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REVIEW PAPER

Rethinking climate migration in sub-Saharan Africa from the perspective of tripartite drivers of climate change

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Abstract

There is limited attention on climate change (CC) and human migration among scholars and policymakers. Meanwhile, natural disasters are projected to induce migration in the coming years which will affect millions of people in sub-Saharan Africa (SSA). In this review, we contribute to climate migration literature by highlighting three important factors (i.e. floods, droughts, and sea-level rise) that predispose migrants in SSA to migrate. The review suggests that the environmental impact of CC in SSA cannot be overlooked. For example, the review discovered that the impact of flooding has intensified, and its impact on agriculture will affect rural–urban migration, forcing farmers to look for alternative job opportunities. Moreover, due to the lack of rainfall to support agricultural activities, the option of migrating away from agriculture and settling in urban areas becomes a possible coping strategy. Rising sea level will adversely affect many, due to a lack of adaptive capacity and emergency preparedness. This should concern policymakers because the major trend in migration, whether climate-related or not, is a movement from rural to urban areas which poses significant challenges to urban sustainability and climate resilience. Given the impact of floods, droughts, and sea-level rise in SSA, we propose the promotion of adaptive capacity through the encouragement of climate insurance programme which is limited in SSA, alternative livelihood opportunity programmes, and providing financial resources for climate adaptation initiatives.

Keywords Adaptation · Migration · Drought · Flood · Sea-level rise · Sub-Saharan Africa

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Introduction

Climate change-migration nexus has gained prominence among scholars and policymakers (Black et al. 2011a, b; Piguet et al. 2011; Warner et al. 2010). The Sustainable Development Goal (10.7) have a strong focus to "facilitate orderly, safe and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies". Research reveals that there will be an increase in human migration due to the inability of people to adapt to the impacts of CC (Klaiber 2014; Maharjan et al. 2020). Previous research has also cautioned that CC will continuously cause human migration, and in turn undermine national development, create inequalities, violate human rights, and promote insecurity (Piguet et al. 2011).

SSA contributes less to the global emission of greenhouse gases than industrialised countries. But with CC closely entwined with development, the vulnerability of some developing regions (most locations are rather dry climatic zones) means poor countries in the global south are more at risk to CC effects. This is mainly because of their vulnerability to such events (e.g. droughts and floods). Current projections show that SSA will be the area most affected by CC, along with small island states and coastal and deltaic regions (Gemenne 2011a). Moreover, in 2018, the World Bank had projected that by 2050, up to 143 million persons could potentially lose their homes to climate-related events in SSA, Latin America, and Southeast Asia alone (Podesta 2019). Thus, assessing the consequences of CC on migration has become increasingly relevant, especially in Asian and African countries where climate vulnerability is high (Kleemans and Magruder 2018; Strobl and Valfort 2015). In addition, the introduction of the Kampala Convention, adopted in 2009, has recognised the issue of climate-induced internal migration. Therefore, the Kampala Convention encourages the protection of people affected by climate-induced migration through proper planning (e.g. early warning system), humanitarian assistance, community engagement, remediation, and proper documentation of displaced persons. This need can be achieved by holistically taking into account the tripartite (Three) dimensions of climate change-induced migration in the SSA (Hope and Lekorwe 1999; McLeman and Smit 2006; Gemenne 2011a, b; Lemos et al. 2013; Serdeczny et al. 2017).

Against this backdrop, there is a limited effort by the government in SSA in implementing sustainable solutions to protect vulnerable communities against CC impact. The impact of CC, if not adequately managed, will undermine the progress of development, especially given the limited adaptive capacity of the vulnerable people (Lemos et al. 2013). While policymakers and scholars are addressing migration in the developed countries, limited attention has, however, been directed to the climate change-related drivers, namely flood, high temperature, heat, drought, sea-level rise, forest degradation, forest fire, erosion, and all other factors that trigger migration in developing countries, particularly in SSA. According to the International Disaster Database of the Centre for Research on the Epidemiology of Disasters (CRED 2015), natural disasters such as droughts and floods has affected more than 28 million people in West Africa from

2010 to 2014, adding pressure to food insecurity and thus further exacerbating the vulnerability of local populations.

In SSA, there is a long history of rainfall variability, flood, and drought and is projected to experience climate induce migration in the coming years (Gemenne 2011b). For example, Mozambique and Nigeria are highly vulnerable to sea-level rise because these countries have high populations which means more people will be affected by floods annually (Hinkel et al. 2012). In terms of drought, in the past, Burkina Faso, Cape Verde, Chad, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, Senegal, and Sudan were mostly affected in 1984 (Gommes and Petrassi 1996). In some cases, for example, in Ethiopia, about 600,000 people move from central/northern to south-west/west because of poor agricultural production attributed to the change of climatic condition between 1984 and 1985 (Ezra and Kiros 2001). Another example is that in Rwanda, in the 1990s, about 1.7 million people migrated to the north Zaire because of unproductive agricultural land, water scarcity, and deforestation (Patterson 1995). In Kenya, environmental stability has affected migration and about 150,000–200,000 people migrated from Western, Northern to Rift Valley, while some of the settled in West, urban centres (Gould 1994). The CC drivers do not work in isolation as it can influence economic (e.g. population growth, income inequalities) or social drivers (unemployment), causing migration to occur significantly. In SSA, population movements, including displacement, are generally caused by economic crises, conflict, violence, violations of human rights, large-scale development projects, environmental change, and natural disasters. The influence of environmental change on migration is further complicated by the indirect nature of the impacts of many environmental changes (Foresight 2011). Therefore, we argue that since SSA is dependent on the environment for their survival, the region is most likely to exhibit climate migration due to environmental crises. Hence the need to examine the CC-related drivers and rethink about how to resolve the problem for better condition for SSA.

