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Climate Change and Migration: Reviewing the Role of Access to Agricultural Adaptation Measures

Manisha Mukherjee*

Abstract

This study examines the moderating role of access to agricultural adaptation measures in how climate change is affecting human migration in the middle- and low-income countries. The literature on the association between climate change, agricultural production, and migration has seen a dramatic expansion in the past decade and highlighted the complexity of the process. Yet, a crucial link that is missing in the discussions is the interlinkage between migration responses and access to in-situ agricultural adaptation measures. To address this gap, I build this study on an emerging approach that treats adaptation to climate change as an additional component of sustainable economic development. I systematically review 81 quantitative and qualitative studies on the nexus of climate change, migration, and agriculture in the middle- and low-income countries and investigate the migration responses of agricultural households in conjunction with access to agricultural adaptation measures. I find a significant overlap between the social class of farmers, their capabilities to adapt in situ, and their migration decisions. The migration responses vary across agricultural households based on access to in-situ adaptation measures. Additionally, this interaction is heavily moderated by other local contextual factors- such as easy access to credit, participation in social networks, ethnic and social fractionalization, presence of conflicts, and social structures. Based on the findings, I propose a conceptual framework that could aid in deconstructing the migration responses of agricultural households in less-developed countries. Furthermore, I highlight critical policy gaps in building climate-resilient rural economies and suggest future research agendas with regard to climate change, migration, and agricultural adaptation measures.

JEL Classification: O13; O15; Q01; Q15; R2

Keywords: Climate change, Human mobility, Agriculture, Adaptation, Economic development, Systematic review

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I Introduction

In its recent sixth assessment report, the Intergovernmental Panel on Climate Change (IPCC) asserted that global warming of 1.1 °C above pre-industrial levels is disrupting every aspect of human society (IPCC, 2021). Extreme events such as droughts and heat waves are becoming increasingly common in all parts of the world (Mukherjee & Mishra, 2021). This is especially the case in middle- and low-income countries located in low-latitude regions and near the equator, where climate change is affecting water supply and agricultural production and limping livelihoods (Auffhammer et al., 2012; Lobell et al., 2008; Mendelsohn, 2009). Climate change is disproportionately impacting rural and marginal sections of the population in these countries and could exacerbate poverty, inequality, and conflicts, which in turn could impair their economic growth and development potential (Hallegatte et al., 2018).

This paper focuses on how climate change impacts migration in rural areas in less-developed countries[1] via an unexplored channel: access to in-situ agricultural adaptation measures. The study is certainly not one of the first to review the implications of climate change on human migration patterns. On the contrary, the literature on the issue has vastly expanded, especially over the past decade. In a seminal work, Black et al. (2011) emphasized the "deep human-environment relations" influence every social and cultural aspect, including settlement locations and attachment to places. Thus, an environmental change such as anthropogenic climate change could alter the incentives to stay or migrate, though it could be forced at times. The earlier debates on the issue treated migration due to climate change as a possible threat (Hartmann, 2010) and predicted that climate change could induce a mass displacement of the population from rural to urban areas and from the global south to the north. Some initial estimates even suggested that by 2050, climate change could lead to the movement of approximately 200 million people (Myers, 2002; Myers & Kent, 1995). In recent years, however, the narrative is undergoing a remarkable transformation. The latest evidence indicates that not everyone is migrating in response to climate change in less-developed countries. Moreover, an increase in vulnerability from climate change does not necessarily lead to higher chances of migration (Cattaneo et al., 2019). On the contrary, the increased vulnerability could perpetuate immobility and worsen poverty traps.

The moderating role of access to agricultural adaptation is particularly relevant as the agricultural sector is most at risk to the effects of climate change, especially in less-developed countries. Agricultural systems have co-evolved with certain temperature levels for centuries, and increases in mean temperature drastically undermine agricultural yields (Burke et al., 2015). The decline is steeper in less-developed countries where the average temperature levels are already near crop tolerance levels (Cline, 2007). For instance, a study by Dell et al. (2012) documented that a rise in temperature by unit degree Celsius could lead to a fall in agricultural output growth by 2.66 percentage points in poor countries with no such impacts on rich countries. The agricultural sector is also vital as it is the predominant

[1] Less-developed countries is used as a collective term for middle-and low-income countries throughout this article.

source of livelihoods in rural areas in these countries (Dethier & Effenberger, 2012). Climate change, therefore, poses a direct threat to the incomes and food security of millions of people residing there.

To effectively mitigate and adapt to climate change, in COP21 in Paris, governments of both developed and less-developed countries came together and agreed to reduce the usage of fossil fuels with a complete waiver by the end of the century to limit global warming to 2 °Celsius (Bisbis et al., 2018). The United Nations also introduced sustainable development goals, under which countries decided to include their mitigation and adaptation efforts as crucial components in their development agendas. However, designing optimum adaptation policies for the governments of less-developed countries has not been straightforward. First, it is becoming increasingly clear that autonomous or private adaptation is often not possible in less-developed countries due to various barriers, and there are persistent "adaptation gaps" (Carleton & Hsiang, 2016; Hsiang & Narita, 2012). Secondly, these countries face the challenge of maintaining economic development while simultaneously adapting to the changing climate (Castells-Quintana et al., 2018). It is, therefore, essential to frame better-target policies that enhance the adaptation capacities of the most vulnerable populations in these countries while not harming national development goals.

In this article, I study the effects of climate change on migration *through* the impact of climate change on agriculture in rural areas in less-developed countries. This investigation will be particularly relevant for identifying and designing adaptation policies for rural areas in less-developed countries. I will argue in this paper that access and barriers to in-situ agricultural adaptation measures play a crucial role in migration decisions.

This study is built on some recent reviews of the literature on climate change and migration, such as those by Cattaneo et al. (2019)), who stressed the potential inhibiting effects of climate change on migration and highlighted the heterogeneity of migration responses to climate change across different contexts. Another critical study reviewing the quantitative evidence by Hoffmann et al. (2021) also emphasized this heterogeneity and partly linked this to differences in methodological considerations, such as data sources, and different econometric models. Although there is now consensus that local contexts significantly influence migration responses to a changing climate, there needs to be a larger understanding of these contextual factors and their role in influencing migration responses to climate change (Black et al., 2011; Hoffmann et al., 2021).

To contribute to this debate, I try to understand migration responses to climate change from the perspective of an agricultural household. I explain how local contextual factors such as access and barriers to in-situ agricultural adaptation measures play a critical role in determining migration responses. I consider access to in-situ agricultural adaptation measures as a critical component of the broader agenda of sustainable economic development. That is, I develop the approach on the notion that adaptation to climate change and sustainable economic development go hand-in-hand and are influenced by both micro-level constraints and macro-level trends that ultimately determine the vulnerability of a household to climate risk (Castells-Quintana et al., 2018).Steady access to agricultural adaptation measures is an

outcome of economic development. However, effective agricultural adaptation contributes to economic development by raising rural productivity levels and building climate resilience.

I conduct a systematic review of the evidence on the moderating role of agriculture in the relationship between climate change and human migration in less-developed countries. The review is restricted to these countries because significant parts of their rural populations are directly or indirectly dependent on the agricultural sector. The scope of the study is also narrowed down to three phenomena of slow-onset events of climate change: temperature increases, precipitation changes, and droughts- with demonstrable evidence of their impact on agricultural productivity levels in the low-latitude and near-equator regions (Cline, 2007; Li et al., 2009; Lobell & Gourdji, 2012; Parry et al., 1999; St.Clair & Lynch, 2010). The final sample in the review consists of 81 quantitative and qualitative studies on the topic.

