152809

Awumbila, M., Teye, J. K., Litchfield, J., Boakye-Yiadom, L., Deshingkar, P., & Quartey, P. (2015). Are migrant households better off than non-migrant households? Evidence from Ghana. *Migrating out of Poverty (MOP) Working Paper 28*. University of Sussex. [migrating-outofpoverty.dfid.gov.uk].

Bawakyillenuo, S., Yaro, J. A., & Teye, J. (2016). Exploring the autonomous adaptation strategies to climate change and climate variability in selected villages in the rural northern savannah zone of Ghana. *Local Environment, 21*(3), 361–382. https://doi.org/10.1080/13549839.2014.965671

Bendandi, B., & Venier, M. (2017). Vulnerability and resilience in West Africa: Understanding human mobility in the context of land degradation. KNOMAD Working Paper No. 25.

Black, R. (2001). *Environmental refugees: myth or reality? New issues in refugee research* (Vol. 34, pp. 1–19). United Nations High Commissioner for Refugees.

Black, R., Adger, W. N., Arnell, N. W., Dercon, S., Geddes, A., & Thomas, D. (2011). The effect of environmental change on human migration. *Global Environmental Change, 21*(Supplement 1), S3–S11.

Boatemaa, M. A., Appeaning Addo, K., & Mensah, A. (2013). Impacts of shoreline morphological change and sea level rise on mangroves: The case of the Keta coastal zone. *Journal of Environmental Research and Management, 4*(11), 359–367. http://www.e3journals.org/cms/articles/1387371004_Kwasi%20et%20al.pdf. Accessed 9 Jun 2016.

Carling, J. (2002). Migration in the age of involuntary immobility: Theoretical reflections and Cape Verdean experiences. *Journal of Ethnic and Migration Studies, 28*(1), 5–42. https://doi.org/10.1080/13691830120103912

Cattaneo, C., & Massetti, E. (2015). *Migration and climate change in rural Africa* (Working papers 2015.29). Fondazione Eni Enrico Mattei.

Coulibaly, L (2019). *Ivory Coast town sinking underwater as coastal erosion advances*. Reuters report of September 10, 2019. https://www.reuters.com/article/us-ivorycoast-environment-coastal-erosio-idUSKCN1VV1HD

Davies, R (2015). *Deadly Floods in West Africa – Togo, Benin and Ghana Hit by Heavy Rain*. http://floodlist.com/africa/deadly-floods-west-africa-togo-benin-ghana

Doevenspeck, M. (2011). The thin line between choice and flight: Environment and migration in rural Benin. *International Migration, 49*(S1). https://doi.org/10.1111/j.1468-2435.2010.00632.x

Dossou, K. M. R., & Glélhouenou-Dossou, B. (2007). The vulnerability to climate change of Cotonou (Benin): The rise in sea level. *Environment and Urbanization, 19*(1), 65–79.

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*, 3175–3203. https://doi.org/10.3390/su7033175

Emetere, M. E. (2017). Investigations on aerosols transport over micro- and macro-scale settings of West Africa. *Environmental Engineering Research, 22*(1), 75–86.

Essegbey, G. O., Nutsukpo, D., Karbo, N., & Zougmoré, R. (2015). *National climate-smart agriculture and food security action plan of Ghana (2016–2020)* (Working paper no 139 ed.). CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

Ezeife, N. D. (2014). Projected impact of global warming on West Africa: Case for regional and transnational adaptive measures. *Annual Survey of International & Comparative Law, 20*(1), Article 9. https://digitalcommons.law.ggu.edu/annlsurvey/vol20/iss1/9 20(1)

Fagotto, M. (2016). *West Africa is being swallowed by the sea.* https://foreignpolicy.com/2016/10/21/west-africa-is-beingswallowed-by-the-sea-climate-change-ghana-benin. 01 Feb 2019.

Ferris, E., & Stark, C. (2012). *Internal displacement in West Africa: A snapshot*. Project on Internal Displacement. Brookings-LSE.

Fontaine, B., Janicot, S., & Monerie, P. (2013). Recent changes in air temperature, heat waves occurrences, and atmospheric circulation in Northern Africa. *Journal of Geophysical Research: Atmospheres, 118*(15), 8536–8552. https://doi.org/10.1002/jgrd.50667

Foresight. (2011). *Migration and global environmental change. Final project report*. The Government Office for Science.