Taken together, this study provides what needs to be done by the state and international communities to eradicate the main challenges that cause people to be vulnerable to CC. More so, the study contributes to the global discussion on the complex nature of extreme weather and migration movements and will therefore suggest how migration studies could benefit from considering this neglected context. Within this literature on CC and migration, it is commonly known that flood, drought, and sea-level rise are the main drivers that are projected to increase and affect migration in SSA significantly (Hope and Lekorwe 1999; McLeman and Smit 2006; Gemenne 2011a, b; Serdeczny et al. 2017). While Grote and Warner (2010) was specific to some selected countries (i.e. Ghana, Mozambique, Niger, and Senegal) in SSA to assess the extent of environmental factors that are likely to trigger migration in SSA. This study specifically examines flood, drought, and sea-level rise as the key CC related drivers in SSA. Accordingly, the main goal of this study is to have an in-depth examination of three important factors (i.e. floods, droughts, and sea-level rise) that predispose migrants in SSA countries to migrate. The study addresses how floods, droughts, and sea-level rises influence migration in SSA.

Theoretical and conceptual framework for the analysis

This study used the term "climate migrant" to refer to persons who are compelled by climate events (e.g. flood, drought, heat, and sea-level rise) to leave their home and move either within their countries (internal migration) or abroad (transnational or cross-border migration) (IOM 2007). This means that disasters often generate migration of people away from the affected areas. The most elementary way of explaining international migration is by identifying 'push' and 'pull' factors. Ravenstein (1889) explains push factors of migration to include economic, political, social, violent, or environmental circumstances at the place of origin which put pressure on people to migrate, alternatively, Lee (1966) argues that pull factors are incentives at a possible place of reception. Castles et al. (2005) indicates that the reason for migration is the fact that the costs for staying at the place of origin have to be lower than the basic information costs. Stark and Levhari (1982) argues that the migration decision normally is not only made by the individual but by the household that he or she belongs to. In these contexts, it is important to note that the influence of migration is multi-dimensional and context-specific.

In view of Kluger et al. (2020), migration is an important risk coping strategy. They further argue that moving between and within different geographic regions represents an adaptation strategy of natural resource users worldwide to cope with sudden and gradual changes in resource abundances. There is also empirical evidence available showing that migration is a possible coping strategy for households in order to reduce their vulnerability to environmental shocks (e.g. Edward et al. 2012; Ruano and Milan 2014; Warner et al. 2012a, b). In fact, members of the household could either stay at their place of origin or migrate.

The interactions among environmental change, drivers, and the personal characteristics of individuals can influence migrants, either to decide to move or stay in climate risk areas (Black et al. 2011a, b). As the literature has revealed that people migrate based on some key drivers such as environmental, social, economic, demographic, and political, however, CC increases the risks of these factors (Black et al. 2011a, b). Although the economic driver remains the most determining factor for migration (Ginnetti et al. 2013), environmental change can, however, have an impact directly on human beings and the environment. This will depend on economic, social, demographic, and political drivers. In this study, the environmental change, including flood, drought, and sea-level rise that influence migration will be our focus. Drawing from the migration concepts and related literature, a conceptual framework has been developed to guide the study as indicated in Fig. 1. The interconnectedness of the concepts has a strong influence on climate migration as well as the decision to migrate or not. Figure 1 shows the relationship of environmental factors/climate change-related drivers on migration mediated by intervening factors.

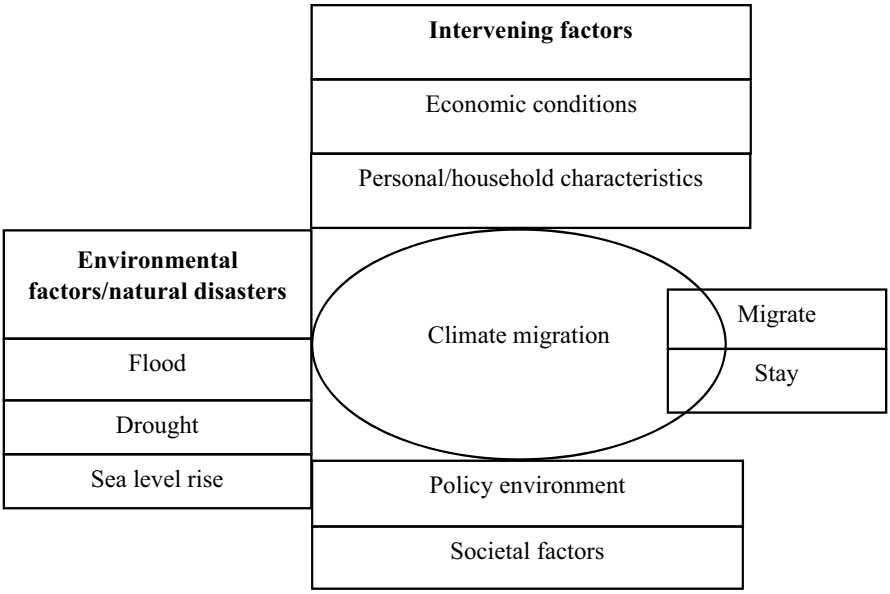

Fig. 1 A conceptual framework showing the influence of environmental factor on climate migration mediated by intervening factors

Environmental factors

Several environmental drivers cause human migration which may be interrelated (Filho et al. 2018; Hussain et al. 2020; Ali et al. 2020). Through CC, environmental disasters, including flood, droughts, and sea-level rise are likely to promote environmental changes. These factors may result in loss of homes or livelihoods. These changes can be reduced through climate adaptation. Apart from the environmental drivers, the literature review has revealed that several other factors trigger migration, including social, economic, political, and demographic (Black et al. 2011a, b).