The findings broadly underline two main determinants of migration decisions of agricultural households to climate change: access to in-situ adaptation measures and liquidity constraints. Furthermore, how these two determinants affect migration responses is moderated by other contextual factors such as easy access to credit, social networks, social fractionalization, susceptibility to conflicts, and social structures. I draw on the theory of New Economics of Labor Migration (NELM) and its various extensions to interpret the findings and note that the findings align with theoretical predictions. Furthermore, I observe a significant overlap between the social class of farmers, their capabilities to adapt in situ, and their decisions to migrate. The main takeaway of this paper is that migration responses of agricultural households to climate change cannot be seen in isolation, as also stressed by Black et al. (2011) , but needs to be seen in the broader context of economic development. Based on the findings, I build a conceptual framework that could aid in deconstructing the migration responses of agricultural households in less-developed countries. Furthermore, I highlight critical policy gaps in building climate-resilient rural economies in these countries and suggest future research agendas on the agricultural channel in climate change and migration.

The rest of this article is organized as follows. Section 2 presents an overview of current knowledge regarding climate change and agriculture, focusing on the impacts of climate change on the agricultural sector in less-developed countries. I also provide an overview of in-situ agricultural adaptation measures and discuss the barriers and challenges an agricultural household faces in accessing these measures in these countries. Next, in Section 3 explains the theoretical and empirical underpinnings for the migration decisions of agricultural households and their interactions with access and barriers to in-situ agricultural adaptation measures. Section 4 describes the methodology of the systematic review, and Section 5 illustrates the results and presents a discussion. Finally, Section 6 is dedicated to policy gaps, and Section 7 concludes by outlining the recommendations for future studies.

II Climate Change and Agriculture

Some of the world's poorest countries are highly agrarian- the sector serves as a major source of livelihoods in rural areas. In Appendix A, I present indicators on poverty, employment share in agriculture, and prevalence of undernourishment in a few selected less-developed countries that underline the vulnerability of these countries to climate change. Besides, average agricultural productivity levels in less-developed countries have always been lower compared to those in developed countries, and now they face the challenge of adapting their agricultural sector to the changing climate.

Cline (2007) explicates two ways in which warming harms crop yields in less-developed countries that are mainly located at low-latitude and near the equator where temperatures are already near tolerance levels. First, warming accelerates the development of crops resulting in less grain production. Second, warming obstructs the way through which plants derive moisture. It speeds up evaporation from the soil and increases transpiration from the plants- the combined effect is called evapotranspiration- leading to loss of moisture from the leaves. Along with Cline, several other studies provided evidence of the diminishing effects of warming on agricultural production in less-developed countries across the globe. For instance, Schlenker and Lobell (2010) documented that warming severely impacts the yields of maize, sorghum, millet, and groundnut, which are key crops in Sub-Saharan Africa (SSA). Taraz (2018) showcased that higher temperatures reduces yields in all districts of India. Besides, the monsoon rainfall, vital to rice production in India, is becoming less frequent and more intense (Auffhammer & Schlenker, 2014). Regional warming and increasing air dryness have steadily cut Brazil's agricultural yields since the 1980s (Rattis et al., 2021). Temperature rise is decreasing maize yields in rainfed fields in Mexico (Ureta et al., 2020). Besides staple crops, climate change is affecting regional specialty crops that could be scathing for rural areas, as shown by Mukheibir (2008) for South Africa. Moreover, pests and disease infestations might become more intense, further damaging crop production (Newton et al., 2011).

The in-situ adaptation measures that the farmers in these countries could implement include following traditional practices to deal with weather or climate variability, investing in new and mechanized agricultural technologies, and using new crop varieties. The in-situ adaptation measures are broadly classified into inter and intra-crop adaptation measures. The intra-crop adaptation means farmers continue to grow the same crops but adjust their agricultural practices to deal with climate variability (Taraz, 2018). An example of this is investing in irrigation systems and changing the amount or timing of the irrigation. It also consists of investing in improved irrigation technologies and water delivery systems that could enhance the water retention capacity of soil and aid in times of drought (Porter et al., 2014). However, about 70 percent of agriculture is rainfed, and access to irrigation is a challenge, particularly in less-developed countries. For instance, only 4 percent of agricultural land in Sub-Saharan Africa is irrigated compared to 18 percent globally (Henderson et al., 2014; Yu et al., 2010). In AppendixB, I showcase the evidence on the extent of agricultural irrigation in selected semi-arid countries that hints at paltry access to irrigation in

less-developed countries. Intra-crop adaptation also includes using fertilizers and changing fertilization rates. But again, the usage of fertilizers is scant in less-developed countries, where farmers are often unable to meet high fertilizers costs (Croppenstedt et al., 2003; Duflo et al., 2011).

Inter-crop adaptation involves crop diversification and shifting to heat-resistant and drought-resistant crops. It also involves planting short-duration cultivars and growing early-maturing cultivars, among others (Ponce, 2020; Taraz, 2018). These practices, though, require complementary measures to be effective. For instance, changing crop varieties have been shown to be successful when complemented with soil and water conservation measures (Ponce, 2020). Both inter and intra-crop adaptation could be part of autonomous (private) adaptation in the absence of any barriers. However, evidence, especially in less-developed countries, indicates that such autonomous adaptation is not occurring (Castells-Quintana et al., 2018). Poor and marginal sections of rural populations in less-developed countries face multiple socioeconomic barriers to adapting effectively. Hence, studies have consistently raised the issue of meagre agricultural adaptation in less-developed countries (Hertel & Lobell, 2014).

More importantly, autonomous adaptation requires infrastructural support, which is often lacking in less-developed countries. The provision of basic amenities that could enable agricultural adaptation, such as safe housing, access to water, sanitation facilities and energy, and better road connectivity, continues to remain poor in less-developed countries. Rural infrastructure, from better roads to agricultural canals, pumps, tubewells, and uninterrupted access to electricity, could enhance farmers' uptake of new agricultural adaptation measures (Genius et al., 2014; Wang et al., 2014).

III Agriculture and Migration: Theoretical and Empirical Underpinnings

To understand the migration responses to climate change from the perspective of an agricultural household in the context of less-developed countries, I draw from Stark and Bloom (1985) 's New Economics of Labor Migration (NELM) and its various extensions. NELM conceptualizes migration as a risk-diversifying strategy rather than only as a response to the income differentials or the relative differences in opportunities between origin and destination areas as in the Neo-classical and push-and-pull theory (Lee, 1966; Lewis, 1954; Massey et al., 1993). Members of a household enter into a contractual agreement in which one or more members migrate to sectors with earnings either negatively correlated or not highly positively correlated with that of origin sectors. Stark and Bloom emphasize how both parties (migrating and non-migrating) benefit in this arrangement as earned remittances are shared and provide coinsurance to the household.