Gbetibouo, G. A. (2009). *Understanding farmers' perceptions and adaptations to climate change and variability: The case of the Limpopo Basin, South Africa* (p. 52). International Food Policy Research Institute.

Gemenne, F., Bruker, P., & Ionesco, D. (2014). *The state of environmental migration 2014: A review of 2013* (p. 258). IOM.

Gliessman, S. (2021). Agroecology and the transition to sustainability in West African food systems. *Agroecology and Sustainable Food Systems, 45*(2), 157–158.

Gravesen, M., Jarawura, F., Kleist, N., Lindegaard, L. S., & Teye, J. K. (2020). *Governance, climate change and mobility in Ghana* (DIIS Working Paper, No. 2020:06). Danish Institute for International Studies (DIIS).

Heinrigs, P. (2010). *Security implications of climate change in the Sahel Region: Policy considerations*. Organization for Economic Cooperation and Development Sahel and West Africa Club Secretariat.

Henry, S., Boyle, P., & Lambin, E. F. (2003). Modelling inter-provincial migration in Burkina Faso, West Africa: The role of sociodemographic and environmental factors. *Applied Geography, 23*(2–3), 115–136.

Hillmann, F., & Ziegelmayer, U. (2016). Environmental change and migration in coastal regions: Examples from Ghana and Indonesia. *DIE ERDE – Journal of the Geographical Society of Berlin, 147*(2), 119–138.

Hugo, G. (1996). Environmental concerns and international migration. *International Migration Review, 30*(1), 105–131. Intergovernmental Panel on Climate Change (IPCC) (1990) First Assessment Report (Cambridge: Cambridge University Press).

Hugo, G. (2011). Future demographic change and its interactions with migration and climate change. *Global Environmental Change, 21S*, S21–S33.

Hulme, M., Doherty, R., Ngara, T., New, M., & Lister, D. (2001). African climate change: 1900–2100. *Climate Research, 17*, 145–168.

Hummel, D. (2016). Climate change, land degradation and migration in Mali and Senegal – Some policy implications. *Migration and Development, 5*(2), 211–233.

IOM (International Organisation for Migration). (2007). *Discussion Note: Migration and the Environment (MC/INF/288–1 November 2007 – Ninety Fourth Session)*. International Organisation for Migration, Geneva, 14 February 2008 IOM.

IOM. (2020). *West and Central Africa-irregular migration routes to Europe*. https://migration.iom.int/reports/west-and-central-africa-%E2%80%94-irregular-migration-routes-europe-january-%E2%80%94-june-2020

IOM. (2021). *Environmental migration*. Disaster Displacement and Planned Relocation in West Africa. IOM.

IFRC. (2020). *Sierra Leone: Floods – Emergency Plan of Action (EPoA)*. https://reliefweb.int/report/sierra-leone/sierra-leone-floods-emergency-plan-action-epoa-dref-n-mdrsl008-final-report

IPCC (Intergovernmental Panel on Climate Change). (2012). Managing the risks of extreme events and disasters to advance climate change adaptation. In C. B. Field, V. Barros, T. F. Stocker, D. Qin, D. J. Dokken, K. L. Ebi, M. D. Mastrandrea, et al. (Eds.), *A special report of working groups I and II of the intergovernmental panel on climate change*. Cambridge University Press.

IPCC. (2018). Allen M. R., et al. (2018). Framing and context. In Masson-Delmotte, V.P et al. (Eds), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter1_High_Res.pdf

Jarawura, F. X. (2013). *Drought and migration in Northern Ghana*. PhD University of Ghana, Centre for Migration Studies, unpublished thesis.

Jarawura, F. J., & Smith, L. (2015). Finding the right path: Climate change and migration in Northern Ghana. In F. Hillman, M. Pahl, B. Rafflenbeul, & H. Sterly (Eds.), *Environmental change, adaptation and migration. Bringing in the region* (pp. 245–266). MacMillan Palgrave.

Mata-Codesal, D. (2018). Is it simpler to leave or to stay put? Desired immobility in a Mexican village. *Population, Space and Place, 24*(4), e2127. https://doi.org/10.1002/psp.2127

Mbiyozo, A. (2020). Migration: A critical climate change resilience strategy. *Institute for Security Studies Policy Brief, 151*(Nov 2020) https://media.africaportal.org/documents/policy-brief-151.pdf

Mensah-Bonsu, A. (2003). *Migration and environmental pressure in northern Ghana*. PhD thesis, Amsterdam, Vrije University.