Intervening factors

Migration will occur or not depends on the outcome of the mediating of community, household and individual factors, socio-economic conditions of households, including gender, age, income, education, and marital status (Afifi et al. 2014; Mastrorillo et al., 2016; Abu et al. 2014; Foresight 2011). Morrissey (2012) indicates that the existing evidence across the SSA suggests that migration can be one of a portfolio of societal responses to environmental change and variability and one which is mediated by socio-economic factors of would-be migrants. However, the decision to migrate and stay could be strongly influenced by the existing policies, cost of moving and social network, the type of climate shock, and the capacity

of institutions (local, national, and international) to prevent the adverse effects of climatic shocks. For example, the support from institutions, extended family unions, or religious organisations, in sheltering displaced persons, can make migration less likely (Warner et al 2012). More so, during poor agricultural productivity, individuals who have limited financial capacity are less likely to migrate to respond to this change. Ginnetti et al. (2013) report that environmental stress resulting from climate change could diminish livelihood and increase mobility to the point of rupture.

Method

Search strategy

This paper highlights three important factors including floods, droughts, and sea-level rise that predispose migrants in SSA countries to migrate. The key question this study tends to address is what are the impacts of flood, drought, and sea level on migration in SSA? To do this, we relied on secondary data (journal articles) whose collection was based on a broad theme from the research questions of the study: the influence of intervening factors (obstacles or facilitators) on migration.

The study adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach (Moher et al. 2009) to guide the methodological process and to screen the literature obtained from the databases. PRISMA approach has been widely used by many scholars and organisations for quality systematic reviews and meta-analysis. The PRISMA approach emerged as a response to the reported low-quality reviews, and conceptual and practical issues that were associated with systematic reviews and meta-analysis (Johansen and Thomsen 2016). Furthermore, Gascon et al. (2016) also argue that PRISMA approach is an appropriate method for synthesising all empirical evidence to answer research questions. Other scholars (e.g. Brooks and McNeely 2013; Johansen and Thomsen 2016) emphasised that PRISMA moderates and ensures that the selection process of papers, articles, and publications is substantially transparent and accurate as well as addresses the consistent flow of information through different phases of the review. It also specifies the total number of articles discovered, screened, eligible, and adopted for a study. In spite of the strengths of the PRISMA approach, it fails to capture the results of continual searches used in systematic reviews and as a result undermines the quality of reviews conducted (Tao et al. 2011; Kahale et al. 2021). Moreover, it does not directly detail an in-depth manner of conducting systematic reviews. To address these limitations, the current study continued to update the list of literature used for the study with newly published ones and those that were inadvertently missed during the search with the snowball technique. Snowballing is an approach of reviewing the reference list of the manuscripts that were reviewed and identifying relevant references for the work. The screening process (see below sections) also helped to mitigate the weaknesses.

The initial scoping of the literature involved searches on electronic data basis by the primary author and an assistant. Scopus, Web of Science, ScienceDirect, Springer, JSTOR, and Directory of Open Access Journals (DOAJ) were searched for articles and other publications relevant to CC and migration by keeping a focus on the tripartite factors (floods, drought, and sea-level rise) that are mainly associated with migration. Search for phrases and keywords were used together, including "climate change and migration", "floods and migration", "drought and migration", "sea-level rise and migration" were done in English employing the Boolean search strings (AND/OR). Furthermore, Google, Google Scholar, and Mendeley were used to search for relevant literature. The bibliography at the end of each retrieved article was also sought to identify articles that discuss the tripartite factors (floods, drought, and sea-level rise) in SSA. In this review, a snowball approach of the references was applied to the "more relevant" articles to identify peer-reviewed journal articles that may have been missed.

Quality criteria

To prevent drawing inaccurate conclusions, it was required to assess the quality of the studies that were identified. We assess the studies using seven broad criteria in our assessment (Dos Santos and Beavan 2015). These were the study's applicability to the review issue; the study's design; the results transferability; the use of context to allow findings to be compared to interns in SSA; data collecting; analysis; and finally, a discussion of reflexivity as it relates to recognising personal biases. The following briefly describes the criteria used to assess the quality of the studies.

Relevance: the identified relevant studies are clearly described and contribute to the goal of the study. The design: the study relied on PRISMA approach to identify and screen peer-reviewed articles against the inclusion criteria for those most relevant to the study. Transferability: the results of the identified relevant studies were analysed based on the objectives and aim of this study and the methodological approach used in this study can be applied in other contexts and studies. The context: the study discusses the tripartite factors (floods, drought, and sea-level rise) that predispose migrants in SSA to migrate that SSA. Data collection: the identified studies were assessed to ensure that the results they produced were consistent, correct, complete, and credible. Data analysis: a methodical process was employed. The authors simply collected and summarised key findings concerning our understanding of CC impact parameters as drivers of migration (i.e. floods, drought, and sea-level rise) in SSA. Reflexibility: In order to control bias in the study, we incorporate reflexivity into our research process.

Inclusion and exclusion criteria

We examine relevant publications or studies and conduct a discussion on CC impact parameters as drivers of migration (i.e. floods, drought, and sea-level rise) in SSA. The study must meet the following criteria: (1) papers that study the relationship between climate and migration in SSA countries, (2) papers that examine CC impact

on migration in SSA, and (3) papers that provide strategies for climate migration for SSA. The exclusion criteria include (1) review articles, primary research, case reports, guidelines, dissertations, and a consensus of opinions that are unrelated to the research topic; (2) those not referring to the association between climate vulnerability and migration; (3) those without quantitative data referring to the association; (4) all other languages; (5) studies on CC before the year 2000.