Extending the argument, Lucas and Stark (1985) claimed that "tempered altruism or enlightened self-interest" sustain this kind of contractual agreement within a household amongst its migrant and non-migrant members. The non-migrant members benefit by

spreading income risks using remittances during agricultural failures. Although a component of altruism is involved, migrants may also continue to stay in the agreement as part of their earnings as remittances are invested in better agricultural technologies by a trustworthy family member back home. This also contributes to the accumulation of assets and power, which ultimately benefits them when they intend to return. Besides, migrants stay in the contract out of pure interest to inherit, which rises with larger remittances. This implies that this kind of agreement might mainly be observed in households that are relatively better off with medium-sized lands and livestock and could benefit from remittances to invest more in agricultural activities. This is also in line with Stark and Taylor (1991) ,who asserted that, for a certain range of wealth, returns to investment in physical assets could be extremely high, incentivizing farmers to migrate and send remittances. These remittances also contribute to children's education and human capital accumulation. Besides, the household or immediate family members support the migrant members during the initial period of job search at the destination. Lucas and Stark's argument relies on the assumption of imperfect capital markets at origin areas prevalent in less-developed countries. Migration, in this case, thus acts as an income insurance mechanism[2].

In addition, farmers fail to access loans for better agricultural technologies, and thus migration might mainly occur to reap remittances for investment in agricultural assets. In this case, if the benefit in the form of return on investments on significantly better agricultural technologies made through remittance income is high enough, it leads the farmer to migrate (Katz & Stark, 1986). This depends on the initial wealth level, implying that relatively wealthy farmers with large landholdings may have a low incentive to migrate (Bazzi, 2017).

On the other hand, for smallholder agricultural households living close to subsistence, the losses from migration are such that it makes them highly averse to moving. Liquidity constraints characterize a typical rural area in less-developed countries which might become more binding due to the impact of climate change on agricultural productivity levels. This is the "poverty as vulnerability" view that has been extensively discussed by G. Bryan et al. (2014) and Banerjee (2004) . Living close to subsistence and lack of saving options make experimentation with a new activity, even when it could be profitable for them, appear particularly risky, including investing in new agricultural technologies and migration. Besides, G. Bryan et al. (2014) further argued that these households are seldom part of migrant networks and thus are unaware of opportunities at the destination.

Based on the studies selected in the final sample of the review, I analyze the implications of the aforementioned theories in the backdrop of climate change. I examine how access to agricultural adaptation means is a critical determinant of migrant decisions for agricultural households at different positions of a wealth continuum.

[2]This aligns with the argument by Kleemans (2015) that those who could afford migration could use it as an investment strategy to deal with income risks.

IV Methodology

In this study, I conduct a systematic survey of the literature on the nexus of climate change, agriculture, and migration in less-developed countries. Systematic reviews are helpful in social sciences as they provide a transparent, rigorous, and methodical way to summarise literature and ensure high quality. Moreover, it also allows for identifying the gaps in the literature and developing a research agenda. I follow four factors discussed by Victor (2008) that distinguish systematic reviews from the traditional literature review: comprehensiveness in the coverage; attention to the quality of literature; a transparent and systematic approach to data synthesis, and; clarity and rigorousness in the process.

The literature search was undertaken in September 2021. To be comprehensive, I searched the literature on the Web of Science and the Scopus database and included journal articles, books, book chapters, and working papers. Additionally, the search was augmented by the literature on the CLIMIG database[3], a comprehensive database devoted to the literature on the environment, climate change, and migration. The search was restricted to resources published in English and fields of social sciences, environmental studies, economics, and multidisciplinary areas. To ensure quality, I only chose peer-reviewed journal articles, books, and working papers from reputable international organizations such as World Bank.

In order to maintain rigor and transparency, I included search terms related to slow-onset events of climate change used in literature (Kaczan & Orgill-Meyer, 2020). The search included terms related to slow-onset events of climate change (temperature rise, erratic precipitation and, droughts) and migration in abstract or keywords[4]. To ensure a systematic and clear approach, I documented the different steps of the search and screening process. I recorded the number of studies included and excluded, as well as the reasons for exclusion. This is depicted in the PRISMA flow diagram in Figure1.

The initial search yielded 4049 unique studies from Web of Science, Scopus, and CLIMIG. The inclusion criteria defined for the abstract and full-text analyses are as follows:

1. studies only on middle-income and low-income (poor) countries, collectively referred to as less-developed countries in the paper. I follow the classification carried out by World Bank based on the income levels in 2021[5];

2. studies on the association between slow-onset events of climate change such as erratic warming, precipitation changes, and droughts;

3. studies on the nexus of abovementioned events of climate change, agriculture, and migration at rural sending regions;

4. following Kaczan and Orgill-Meyer (2020) , quantitative studies including climate variability with monthly, yearly or multi-year intervals and employing identification strat-

[3] https://climig.com/

[4] Search terms are: (migration AND (climat* OR weather OR temperature OR warming OR "slow-onset events" OR rainfall OR precipitation OR drought)). Initial search also excluded words unrelated to human mobility such as fish, salmon, trout, mammal, bird, plankton, insect.

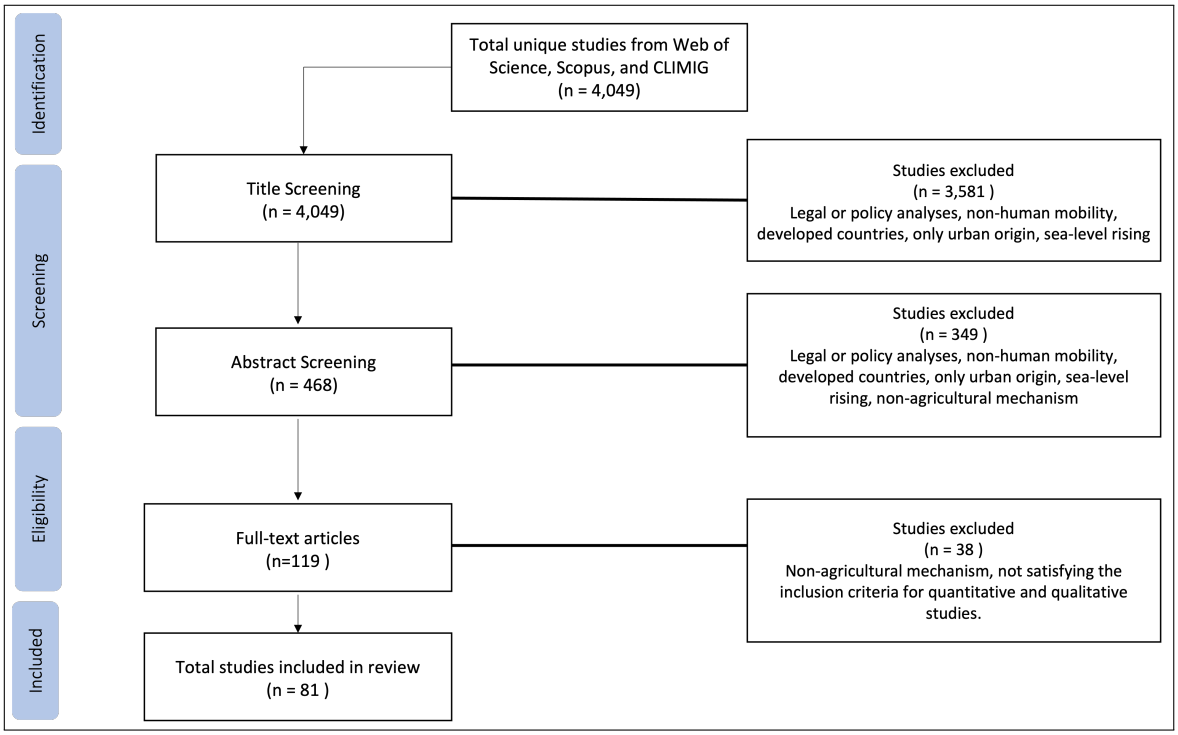
[5] https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2021-2022

egy that controls for other factors and temporal factors affecting the migration are chosen;

5. qualitative studies include observational, primary surveys, and focus group interviews dealing with how erratic warming, precipitation changes, and droughts hamper agricultural livelihoods and regional mobility.