Minia, Z. (2004). *Climate scenarios developed for climate change impacts assessment in Ghana*. The Netherlands Climate Change Studies Assistance Programme (NCCSAP). Phase2—Part, 1.

Ministry of Environment, Science, Technology and Innovation. (2012). *Ghana national climate change policy*. The Ministry of Environment, Science and Technology.

Mora, C., Frazier, A. G., Longman, R. J., Dacks, R. S., Walton, M. M., Tong, E. J., … Giambelluca, T. W. (2013). The projected timing of climate departure from recent variability. *Nature, 502*(7470), 183–187. https://doi.org/10.1038/nature12540

New Humanitarian. (2015). *Rising seas ruining lives in Togo*. News of 13 November 2015 https://www.thenewhumanitarian.org/news/2015/11/13/rising-seas-ruining-lives-togo

Nicholson, S. (2005). On the question of the "recovery" of the rains in the West African Sahel. *Journal of Arid Environments, 63*.

Nka, B. N., Oudin, L., Karambiri, H., Paturel, J. E., & Ribstein, P. (2015). Trends in floods in West Africa: Analysis based on 11 catchments in the region. *Hydrology and Earth System Sciences, 19*, 4707–4719. https://doi.org/10.5194/hess-19-4707-2015

Ntajal, J., Lamptey, B. L., & MianikpoSogbedji, J. (2016). Flood vulnerability mapping in the lower mono river basin in Togo, West Africa. *International Journal of Scientific and Engineering Research, 7*(10), 1553–1562.

Obour, P. B., Owusu, K., & Teye, J. K. (2017). From seasonal migrants to settlers: Climate change and permanent migration to the transitional zone of Ghana. In S. Tonah, M. S. Boatemaa, & J. A. Arthur (Eds.), *Migration and development in Africa: Trends, challenges and policy implications*. Lexington Books.

Owusu, K., & Teye, J. K. (2014). Supplementing urban water supply with rainwater harvesting in Accra, Ghana. *International Journal of Water Resources Development*. https://doi.org/10.1080/07900627.2014.927752

Parsons, L. (2019). Structuring the emotional landscape of climate change migration: Towards climate mobilities in geography. *Progress in Human Geography, 43*(4), 670–690.

Rademacher-Schulz, C., Schraven, B., & Mahama, E. S. (2014). Time matters: Shifting seasonal migration in Northern Ghana in response to rainfall variability and food insecurity. *Climate and Development, 6*(1), 46–52. https://doi.org/10.1080/17565529.2013.830955

Renaud, F. G., Dun, O., Warner, K., & Bogardi, J. (2011). A decision framework for environmentally induced migration. *International Migration, 49*, e5–e29.

Rigaud, K. K., de Sherbinin, A., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., McCusker, B., Heuser, S., & Midgley, A. (2018). *Groundswell: Preparing for internal climate migration*. World Bank. https://openknowledge.worldbank.org/handle/10986/29461 License: CC BY 3.0 IGO

Romankiewicz, C., & Doevenspeck, M. (2015). Climate and mobility in the West African Sahel: Conceptualising the local dimensions of the environment and migration nexus. In H. Greschke & J. Tischler (Eds.), *Grounding global climate change*. Springer. https://doi.org/10.1007/978-94-017-9322-3_5

Sanfo, S., Fonta, W. M., Diasso, U. J., Nikiema, M. P., Lamers, J. P. A., & Tondoh, J. E. (2017). Climate- and environment-induced intervillage migration in Southwestern Burkina Faso, West Africa. *Climate, Weather and Society, 9*, 823–837. https://doi.org/10.1175/WCAS-D-16-0065.1

Salack, S., Klein, C., Giannini, A., Sarr, B., Worou, O. N., Belko, N., Bliefernicht, J., & Kunstmann, H. (2016). Global warming induced hybrid rainy seasons in the Sahel. *Environmental Research Letters, 11*, 104008. https://doi.org/10.1088/1748-9326/11/10/104008

Schraven, B., Adaawen, S., Rademacher-Schulz, C., & Segadlo, N. (2020). *Climate change impacts on human (im-)mobility in sub-Saharan Africa recent trends and options for policy responses*. Internationale Zusammenarbeit (GIZ) GmbH.

Shukla, P. R., Skea, J., Slade, R., Diemen, R., Haughey, E., Malley, J., & Pereira, J. P. (2019). Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes. *Terrestrial Ecosystems*, 35–74.