Data extraction, management, and synthesis

The abstracts and summaries of the searched documents were screened against the inclusion criteria for those most relevant to the study. A detailed evaluation of full-text articles against the inclusion criteria was then followed and key information extracted into a spreadsheet. Baseline characteristics and target parameters were extracted from the selected articles as well. For each study, the author, year of publication, data on floods, drought, and sea-level rise were extracted. Furthermore, the data extracted included information on the study's objectives, the definition of concepts, key results, conclusions, and recommendations. In this review, a content analysis was used to categorise climate-related drivers that predispose migrants in SSA to migrate. In the analysis of the text, first each paper was read and re-read to understand the state of the art of climate change-migration nexus. All the identified papers were coded and grouped according to floods, drought, and sea-level rise based on the description provided in Online Appendix A. The authors then recorded all the personal or household characteristics and intervening factors that influence migration. Initial coding of factors that influence migration in SSA was identified for each study. In case of disagreement, the authors went back to the original sources to verify that all information was correctly interpreted and discussed the conclusions and implications of each study. The authors summarised vital findings and any takeaway messages concerning our understanding of the climate-related drivers of migration (i.e. floods, drought, and sea-level rise) in SSA, and noted gaps for future studies. Consequently, a total of 237 publications were identified. Further analysis was made to remove duplicates, studies with irrelevant topics and abstracts, incomplete documents, and studies that were not written in the English language. After a thorough inclusion and exclusion exercise, a conclusive 35 documents were included for the study. The PRISMA flow diagram in Fig. 2 gives a breakdown of the literature selection process.

Results

This section of the paper outlines the tripartite climate change-related drivers that predispose migrants in SSA to migrate.

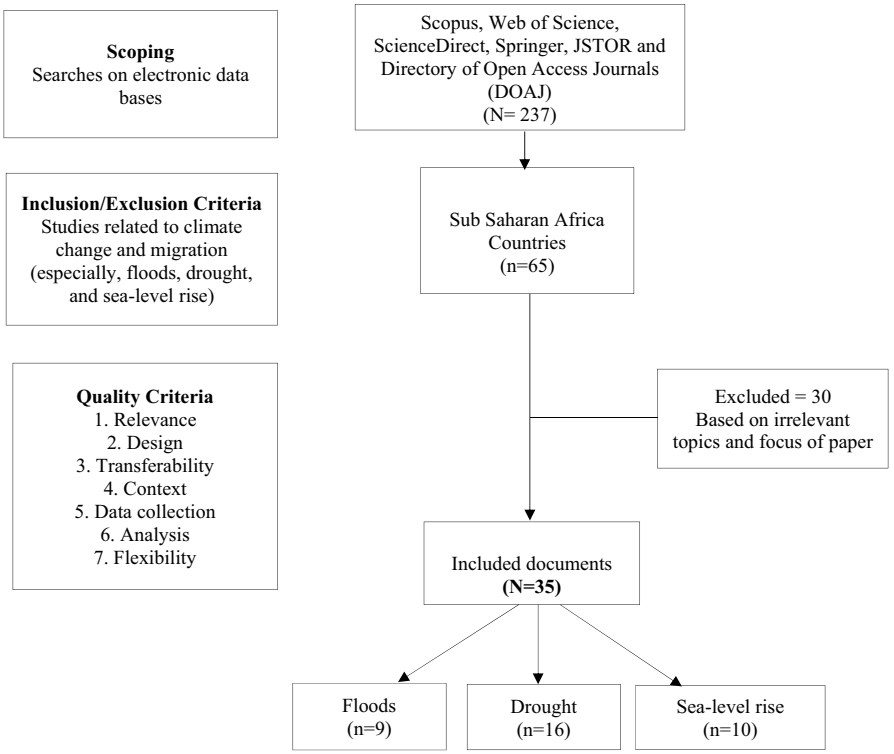

Fig. 2 The PRISMA flow diagram

Floods

Intervening factors

About 70% of Africans are dependent on agriculture for livelihoods, which makes the sector an important to the economies of all African countries. However, research suggests that the effect of flood on agriculture could influence migration from rural/agricultural areas to urban areas (Barrios et al. 2006). For example, farmers could be pushed to seek alternate means of employment as their land is affected by flood no longer able to support plant growth. A study conducted by Armah et al. (2010) also revealed that floods destroy agricultural products of farmers of northern Ghana almost every farming season rendering them no choice but to migrate to other places to search for alternative job vacancies. In Nigeria, South Africa, Ghana, and Mozambique, studies show that the change in rainfall pattern affects crop yields significantly in ways that may cause migration. In Mozambique, for example, it was learned that floods have caused internal migration and this has led many rural people to migrate to towns and cities and adding new population to existing slum communities (Stal 2011).

In the coastline of SSA, many communities are eroded by flood due to sea rise (Hinkel et al. 2012). This has caused a devastating effect on the livelihood of the people, the destruction of economic infrastructure and causing health implications. Since most of the population coastline have an increase in population, the impact of the flood has worsened which affect the economy because many people have to migrate.

Notwithstanding, the impact of climate migration is differentiated by household characteristics. For example, a household survey was conducted to ascertain the impact of an environmental hazard, i.e. sea flooding on migration intentions in three coastal communities in the Dangme East district of Ghana and the result of the bivariate level of analysis showed that, although not statistically significant, almost half of the household heads that experienced sea flooding in the past month of the survey have no intention to migrate. This finding challenges the idea that sea flooding—or other environmental impacts—is likely to force people to out-migrate (Codjoe et al. 2017). Since migration involves financial