The abstract screening and full-text analyses resulted in 81 eligible studies in the final sample.

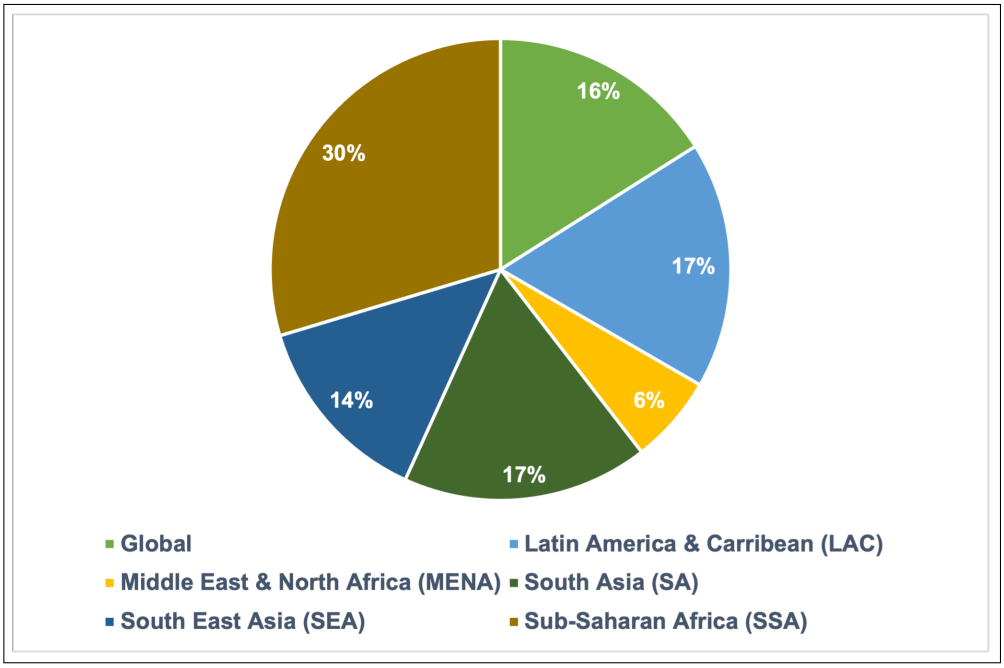
Figure 1: PRISMA Flow Diagram



V Results

This section provides a descriptive summary of the major findings of the review. I note that a relatively high number of studies in the final sample of the review feature Sub Sahara Africa (SSA). SSA is one of the most vulnerable regions to the changing climate and is expected to experience increased warming, changes in rainfall intensity, and high-intensity droughts in the future (IPCC, 2014b; Kotir, 2011). Climate change is an added stressor in SSA as the population is predominantly rural- livelihoods of around 70% of Africans rely on mainly small-scale and subsistence-based agriculture (Serdeczny et al., 2017). It is also the poorest region in the world, with World Bank (2020) estimates confirming that more than 40% population lived below US$1.90-a-day in 2018.

Figure 2: Representation of Regions in the Final Sample



The chart displays the percentage of studies by regions in the final sample of the review. The Sub-Saharan African (SSA) region is represented the most and the Middle-East & North Africa (MENA) is represented the least.

In one of the earlier studies on SSA, Findley (1994) highlighted how the droughts during 1982-83 in Mali transformed migration patterns in the country. Previously, international migration towards France, primarily by wealthier households, was most prominent. This changed into more seasonal or circular internal migration towards urban areas, underscoring how relatively poorer families started engaging in migration more as a risk management strategy. Other studies documented that temperature and rainfall anomalies adversely affect agricultural production and contribute to rising urbanization rates in SSA (Barrios et al., 2006; Marchiori et al., 2012). However, this could be mainly the case in regions with cities as manufacturing hubs and not dependent on the agricultural sector (Henderson et al., 2017)), again stressing that farmers are likelier to move to sectors with earnings not correlated with the agricultural sector. Moreover, with high dependence on agriculture and scant means of adaptation, SSA is also the region demonstrating the "population trapping effects" of climate change that could perpetuate poverty traps. Hirvonen (2016) showcased this for Tanzania, where the temperature rises are inhibiting migration in poor agricultural households. Some other country case studies in SSA with similar results include Botswana and Kenya (Mueller, Gray, & Hopping, 2020), Burkina Faso (Mueller, Sheriff, et al., 2020), and a cross-country analysis by Cattaneo and Peri (2016) .

On the other hand, compared to SSA, the relationship between migration and climate change in the Latin American and Caribbean (LAC) region remains quite understudied.

Projections for the region match the global trend of rising temperature and indicate long summers and high extreme heat days, especially in coastal regions (Reyer et al., 2017). Droughts have also become more frequent in LAC between 1950-2010, which could exacerbate in the coming years (Dai, 2013). LAC is home to the world's largest rainforest, the Amazon, which reportedly, between August 2019 and July 2020, experienced the highest jump in year-to-year deforestation since 2010. This is concerning as it could augment heat stresses induced by climate change on local and regional levels (Alves de Oliveira et al., 2021). Agriculture is an essential sector in LAC and contributes 5-18 percent to the GDP of 20 countries (Morris et al., 2020); thus, the linkages between climate change, agriculture, and migration are forthright. Studies suggest that higher temperatures are increasing out-migration from rural areas in Brazil and Uruguay. However, Bolivia, which is much more agrarian and one of the poorest countries in the region, is experiencing decreases in rural out-migration due to warming (B. Thiede et al., 2016))- another indication of inhibiting effects of climate change on migration. Droughts are observed to be associated with higher out-migration rates in Mexico but largely in communities that have precedence of migration to the US (Hunter et al., 2013). Delazeri et al. (2022) also disclosed that temperature increases reduce out-migration rates predominantly in the deprived agricultural areas of North-Eastern Brazil.

Almost 1/6th of the world's population resides in Southern Asia (SA), which also has the second highest extreme poverty rate after SSA (Islam et al., 2021). In addition, over 70% of people live in rural areas, and the agricultural sector employs 60% of the workforce rendering the region extremely vulnerable to climate change (Bandara & Cai, 2014; Herforth, 2013). Warming, melting of the Himalayan glaciers, and sea-level rise could possibly put livelihoods of billions at risk. The average temperature in SA could reach 2.1-2.6 °C by 2050, and as a result, the Indo-Gangetic plains might become inconducive to wheat farming (Aryal et al., 2020; Ortiz et al., 2008; Tesfaye et al., 2017). Moreover, the monsoon season, essential to rice production in the region, is becoming much weaker and more variable over the years (Loo et al., 2015; Singh et al., 2014). In Bangladesh, the amalgamation of factors such as rising sea levels, salt-water intrusion, and decreasing crop yields has raised the likelihood of households falling into chronic poverty (Olsson et al., 2014). Reviewing the impacts of warming and changing precipitation patterns on migration in Bangladesh, Iqbal and Roy (2015) concluded that rises in rainfall uncertainty and the consequent crop failures are pushing net outmigration rates up. Besides, crop failures are much likelier to induce permanent movements than rapid events such as floods (Gray & Mueller, 2012b). Additional evidence for Pakistan (Mueller et al., 2014) and India (Sedova & Kalkuhl, 2020; Viswanathan & Kavi Kumar, 2015) showcase that warming is soaring migration from rural areas by debilitating rural livelihoods.