Sissoko, K., van Keulen, H., Verhagen, J., Tekken, V., & Battaglini, A. (2011). Agriculture, livelihoods and climate change in the West African Sahel. *Regional Environmental Change, 11*(Suppl.1), 119–125. https://doi.org/10.1007/s10113-010-0164-y

Sow, P., Adaawen, S., & Scheffran, J. (2014). Migration, social demands and environmental changes amongst the Frafra of Northern Ghana and Biali in Northern Benin. *Sustainability, 6*(1), 375–398.

Stanturf, A. J., Warren, L. M., Charnley, S., Polasky, C. S., Goodrick, L. S., Armah, F., & Nyako, A. Y. (2011). *Ghana climate change vulnerability and adaptation assessment*. USDA Forest Services International Program.

Stringer, L. C., Akhtar-Scuster, M., Marques, M. J., Amiraslani, F., Qaatrini, S., & Abraham, E. M. (2011). Combating land degradation and desertification and enhancing food security: Towards integrated solutions. *Annals of Arid Zones, 50*(34), 1–23.

Sultan, B., et al. (2013). Assessing climate change impacts on sorghum and millet yields in the Sudanian and Sahelian Savannas of West Africa. *Environmental Research Letters, 8*.

Sward, J., & Codjoe, S. (2012). *Human mobility and climate change adaptation policy: A review of migration in National Adaptation Programmes of action (NAPAs). Migrating out of poverty research programme consortium*. Working Paper 6. University of Sussex.

Tamba, A. (2020). Over 32,952 people are affected by floods in Gambia. *The Standard News* of 7th October, 2020.

Teye, J. K., & Owusu, K. (2015). Dealing with climate change in the Coastal Savannah Zone of Ghana: In-situ adaptation strategies and migration. In *Environmental change, adaptation and migration* (pp. 223–244). Palgrave Macmillan.

Teye, J. K. (2017). Environmental change and migration in Africa. In M. Awumbila, D. Badasu, & J. K. Teye (Eds.), *Migration in a globalizing world: Perspectives from Ghana, Accra* (pp. 89–106). Sub-Saharan Publishers.

Teye, J. K., Yaro, J. A., & Bawakyillenuo, S. (2015). Local farmers' experiences and perceptions of climate change in the Northern Savannah Zone of Ghana. *International Journal of Climate Change Strategies and Management, 7*(3), 327–347.

Tonah, S. (2000). State policies, local prejudices and cattle rustling along the Ghana-Burkina Faso border. *Africa, 70*(4), 551–567.

UNEP (United Nations Environment Programme). (2011). *Livelihood security: Climate change, migration and conflict in the Sahel*. Geneva, Switzerland. http://www.unep.org/pdf/UNEP_Sahel_EN.pdf

UN Environment Report. (2017). *Environmental displacement. Human mobility in the Anthropocene*. https://wedocs.unep.org/bitstream/handle/20.500.11822/22269/Frontiers_2017_CH6_EN.pdf?sequence=1&isAllowed=y. 25 Jan 2019.

UNESCO. (2012). *Adult and youth literacy. UIS Fact Sheet 2*. UNESCO Institute for Statistics. http://www.uis.unesco.org/FactSheets/Documents/fs20-literacyday-2012-en-v3.pdf

Van der Geest, K. (2011). North-South migration: What role for the environment? *International Migration, 49*(S1), 69–94.

Van Der Geest, K., Vrieling, A., & Dietz, T. (2010). Migration and environment in Ghana: A cross-district analysis of human mobility and vegetation dynamics. *International Institute for Environment and Development (IIED), 22*(1), 107–124. https://doi.org/10.1177/0956247809362842

Van Der Land, V., & Hummel, D. (2013). Vulnerability and the role of education in environmentally induced migration in Mali and Senegal. *Ecology and Society, 18*(4), 14. https://doi.org/10.5751/ES-05830-180414

Walker, K (2021). Immobility: The neglected flipside of the climate displacement crisis. *The New Humanitarian*, 26 April, 2021 https://www.thenewhumanitarian.org/analysis/2021/4/26/the-climate-displacement-crisis-has-a-neglected-flipside

Williams, W. (2019). *Shifting Borders: Africa's displacement crisis and its security implications* (Research paper no. 8). Africa Center for Strategic Studies.

Wilkinson, E., Kirbyshire, A., Mayhew, L., Batra, P., & Milan, A. (2016). *Climate-induced migration and displacement: Closing the policy gap*. Overseas Development Institute (ODI).

Zickgraf, C., Vigil, 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).

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