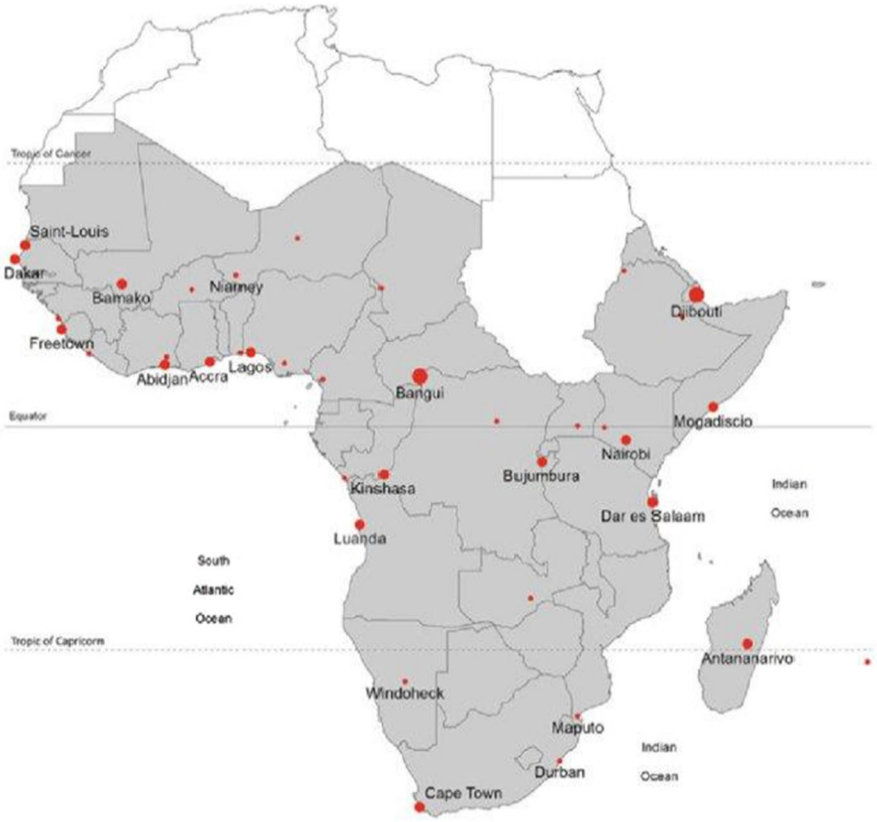

Fig. 3 Large cities in SSA between 1981 and 2013 showing major flood events: 5 times or more flood events (large bullet), 3–4 times flood events (medium bullet), and 1–2 times flood events (dot). Formulated by E. Ponte from CRED EM-DAT. *Source* (Tiepolo 2014)

means to embark, poorer households are unable to migrate in the face of a natural disaster. There are also instances where household may be prevented to move due to the social attachment in the place they reside. The household members temporarily migrate to search for new jobs and return after the environmental situation has improved again, whereas others decide to stay (Grote and Warner 2010). Figure 3 shows large cities affected by flooding along the SSA coastline due to sea-level rise.

Although a substantial amount of research links climate risk to migration flow, it differs in other studies. People are compelled to adapt to climate risk rather than moving, which require a financial capability to do so. CC contributes to loss of capital which could have supported people to migrate. This makes migration less likely to happen (Jha et al. 2018a, b; Maharjan et al. 2020). Apart from the financial aspect, mobility also involves age, networks, and the ability to succeed. CC has the potential to disrupt and significantly invert development in many SSA countries. This is due to their limited capacities to prevent and respond to the impacts of CC. As stated by USGLC (2020), the consequences are particularly severe for the poor and most vulnerable populations such as women and children. Against this backdrop, climate migrants are often described as climate victims in the context of CC and therefore use migration as a common adaption strategy to sustain their livelihood (Laczko and Piguet 2014).

Droughts

Intervening factors Drought is a common phenomenon in most African countries caused by CC. According to Bates et al. (2008), about one-third of the people in Africa live in drought-prone areas which have negative ramifications on the lives and livelihoods of people. This has contributed to, among other things, underdevelopment of the rural areas and consequently migration to the urban areas. However, the risks of displacement are unevenly distributed across SSA. In some parts of SSA like in Zimbabwe, Zambia, and Malawi, lakes have been observed to dry up. Moreover, research conducted by the University of Ghana (2019) indicates that drought forces farmers to migrate from their farming communities (rural) and settle in Tamale (urban) in the northern part of Ghana, while others with financial resources move to bigger cities, including Kumasi and Accra. This implies that SSA could be overwhelmed with drought-driven environmental refugees unless adaptation initiatives are put in place to resolve the increasing drought in the region and reduce potential migration to cities. According to Koko Warner and Afifi (2014), to address rainfall variability in west Africa, four patterns are observed, including "(1) households that use migration to improve their resilience (successful migration); (2) households that use migration to survive, but not flourish; (3) households that use migration as a last resort, an erosive coping strategy; and (4) households that cannot use migration and are struggling to survive in their areas of origin".

Generally, droughts have already grown into a major driver of migration, forcing families and communities to flee their original location. This is expected to increase and displace people, especially in SSA (Barrios et al. 2006). Findings suggest that people from the drier regions are more likely than those from wetter areas to engage

in both temporary and permanent migrations to other rural areas. Also, short-term rainfall deficits tend to increase the risk of long-term migration to rural areas and decrease the risk of short-term moves to distant destinations (Henry et al. 2003). This affects the lives of poor communities, directly impacting livelihoods, limiting crop yield, undermining reproduction, and survival of livestock.

Research by Samimi and Brandt (2012) and Marchiori et al. (2012) reports that due to limited rainfall to support agricultural activities, the option of moving out of agriculture to settle in the urban areas becomes prevalent. In Burkina Faso, for example, droughts which have affected many people, particularly farmers between the 1970s and 1980s had contributed to a steady increase in labour migration to nearby urban areas (Henry et al. 2003). Adaawen et al. (2019) reveal that drought-related factors compel people in the Sahel, East and southern Africa to migrate to other places almost every year. Similarly, the Environmental Change and Forced Migration Scenarios (EACH-FOR) in 2018 also acknowledge drought-induced migration in the SSA countries, particularly Niger, Western Sahara, Senegal, and Ghana.

The effect of climate on migration greatly varies by migrant characteristics (Afifi et al. 2014; Mastrorillo et al. 2016; Abu et al. 2014; de Haan et al. 2002; Ezra and Kiros 2001). For example, high temperature and rainfall shortage affect out-migration of black and low-income South African migrants, whereas those of white and high-income migrants exhibit a weak impact. The higher vulnerability to climate variability among these groups has forced them to use migration as an adaptation strategy (Mastrorillo et al. 2016). Again, Afifi et al. (2014) also found that the wettest and poorest village with the highest rate of education and with the oldest population age-wise have the least out-migration. This raises concerns about the people that might be even more vulnerable to the impact of CC, but cannot afford migration as an adaptation mechanism. Socio-demographic factors such as age, household size, and current migration status are significant predictors of migration intentions, with younger household heads, heads of migrant households, and heads of smaller households being relatively more likely to have migration intentions than other household heads (Abu et al. 2014).