There have also been several studies on changing migration patterns in the Southeast Asian (SEA) region due to climate change. The average temperature has shot up by 0.1-0.3 °C per decade in the last 50 years in SEA, which also faces the constant threat of sea-level rise and salt-water intrusion (Weiss, 2009). For instance, the average temperature levels

in Vietnam have risen by 0.4 °C since 1960 and are projected to rise further (McSweeney et al., 2010). Indonesia is also undergoing similar increases in the average temperature with high variations in precipitation patterns and magnified risks of droughts (IPCC, 2014a). The monsoon season is particularly crucial to rice production in Indonesia, and B. C. Thiede and Gray (2017) showed that the timing of the monsoon onset rather than the total precipitation is altering migration rates out of rural areas. The delay in the monsoon onset associated with increases in non-farm revenues is increasing within-province migrations in the country.

In Vietnam, high precipitation extremes could benefit crop production in some instances; they raise agricultural household incomes but reduce agricultural wages and motivate the highly educated to move to cities in search of salaried jobs (Nguyen, 2021). Additionally, migration could be risky for households close to subsistence; Quiñones et al. (2021) demonstrated that exposure to droughts consecutively for two years makes households more risk-averse and challenges out-migration in Thailand and Vietnam.

Finally, the Middle East and North African (MENA) region are remarkably understudied. The region is the largest producer of refugees in the world and has the highest number of people internally displaced by armed conflicts and generalized violence worldwide (IOM, 2016). While the direct effects of climate on conflicts are unclear, studies have repeatedly stressed that climate change could augment existing political fragility in MENA by debilitating climate-sensitive livelihoods and threatening water security (Sieghart et al., 2018). In addition, the region has been experiencing a rise in droughts since the 1960s and is plagued by water shortages (UNICEF, 2021; Waha et al., 2017). A variety of literature has linked these persistent drought occurrences to unsustainable agricultural policy and political instability in Syria and the eventual internal and international out-migration but illustrates mixed findings (Ash & Obradovich, 2019). Another study on Yemen disclosed that higher temperatures have a minimal negative impact on net migration rates via the agricultural decline, but this could amplify in the future (Joseph et al., 2014).

Overall, these broad findings confirm the expected strong associations between climate change, agriculture, and migration in less-developed countries. The literature explains that migration could be an additional risk management strategy or coping strategy for relatively wealthier agricultural households. More importantly, what is clear from these findings is that, by inducing binding liquidity constraints, climate change could also potentially trap either entire populations of a region or the most deprived sections, thus exacerbating poverty and inequality levels.

VI Access to in-situ agricultural adaptation measures and liquidity constraints

In this section, I interpret the findings from the perspective of theories delineated in section III and highlight two main determinants of migration responses of agricultural households to climate change: access to in-situ agricultural adaptation measures and liquidity constraints.

. A common theme across the reviewed articles is the role of financial resources and

binding liquidity constraints in shaping migration responses to the changing climate. South Asia and Latin America are the regions with some of the highest land inequalities in the world, with the top 10% of landowners possessing 75% of agricultural land; this is followed by China, Vietnam, and Africa (Bauluz et al., 2020)- I illustrate indicators on land inequality in Appendix C. This implies that there are large landowners in the rural regions in these countries with high socioeconomic status who have low incentives to migrate for economic purposes. This echoes the theoretical implications that incentives to migrate decrease at particularly higher levels of wealth. Large landowners in these countries are also reluctant to move as they are reluctant to leave their lands behind (Jayachandran, 2006). Moreover, they have better access to the agricultural markets and enjoy political powers, and the idea of foregoing these opportunities further weakens the incentive to migrate (Baland & Robinson, 2008; E. Bryan et al., 2009; Dustmann & Okatenko, 2014). Less-developed countries also often feature serious land market frictions, which also makes liquidating lands difficult (Lagakos, 2020).

Another more important reason that becomes relevant in the backdrop of climate change is that access to in-situ adaptation measures is attainable to these households (Deressa et al., 2009). The reviewed articles in this study disclosed that large-scale landowners are investing in pumping equipment critical during droughts and the late onset of monsoon seasons in South Asia. In addition, these households could invest in inter-crop adaptation measures such as crop diversification as it is easier to implement on larger plots of land. These households also possess sufficient financial resources to invest in other intra-crop adaptation techniques, such as mechanization and fertilizers. Moreover, access to information and making informed decisions are essential to such an autonomous adaptation that is accessible to relatively wealthier agricultural households. Financial resources also enable access to education, which further promotes the adoption of agricultural adaptation measures. Thus, reviewed studies also demonstrated that the changing climate has much more pronounced effects on agricultural incomes and migration responses of less-educated households than on the high-educated. These findings broadly resonate with the notion that households with resilient livelihoods would not show considerable changes in their migratory patterns due to climate change (Nawrotzki et al., 2015).

Medium landholders utilize migration as a risk management strategy to diversify income sources, reduce dependence on the agricultural sector, and build resilience to the changing climate. These households are well-placed in social networks, meaning they have information on the opportunities and conditions at destinations. Some even move internationally if the household or the region has high precedence of international migration. Most of these migrants are young, higher educated, and male members of the households; they migrate to urban regions that are manufacturing hubs and seek semi-skilled and salaried jobs. The movement could be, at times, long-distance towards those regions that have a considerably better climate than the origin areas where migrants perceive better productivity gains. This kind of migration also generates remittances invested in in-situ adaptation methods back at the origin. For instance, in Tunisia, a study showed how migration is transforming

the agricultural sector as the households spend the remittances to invest in new irrigation techniques and digging wells (Sobczak-Szelc & Fekih, 2020). Another example is of study on China, which showed how out-migration from rural areas in response to heat spells has been falling over time (Gray et al., 2020). Though people migrated initially in response to heat spells, out-migration in response to heat spells has been declining over time. Along with declining productivity levels in the urban regions as a possible reason, another potential reason could be the increased access to adaptation means such as crop adaptation and livelihood diversification which became possible with remittances from the migrant members in the urban regions.

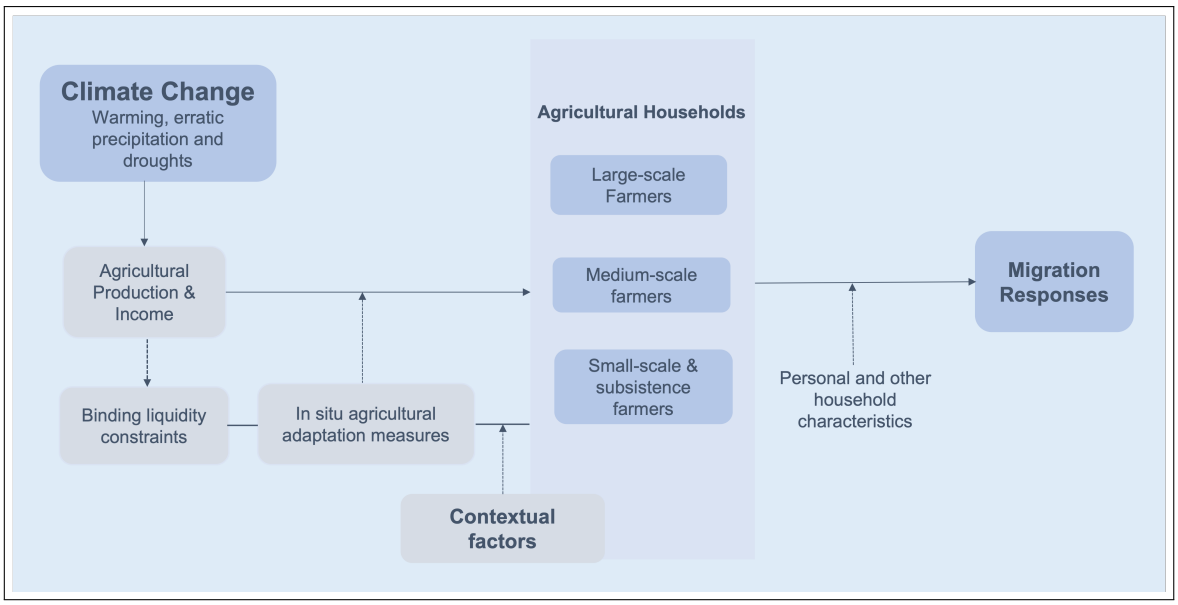
Although an explicit mention of this was not found in the reviewed articles, literature has shown that remittances also enable the accumulation of human capital by increasing school enrolment and towards better health of the household members (Azizi, 2018; Calero et al., 2009). This could further strengthen the adaptive capabilities of these households. Furthermore, migration also enhances social connections and facilitates flows of information, such as on investment in in-situ methods, incentives, and the technical know-how of implementing agricultural adaptation methods.

Agricultural households who are marginal cultivators and landless may have the incentive to migrate for better opportunities but could face difficulties due to high migration costs and liquidity constraints. These are the households that have nothing to lose from moving and in regions with high precedence of out-migration to nearby urban areas, they may move. However, this movement is mainly to the nearest cities where migrants work in informal sectors or as domestic workers and live in precarious conditions (Evertsen & van der Geest, 2020; Rana & Ilina, 2021).

On the other hand, those agricultural households living close to subsistence are highly likely to get trapped in the rural regions due to severe liquidity constraints. They are predominantly from minority and marginalized groups and are mostly low-skilled. Poor households, in general, are less educated, and the poorest countries in the world have the most significant segments of the illiterate population (Roser & Ortiz-Ospina, 2016). This not only limits their social mobility but makes them extremely vulnerable to the changing climate. Declining agricultural productivity levels could dry off the bare-minimum incomes and increase the chances of falling into poverty. Moreover, severe liquidity constraints and low social connections with little knowledge about the conditions and opportunities at the destination also make them highly averse to the risks of migration. Declining agricultural productivity levels could dry off the bare-minimum incomes and increase their chances of falling into poverty.

Based on these findings, I develop a conceptual framework (3), showing how different classes of farmers are responding to climate change in the context of a less-developed country. Although I establish access to in-situ agricultural adaptation means and liquidity constraints as the determinants of migration responses, these are influenced by certain contextual factors that are the subject of the following sub-section.

Figure 3: Conceptual Framework



VI.I Contextual Factors

The review also disclosed the importance of other contextual factors in access to in-situ agricultural adaptation measures and, thereby, in migration responses. This complexity further adds a layer to the dynamics of migration responses to changing climate and could partly explain the heterogeneous evidence.

First is access to formal credit and insurance markets that are either wholly absent or incomplete in rural areas of less-developed countries (Dercon, 2002). Appendix D presents data on access to credit in selected less-developed countries. The studies in the review have discussed how liquidity constraints faced by poor households could get severe during times of agricultural losses limiting migration. However, adapting to changing climate requires adopting new agricultural technologies, shifting to heat-resistant crops, changing cropping patterns, or even exploring non-farm-based livelihood options which demand uninterrupted access to credit options. Problems in accessing credit make households more averse to experimentation and thus reluctant to undertake measures, even if they believe them profitable. Small land sizes are also not easily divisible for experimenting with practices such as crop diversification and adopting heat-resistant seeds. For example, the small agricultural plots and the reluctance to experiment are discussed as major factors behind the low adoption and diffusion of Green Revolution technologies across South Asia (G. Bryan et al., 2014). Depending on the access of medium, smallholder, and marginal cultivators to financial options in rural areas, migration responses in a region could differ. Furthermore, what needs to be emphasized is that households unable to migrate and adapt in situ could be worse off in a worsening climate, which further dwindles their chances to migrate in the future and increases their vulnerability and chances to fall into poverty.

This last point is critical because vulnerability to climate change and access to adaptation means itself are deeply embedded in social structures. Access to credit, for instance, is stringent across the marginal and backward groups. In India, studies have repeatedly stressed that caste has been a major factor in access to credit. The landless and marginal cultivators mainly belong to the backward castes and are much more vulnerable to climate change than the large-scale farmers. Aslany and Brincat (2021) , in their study on the state of Maharashtra in India, pointed out that adaptation to climate change has been particularly class-specific and thus also caste-specific (Nandwani, 2016; Zacharias & Vakulabharanam, 2011). Similar findings have been documented in South Africa, where those from the non-white and poor population have limited access to credit and are more exposed to the changing climate (Gbetibouo et al., 2010; James, 2014). In the review, I also noted that migration responses differ highly between forward and backward groups in India and South Africa. In Eastern Gangetic plains in India, while higher caste farmers invest in new agricultural technologies and need not engage in migration, warming and agrarian stress permanently push low-caste marginal cultivators to shift to non-farm sectors such as construction or work in brick kilns or as rickshaw pullers or towards nearest rural and urban areas (Sugden et al., 2014).

Social structures and restrictive social norms also produce quite different migration responses to climate change for demographic groups, including women. Female workers in agricultural sectors are highly vulnerable to climate change as they constitute the highest percentage of poor population in the world and often lack the means to adapt (Arora-Jonsson, 2011; Kakota et al., 2011; Sugden et al., 2014). Overall, the studies in this review agreed that male household members are most likely to move in response to climate change. However, I emphasize that it is the social norms and customs that are affecting the female migration responses to climate change quite differently than those of males. Gray and Mueller (2012a) observed that in rural Ethiopia, consecutive droughts are associated with drastic declines in marriage-related female migration rates. It could be a coping mechanism in households facing liquidity constraints as the bride's family bears the marriage expenses. Furthermore, in conflict-prone areas that experience frequent gender-based violence, climate change could induce more women to out-migrate. For example, in the region of Mindanao in the Philippines, extreme heat days and droughts are shrinking smallholder livelihoods, threatening food security and attenuating conflicts. In addition, female agricultural workers in the area are underpaid and are subjected to violence. These have led to high involuntary outward migration, especially women moving to cities (Chandra et al., 2017).

I also observed that in regions with high historical precedence of international out-migration to developed countries where the adoption of new agricultural technologies is relatively higher, being in migrant networks could evade the need to migrate. Previously, I discussed how remittances are helping agricultural households to invest in adaptation measures and contributing to building adaptive capabilities. Contrary to the literature on how participation in social networks usually facilitates migration by alleviating costs, the migrant networks are promoting the transfer of knowledge on in-situ measures between

origin and host communities and furnish the financial resources required for investment in agricultural adaptation measures. For instance, in Mexico, with a history of migration towards the U.S., I found that participation in community migrant networks is reducing out-migration in response to warming by facilitating knowledge of new technologies and cropping patterns. Similar effects are also discussed for Mali, Senegal, and Mauritania, where there is a dense migration history to France, and migrant networks are now obviating the need for other remaining households to migrate.