High temperatures can enhance evaporation from soil, making periods with low precipitation drier. In Nigeria, a growing number of weather-related disasters, including high temperatures, has influenced the movement of people (Dillon et al. 2011). Likewise, the warm temperature has harmed the production of staple crops in Tanzania (Hirvonen 2016). In urban studies, some studies attribute high temperatures to increasing migration flow in some countries (e.g. Uganda), while Kenya and Burkina Faso experience a reduction in migration rates altogether (Borderon et al. 2019). Moreover, findings in Nigeria and Tanzania suggest an increase in the number of days with extreme temperature directly increasing rural out-migration rates.

Sea-level rise

Intervening factors Even though sea-rise level increases the risk of flood along the coast, it is seen as one of the least threats to African countries (Hinkel et al. 2012).

However, the biggest impact is largely felt on coastal regions with rising income and population densities (Hinkel et al. 2012; Dasgupta et al. 2009). The impact of sea-level rise between and within regions varies due to geographical, socio-economic, institutional, and cultural factors. Additionally, limited government action has been taken to support adaptive initiatives. This has resulted in people abandoning their homes for the lack of adaptation options in various coastal regions. The coastal population of SSA is increasing rapidly and research shows that about 1 million in 1990 to 70 million in 2080 will be affected by coastal flood (McGranahan et al. 2007; Kibuka-Musoke et al. 2012). Sea-level rise can also cause soil salinization and thus damage land, agricultural productivity, and food security.

Rising sea levels will adversely affect many, due to a lack of adaptive capacity and emergency preparedness. Management of coastal cities could be difficult and the impacts could be severe due to the lack of emergency preparedness, management, and adaptation measures (e.g. blockage system, and adequate drainage) to reduce current and future vulnerability. Many coastal SSA countries experience rampant coastal erosion and flooding. For example, in Kenya, Oyieke (2000) reveals that 0.3 m of sea-level rise will submerge 17% (4600 ha) of Mombasa district without adaptation. Boko et al. (2007) indicates that East African coastal zones experience flood risk and it is only expected to get much worse in the future with continued rising seas. In Tanzania, the situation is not an exception as Dar-es-Salaam and the islands of Zanzibar face a high risk of sea-level rise and given their highest population densities in the area, this will increase their disaster risk and vulnerability (Nassor and Makame 2021). Nigeria is growing rapidly, as a result of the increasing population, individuals are building in the coastal areas, potentially causing damage to coastal zones. The people who lived there lack resistant buildings, warning systems, blockage systems, and adequate drainage systems and these lowland areas are submerged by seawater rise. This has influenced migration flows in coastal areas of Nigeria (Abdulmalik Mohammed 2019). An earlier study by Ericson et al. (2006) revealed that about 1.4 million people could be displaced as a result of sea-level rise from 2000 to 2050, whereas over 90% of people will be affected in the Nile delta. This suggests that there are potential costs of climate variability and change in coastal areas. Therefore, it is central to adjust or propose possible policies to deal with the increased impact of sea-level rise in the region for future climate change risk and adaptation.

There are limited studies that examine household influence on migration flow. However, an important finding by Zickgraf et al. (2016) considers two case studies related to sea flooding, in particular, Saint-Louis, Senegal, and Cotonou, Benin, which have both experienced significant sea flooding and coastal erosion in recent decades. They show that in Saint-Louis, Senegal, international out-migration was mainly practiced by young men, who often migrated across Senegal's northern border to urban areas in Mauritania, while some successful fishermen were able to relocate to other parts of the Senegalese coast. Table 1 shows the SSA coastline, which is potentially vulnerable to the effect of sea-level rise.

Table 1 Sub-Saharan African coastline

Coastal countries	Coastal length (km)
1. Angola	1712
2. Benin	122
3. Cameroon	548
4. Cape Verde	724
5. Comoros	340
6. Congo	164
7. Cote d'Ivoire	1034
8. Democratic Republic of Congo	130
9. Djibouti	311
10. Equatorial Guinea	421
11. Eritrea	1214
12. Gabon	1453
13. Gambia	446
14. Ghana	714
15. Guinea	547
16. Guinea-Bissau	1227
17. Kenya	584
18. Liberia	559
19. Madagascar	5055
20. Mauritania	222
21. Mauritius	839
22. Mozambique	3114
23. Namibia	1520
24. Nigeria	1571
25. Reunion (France)	201
26. Sao Tome and Principe	170
27. Senegal	1,053
28. Seychelles	151
29. Sierra Leone	689
30. Somalia	3073
31. South Africa	3079
32. Sudan	631
33. Togo	50
34. United Republic of Tanzania	1390

Source adapted from Hinkel et al. (2012)

Discussion

Climate migration from the perspective of flood, drought, and sea-level rise

This paper highlights three important factors, including floods, droughts, and

sea-level rise that predispose migrants in SSA to migrate. The result suggests that the environmental impact of CC in SSA cannot be overlooked. Although Africa contributes less to any continent to global and regional climatic changes, there is a limited commitment from the rich countries to support African countries, in general, to cope with the CC impact and achieve their development priorities. Poverty has contributed to the less utilisation of adaptive measures in the continent. In most cases, the cost of adaptation for SSA to cope with the effect of CC is expensive and difficult to afford. For example, the high cost of acquiring some adaptation strategies, also deter farmers from continuing their farming activities. According to Marchiori et al. (2012), about 5 million people in SSA have migrated between 1960 and 2000 due to climate variability and change. It was further suggested that an additional 11 million inhabitants may migrate yearly towards the end of the twenty-first century due to weather anomalies. Also, a report by OCHA Services (2020) reveals that tens of thousands of SSA are forced by floods to either migrate internally or externally every year in search of flood-free environments. This suggests that there is a need to understand local scale climate patterns and trends and vulnerability context to implement effective adaptation measures.