Lastly, adapting to climate change could be much more challenging in highly-fractionalized and conflict-prone societies dependent on climate-sensitive livelihoods. Collier et al. (2008) discussed this for Africa, where high ethnicity-based fractionalization and risks of conflicts could be a hindrance to adaptation, especially by obstructing the movement of people. Movements across ethnic boundaries could escalate conflicts, and even if people end up moving across ethnic borders, they never gain access to land rights. In the review, I found evidence of how climate change could lead to forced migration in agricultural regions undergoing political transformations and which are prone to conflicts. These risks could be reduced by appropriate policies that could address high disparities in access to means to adapt across groups.

VII Policy Gaps

In the previous sections, I have presented a review of migration responses of agricultural households in less-developed countries and argued that along with liquidity constraints, access to in-situ agricultural adaptation measures is a critical determinant of migration responses. I also examined several local contextual factors shaping access to in-situ agricultural adaptation means and migration outcomes. The results bring to attention several critical policy gaps in strengthening rural economies in less-developed countries and making them resilient to a changing climate.

Liquidity constraints prevail in rural regions of less-developed countries, and when climate change damages agricultural production and causes drastic income losses, they become severely binding. Moreover, the absence of consumption smoothing mechanisms and the general obstacles in accessing financial services perpetuate poverty by hindering migration, which could help cope with the falling incomes. This is much more prevalent among marginal cultivators who decrease their consumption significantly to cope with these declines (Kochar, 1999). At times, small-holder farmers borrow at exorbitant interest rates from local moneylenders to cope, which exaggerates the impact (Banerjee & Duflo, 2011). Several studies indicate that lean agricultural seasons, droughts, and crop failures are linked with low health outcomes and declines in human capital (Burgess et al., 2014; Graff Zivin et al., 2017; Hoddinott & Kinsey, 2001; Maccini & Yang, 2009). With a changing climate, these could become much more prevalent and impair the overall economic development potential of less-developed countries. As discussed previously, policymakers in these countries face the dual challenge of economic development and climate change adaptation. From the findings

of this review, it is clear that economic development policies to tackle poverty are critical in reducing vulnerability to climate change and that these need to be supplemented with effective adaptation policies. As the review indicated, migration responses and autonomous adaptation are moderated by contextual factors, and thus, policies have to be moulded to fit different contexts.

Although governments have made strides in enhancing the financial inclusion of rural populations, much needs to be done primarily to encompass the most vulnerable populations. The World Bank estimates that 1.7 billion adults worldwide remained unbanked in 2017, half of whom are women and poor households in rural areas[6]. Expanding banks in rural areas have been instrumental in decreasing liquidity constraints; it results in a decrease in borrowing rates, diversification of rural economies, and an overall decrease in poverty levels (Burgess & Pande, 2005). Problems in accessing financial services also set back the uptake of various in-situ adaptation measures among marginal farmers. Farmers need to opt for new technologies and change cropping patterns, which would only be possible with uninterrupted access to credit. Governments need to build more diversified rural economies that are not entirely dependent on agriculture. This implies providing incentives and designing policies to encourage entrepreneurial actions and shift to non-farm sectors (Castells-Quintana et al., 2018). It also means facilitating beneficial migration. An example of this is given by G. Bryan et al. (2014) , who argued that a small migration subsidy could encourage subsistence households to overcome aversion to migration-related risks. Moreover, this must be augmented with job search assistance at the destinations; spatial and seasonal matching of employers and employees could successfully lead to beneficial migration.

An important point that remains to be addressed is the case of maladaptation. Maladaptation can occur from actions or inaction that may seem adaptive but could increase risks and vulnerability to climate change in the present or the future (Noble et al., 2014). This could include some in-situ adaptation mechanisms that could resolve the adaptation problem in the present but could be harmful in the future, for example, excessive use of groundwater for irrigation. Therefore, the stakeholders and policymakers need to work together to identify what could be potentially maladaptive and how to avoid it so that it does not hinder adaptation. In this regard, I emphasize the message from Castells-Quintana et al. (2018) that adaptation strategies "need to recognize the opportunity of leveraging underlying dynamics of economic development" and "become more transformational in nature."

This also includes devising migration policies such as those discussed in G. Bryan et al. (2014) to facilitate beneficial migration, policies to shift away from farm sectors in areas already facing agricultural losses, and where in-situ adaptation measures might fail and are turning maladaptive. As Collier et al. (2008) explained, climate change could drastically undermine productivity in certain regions and sectors, which would require migration to more productive regions and sectors. This shift from low-productive to high-productive sectors is a component of the structural transformation of an economy and its economic development (Harris & Todaro, 1970; Lewis, 1954). In these cases, necessary policy actions

[6] https://www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020

would include building capacities to absorb migrants at destination regions and sectors.

Additionally, policies generating job opportunities outside farm sectors, such as MGNREGS[7] in India, and social protection policies, such as Bolsa Familia[8] in Brazil, play a critical part in building resilience to the changing climate. These social protection policies increase the accumulation of physical and financial assets and contribute to human capital development (Adam, 2015; Gutiérrez et al., 2014; Herwehe & Scott, 2018; Tirivayi et al., 2016). However, these measures should be complemented with the provision of adequate infrastructure. Lack of basic amenities such as proper sanitation and clean energy are linked to harmful health outcomes and could increase vulnerability to climate change (Haines et al., 2007; Sinha et al., 2022). The provision of rural infrastructure, such as the building of canals that could ease irrigation options, better roads that could enhance connectivity and access to agricultural markets, and improvement in public services, including uninterrupted electricity, could facilitate farmers' adoption of agricultural adaptation measures (Wang et al., 2014). Furthermore, investment in essential services such as education and healthcare contributes directly to building the adaptive capacity of populations (Eakin et al., 2014).

Better transport infrastructure also reduces migration costs from rural to urban areas. A decreased commuting cost also eliminates the need to move to the nearby cities permanently. It decreases the psychic costs of migration that comes with separation from one's family and addresses the issue of place attachment in which people are reluctant to move far away from their communities despite falling incomes[9].

VIII Conclusion and Future Research

The notion that climate change would lead to vast amounts of populations moving from rural to urban areas and from the global south to north has undergone a drastic reconsideration in recent years. In this study, I systematically reviewed the literature on the nexus of climate change, agriculture, and migration in less-developed countries. I attempted to understand the migration responses from the perspective of agricultural households and established how access to in-situ agricultural adaptation measures is interlinked with their migration responses. In doing so, I consider that economic development and adaptation to climate change go hand-in-hand and interpret the extant evidence by using the theories of economic development on migration in the context of rural areas in less-developed countries.

The results reveal that migration responses to climate change vary significantly across different classes of farmers, a prime reason for which is the high disparities in their access to in-situ agricultural adaptation measures. While large-scale farmers do not need to engage in

[7]MGNREGS is Mahatma Gandhi National Rural Employment Guarantee Scheme is the largest world guarantee program in the world. It guarantees 100 days of wage employment per year to rural households.

[8]Bolsa Familia is the world's largest conditional cash transfer scheme that has benefited over 13 million families a year in Brazil and helped in addressing poverty and inequality.

[9]Literature argues that psychic costs of migration due to separation from friends and family rises with distance (Brueckner & Lall, 2015). Thus, better commuting facilities that could evade this distance and reduce the pressure to move permanently could also potentially reduce the psychic costs of migration.

migration, for medium-scale and small-scale farmers who could afford it, migration could be a successful risk diversification strategy and a means to earn more to invest in in-situ agricultural adaptation measures. On the other hand, subsistence farmers face several barriers to adapting effectively in-situ and cannot migrate and, thus, could be worse off with changing climate limping agricultural livelihoods in the absence of correct policy interventions.

Local contextual factors could affect these migration responses as they influence access to in-situ agricultural means. Based on this review, I develop a simple conceptual framework depicting the role of in-situ adaptation measures and how different local contextual factors modify migration responses of agricultural households. Through the review, I also identified policy gaps that remain to be addressed in building adaptive capacities of rural economies in less-developed countries and emphasized that policies need to be tuned to fit different contexts. In this study, I stressed the idea that adaptation strategies need to be considered in the broader context of economic development. That is, issues such as economic development, climate resilience, and economic development cannot work in silos and requires an integrated approach. Therefore, optimal adaptation strategies must be a critical component of policies on achieving sustainable economic development, which would also help evade friction between climate and developmental goals.

Finally, through the review, I identify three open issues that need to be prioritized for further research. First is the impact of climate change on female migration. The review disclosed a significant lacuna of research on the effects of climate change on female migration. Studies underline how female agricultural workers are underpaid, much more deprived than male workers, and highly vulnerable to climate change with limited freedom to migrate (Denton, 2002; Rani et al., 2013). In rural regions prone to conflicts and with a high incidence of gender-related violence, changing climate by exacerbating conflicts and food security could also lead to the forced migration of women and increase the likelihood of them being subjected to human trafficking (Sugden et al., 2014). This makes this issue highly complex and critical, requiring much more research attention. Another promising avenue for future research is the issue related to conflict risks. The review highlighted how conflict-prone regions such as MENA remain remarkably understudied. Studies repeatedly highlight how climate change could escalate conflicts in fractionalized and politically unstable, and conflict-prone areas by impacting climate-sensitive livelihoods such as agriculture (Barnett & Adger, 2007; Koubi, 2019). These mechanisms need to be further examined so that target populations can be identified and the policies and international dialogues on climate change and migration can be steered accordingly. Lastly, future research on climate change, agriculture, and migration needs to focus more on access to in-situ agricultural adaptation measures and, more importantly, how the local contextual factors affect the process. The review disclosed that the role of social networks is evolving with climate change. Therefore, a central question for future research is how social networks determine access to in situ agricultural adaptation and, thereby, migration decisions of agricultural households.

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Supplementary Material: The supplementary material containing the list of studies in the final sample of the review is available upon request.

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Appendices

A Poverty and agricultural sector in less-developed countries

Some of the world's poorest countries largely depend on the agricultural sector. As Table 1 exhibits, low-income countries have very high poverty rates compared to the world average, and the agricultural sector employs more than 65% of total employment. Besides, Table 2 shows a high prevalence of undernourishment in less-developed countries. This shows the extent of under-development in these countries. Such high dependence on the agricultural sector and high deprivation rates make these countries extremely vulnerable to climate change.

Table 1: Poverty headcount ratio and share of agriculture in employment in selected middle-income and poor countries

	Poverty headcount ratio at $2.15 a day (2017 PPP) (% of population)	Employment in agriculture (% of total employment)
Burkina Faso	30.5	50.84
Ethiopia	27	73.51
Malawi	70.1	78.78
Yemen	19.8	29.79
Bangladesh	13.5	48.71
Kenya	29.4	57.51
Bolivia	1.9	33.42
Vietnam	1.2	50.02
Ecuador	3.6	28.47
Brazil	5.4	13.16
South Africa	20.5	6.23
Low-income countries	43.9	65
Low and middle-income countries	10	40.07
Sub-Saharan Africa (SSA)	35.1	58.09
World	8.4	33.27

Source: World Development Indicators, World Bank. Data for poverty headcount ratio (at $2.15 a day , 2017 PPP) for 2019 or closest year with available data. The share of agriculture in total employment is averages for the period 2000-2019.

Table 2: Prevalence of undernourishment in selected middle-income and poor countries

	Prevalence of undernourishment (percent) (3-year average)
Burkina Faso	14.1
Ethiopia	21.9
Malawi	17.6
Yemen	42.8
Bangladesh	11
Kenya	25.6
Bolivia	11.9
Vietnam	6.2
Thailand	8
Ecuador	13.7
Brazil	2.6
South Africa	6.3

Source: Food and Agricultural Organization (FAO). The prevalence of undernourishment shows the probability that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover her/his energy requirement for an active and healthy life. The indicator is 3 year average for the period between 2018-2020.

B Agricultural irrigation in less-developed countries

Access to irrigation remains scant in less-developed countries. Table 3 presents the indicator for agricultural irrigation in selected semi-arid countries. The data emphasize the extent of rain-fed agriculture in these countries, which are projected to experience high declines in agricultural productivity due to climate change.

Table 3: Agricultural irrigated land in selected semi-arid countries

	Agricultural irrigated land (% of total agricultural land)
Botswana	0.0096
Ethiopia	0.4714
Ghana	0.2834
Uganda	0.073
South Africa	1.66

Source: World Development Indicators, World Bank. Agricultural irrigated land refers to agricultural areas purposely provided with water, including land irrigated by controlled flooding. Data is for 2020 or closest year with available data.

C Agricultural land distribution in less-developed countries

Furthermore, the inequality in possession of agricultural land is quite high in less-developed countries, especially in South Asia, as shown in Table 4.

Table 4: Agricultural land distribution in selected middle-income and poor countries

	Bottom 50%	Middle 40%	Top 10%	Gini Index
India (2012)	1.2	28.2	70.6	0.82
Bangladesh (2015)	0	31.5	68.5	0.84
Pakistan (2010)	1.4	32.2	66.4	0.80
China (2012)	10	38.4	51.5	0.64
Vietnam (2014)	7	41.1	51.9	0.68
Ecuador (2014)	1.1	28.6	70.3	0.82
Guatemala (2000)	0	22.7	77.3	0.88
Ethiopia (2015)	0.4	28.4	71.2	0.83
Gambia (2015)	2.8	42.5	54.7	0.73
Malawi (2016)	5.3	37.3	57.4	0.72
Niger (2014)	0.3	44.6	55.2	0.75
Nigeria (2015)	5.3	39.1	55.6	0.71
Tanzania (2015)	3.3	32.3	64.4	0.77

Source: Bauluz et al. (2020) . The data is on the distribution of agricultural land value, including the landless population.

D Access to credit in less-developed countries

Access to credit remains challenging in less-developed countries. As Table 5 shows, compared to world averages, the SSA region has deficient access to finance.

Table 5: Access to credit in selected middle-income and poor countries

	Account (%)	Financial institution account (%)	Commercial bank branches (per 100,000 adults)
Burkina Faso	43	23	2.82
Ethiopia	35	35	2.94
Malawi	34	23	2.27
Bangladesh	50	41	8.99
Kenya	82	56	4.67
Bolivia	54	55	68.81
Vietnam	31	30	4.01
Ecuador	51	51	9.74
Brazil	70	70	17.88
South Africa	69	67	9.22
Low-income countries	32	23	2.88
Sub-Saharan Africa (SSA)	43	33	4.52
World	68	67	10.78

Source: World Development Indicators, World Bank. Accounts are % of population aged 15+. Data on account and financial institution account are for year 2017. The data on commercial bank branches is for year 2020 or for closest year with available data.

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