Various community factors including culture, migration history, and levels of development could play important roles in the migration intentions of households. The decision to migrate due to CC depends on many factors, namely socio-economic, political, and institutional factors. Other intervening obstacles to movement in SSA include the cost of moving and access to the means of moving. The cost of migration is a major hindrance for vulnerable communities in most SSA who want to move. A flood can affect the physical properties and livelihoods of people, particularly the people who live in low-lying areas. However, females are more vulnerable to flood than males, due to their financial capacity to adapt. Alternatively, people choose to stay and adapt to hazards instead of migrating. In some other communities (e.g. small island states), people prefer to stay because their land is part of their cultural identity. Black et al. (2011a, b) and Foresight (2011) have argued that poor populations may face difficulties migrating because migration is costly and requires resources.

Moreover, in a situation where climate shocks affect agricultural productivity, and farmers have limited alternate livelihoods in the rural areas, farmers tend to out-migrate (Mueller et al. 2020). In some cases, farmers shift to other local coping strategies. However, according to studies (e.g. Mueller et al. 2020; Mensah et al. 2020), the coping or adaptive strategy remains viable provided it is resilient to climatic conditions. This implies that climate impacts on agricultural productivity will continuously affect poor farmers and can trigger migration in SSA. Studies provide evidence that climate shock and unemployment have a strong link. For example, Harvey et al. (2014) argue that pest and disease and extreme weather events pose a challenge to poor farmers. This has led to low farm income due to crop failure. Although farmers are adopting several coping strategies, these are insufficient to increase agricultural productivity owing to the lack of finances, education, and technological support. Nevertheless, climate shock may disproportionately affect the availability of

local jobs, which could lead people to out-migration. The local government has a critical role to play in addressing climate migration while respecting international standards on migration. Given the increasing impact of sea-level rise in SSA coastal lines, coupled with low adaptive and financial resources, international donors and organisations in the field of humanitarian relief often provide support to avoided protracted displacement. In line with SDG 13—"take urgent action to combat CC and its impact"—SSA countries should focus on the climate-induced migration at the core of the problem to be considered at the national and regional level.

Planning for climate migration for policy development

Generally, there is a unanimous understanding among experts that climate factors are a major driver for migration. Some factors occasionally operate singly, but on many occasions, through other mechanisms—for example through loss of livelihood due to environmental disturbance (Martin 2009). Scrutiny from both the public and policymakers has led to global policy discussions at the level of United Nations member states, resulting in 'the Task Force on Displacement' under the CC negotiations and the first intergovernmental agreement on international migration known as 'the Global Compact for Migration'. These efforts have helped create the needed understanding of climate as a key driver of migration and a need for timely response (Chazalnoel 2020). The UNFCCC Cancun Adaptation Framework was adopted in 2010. One of their commitment was to implore states to commit to developing measures for improving the understanding of climate-induced migration and planned relocation and facilitate cooperation in addressing the challenges associated with it (Wright et al. 2020).

Given the above context, different approaches can be employed to manage the challenges of climate migration. The International Organization for Migration (IOM) supports a dual approach system. The first element requires states to review their CC policies to adequately reflect climate migration on the one hand and migration policies on the other hand. This will ensure that CC elements are properly infused in national climate and environmental policies and laws, to avoid or reduce climate-induced or forced migration of persons. The second element requires states to revisit existing migration management tools to understand how they can be reshaped and what kinds of tools could be further introduced as responses to climate-induced migration (Chazalnoel 2020). The Cancun Adaptation Framework of 2010 had developed a guideline for the implementation of strategies and programmes through the National Adaptation Plan (NAP) as a response tool to migration. The NAP could respond in two ways. First, it could establish adaptation or management strategies that can build communities resilient against the impact of CC, thereby lessening the need for future migration and displacement. Second, it could consider measures that will facilitate migration as an important adaptive measure. A policy brief titled "Integrating human mobility issues within National Adaptation Plans", jointly prepared by the United Nations University Institute for Environment and Human Security (UNU-EHS), IOM and the Nansen Initiative, highlights six stages

of planning and implementation for mainstreaming migration into NAP. Based on Wright et al. (2020) and Warner et al. (2013), the six stages are discussed below:

Stage 1: assessing and analysing the situation

Developing a reliable and evidence-based response requires the availability of, and adequate access to relevant environmental data, particularly relating to CC risks, impacts and vulnerabilities, migration, and demographic dynamics. The countries affected by the impact of CC need reliable scientific information to adequately identify vulnerable communities to extreme weather events such as drought and torrential rainfall or other CC impacts like flooding. Previous research, particularly in North East India (Paul et al. 2019), Coastal Vietnam (Thi et al. 2018), and Nepal (Gentle et al. 2018), has demonstrated that raising public awareness and providing relevant climate information resources are critical in reducing people's vulnerability to extreme CC events. This implies that access to reliable data is also necessary to determine the direction of migration and the best location for the relocation of displaced persons. National assessment on migration and CC provides policymakers with the opportunity to effectively review the latest data on migration as well as national environmental challenges so that they can come up with informed response strategies.

Stage 2: determining national priorities related to migration

After evaluating migration and CC situations based on an assessment of relevant data for understanding the most pressing national challenges regarding human mobility and CC, the next step is to define national action priorities as recommended by the Task Force on Displacement, which should be reflected in the NAPs. This will be important for effective channelling of finance and other related resources where capacity building is required. It is also important at this stage to identify relevant institutional mechanisms that will improve coordination of integrated policy-making across government institutions, an example could be to set up an inter-ministerial working group on migration and CC. Zetter et al. (2011) found that Vietnam and Bangladesh have successfully implemented national CC plans to safeguard environmentally displaced individuals. This suggests that regardless of the extent of environmental policy, the lack of strong legal frameworks to safeguard environmentally displaced individuals is crucial and must be addressed by policymakers in SSA.

Stage 3: planning action and programmes

Climate change-induced migration can be addressed through government activities in two ways. Either through policies, programmes and activities tailored to avoid population displacement from CC events or those aimed at facilitating easy migration as part of adaptation measures. According to Thomas and Benjamin (2018), only a few developing countries have made progress in adopting policies to address climate-induced migration and displacement. The study further made

an exception for the Pacific and Caribbean states of Fiji and Kiribati in Oceania. In Fiji, findings indicate that relocation of communities to higher ground is part of their existing adaptation efforts, whereas Kiribati has a National Framework for Climate Change and Climate Change Adaptation, developed in 2013, that includes a section on population and resettlement in the face of extreme climate events. Romero et al. (2018) also stress that forced relocation coupled with insufficient governance mechanisms and budgets to address CC impact and support adaptation strategies can result in the loss of community and culture, as well as health and economic consequences. This implies that it is necessary to develop management policies to tailor climate-induced displacements. It is essential to carefully plan actions and programmes because they can affect migration in ways that were not anticipated, even though human mobility, displacement or even relocation are not clearly captured in their aims or assessment criteria. This situation could arise where, for example, an adaptation measure helps a community population to engage in activities that provide them with more secured livelihood, peace, food, and water security. These impacts could reduce the urge among the population to migrate in search of work in other locations. Systematically considering the potential positive or negative impacts of migration at the planning phase can provide a clearer picture of the operational outcomes.

Stage 4: developing and financing capacity

A robust NAP will possibly require capacity building initiatives of various personnel at different levels, to ensure that the NAP strategies are effectively implemented according to national climate action plans. Capacity building and raising awareness through training workshops and distribution of manuals to policymakers and other relevant stakeholders need to mitigate and adapt to the impact of CC. From a policy perspective, Jha et al. (2018a, b) conclude that the attention should focus on risk reduction, development, and capacity building in rural areas. They further indicate that government and other stakeholders work to develop non-climate-sensitive livelihood options to diversify household income and improve adaptive capabilities. Furthermore, policies must nurture and deepen social networks through community engagement to increase group-based adaptation approaches and training on knowledge-intensive adaption solutions. It is therefore imperative to scope the accessible funds for financing CC adaptation and migration action plans of the NAP.

Stage 5: implementing plans There is a need to shift to more national strategic adaptation planning for achieving development resilient to climate change and successful implementation of the National Adaptation Plan. The operational and institutional measures must have clear objectives, beneficiaries, roles, and timelines. For example, the event of sudden-onset and slow-onset climate disasters show varied timelines, which require different approaches to solving the problem. In the event of a sudden-onset climate disaster (e.g. hurricanes or cyclones), a sequenced timeline with emergency plans is inevitable to quickly relocate the affected population out of danger. Besides, a planned relocation will be successful if there is a clear understanding of the vulnerabilities of the affected environment and other key dynamics of the community.

For example, Tabe (2019) in his study, recommended that proper strategic adaptation planning and preparation by local governments can help people to escape the negative impacts of droughts among the Gilbertese in the Pacific Ocean. Resettlement is one of the most important measures for forced migration which is very difficult to tackle in most developing countries, particularly African countries, as these countries are faced with weak financial capacity to take resettlement measures.

Stage 6: monitoring and evaluation

The first two stages involve assessing relevant environmental data to understand CC risks, impacts, and vulnerabilities, including migration and demographic dynamics, and to define the most pressing national challenges relating to human mobility and CC. These steps should provide the basis for benchmarks to determine whether action plans are supporting or undermining adaptation. Further, CC data, knowledge, policy, and institutional arrangements could be infused into the benchmarks as indicators for progress in future monitoring and evaluation exercises. While relatively few countries (e.g. Germany, Philippines, Australia, and Morocco) have designed and implemented a national M&E system for adaptation, a number of countries have indicated in their national determined contribution (NDC) that they are developing one or plan to do so (Vallejo 2017). For example, in Morocco, a national system is under development, building on sub-national efforts; Regional Environmental Information System (SIRE) in pilot regions focussing on changes in vulnerability in key sectors (water, agriculture, tourism, and biodiversity/forests), the status of implementing interventions, and impacts/lessons learnt from those measures, all based on readily available data. This therefore implies that the data records present the need and guide for further monitoring and evaluation for CC vulnerabilities in the regions.

Conclusion and recommendations

CC will continuously cause human migration, and in turn, undermine national development, create economic crises, inequalities, violate human rights, and promote insecurity, it is necessary to strengthen policies on climate change-related drivers and promote the long-term resilience of SSA countries in the face of the growing effects of climate variability and change. In this context, we set out to examine three important factors (i.e. floods, droughts, and sea-level rise) that predispose migrants in SSA countries to migrate from their original location. The study addresses how floods, droughts, and sea-level rise can influence migration in SSA. This study reveals that environmental factors play an increasingly important role in driving migration in SSA at present and in the future. However, flood, drought, and sea-level rise are key and expected to increase in the coming years which will displace many people in SSA who primarily depend on climate-sensitive resources for their survival. This will also destroy physical properties and livelihoods if adaption mechanisms, including CC disaster preparedness and financial capacity are not considered.

According to this review, the actual situations for climate change-related drivers and migration are country-specific. Therefore, the challenges of CC, if not adequately managed, can invert the progress of development in SSA. There is the need to strengthen policies that are created in the African continent to promote the long-term resilience of communities in the face of the growing effects of climate variability and change. This can also be done by implementing livelihoods options and promoting insurance which provides resilient communities with long-term resilience to CC impacts. These policies are also likely to be more robust to future uncertainty, if the national government, rich countries, and international donors take steps in supporting vulnerable countries or fund programmes that aid climate migrants, particularly in SSA who are faced with financial difficulties.

The results provide robust evidence that flood, drought, and sea-level rise have important consequences for population mobility in SSA. Therefore, we recommend future studies to explore the relationships between personal/household/community characteristics and climate migration with particular emphasis on flooding and sea-level rise in SSA. This is because climate migration varies in terms of personal/household/community characteristics and must be considered.

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