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Effects of land degradation induced migration in Africa

Providing evidence on the role of climate and environmental change as drivers of migration

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INTRODUCTION

In many parts of the world, climate change and migration are closely interrelated. Today, many people living in industrialized countries are not aware of where food, water and energy come from, and their migration behaviour is rarely determined by changes in climate and environmental conditions. However, in developing countries, migration patterns continue to depend heavily on basic ecosystem goods and services. In these parts of the world, migration is a crucial component of livelihoods and rural communities are strongly influenced by climate change and environmental degradation.

As this thesis will describe, migration is a key way by which households cope with changes in the environment. Under extreme conditions, such as natural disasters, migration is a last-resort survival strategy. Although these cases of absolute distress continue to happen, they are less common forms of environmental migration, which occur more commonly to address the need of diversify the household income and to reduce the exposure to environmental and climate related risks and hazards (McLeman 2014). This type of migration tends to be ignored and raises almost no interest in the media. However, to fully understand migration dynamics in less developed countries, it is essential to consider the role played by climate change and environmental degradation on the decision to migrate.

The decision of an individual or household to migrate is influenced by a range of determinants operating at different levels, as illustrated by the Foresight report's theoretical framework (2011). At micro-level, the local factors that interact with the household or individual actions and decisions include age, family size, household income, livelihood strategies, and so forth. At meso-level, migration decisions are shaped by determinants like social network or the ability to access migrant smuggling organizations. At macro-level, factors like political, demographic and economic processes operate beyond the direct control of individuals, households, or communities but equally play a role in determining their choices. Climatic and environmental changes intervene on the whole system and can influence migration decisions by interacting with the others factors. In this complex set of interconnections, vulnerability and adaptive capacity clearly depends on wider social, economic, and political processes.

Researchers have investigated the connection between environmental change and migration since the days of Ravenstein, considered the "father" of the modern migration theories. Nevertheless, the interest for the environmental drivers of human mobility has dropped for almost a century, until climate change has started to dominate the international agenda. Gemenne (2011) identifies four main problems of the existing literature the nexus of environmental and climatic changes and migration. First, the multiple disciplines that have addressed the subject (i.e. natural and social sciences, disaster risk reduction, migration and development) offered different, and

sometimes conflicting, viewpoints on the topic. Multi-disciplinary by nature -because the study of environmental change usually draws on the natural sciences, the study of migration is typically the reserve of the social sciences- the study of environmental migration suffers of a general lack of holistic theoretical approaches. Second, the research agenda on the nexus environment-migration is driven by a growing body of 'grey' literature, often produced by governments, international agencies, and non-governmental organizations with a 'practical orientation'. Third, the importance assumed by climate change on the international agenda has overshadowed the research on other types of environmental change as drivers of migration. This shift of the focus contains the implicit assumption that results related to climate change hold true for other kinds of environmental events. Finally, another crucial challenge is the general lack of empirical data, which is paramount for both research and policy design.

Aware of these controversial aspects, the author tried to address this complex subject by adopting a mix of different approaches that take in consideration the challenges and gaps in knowledge. In particular, the aim of this thesis is to provide new evidence on relationship between climatic and environmental changes and migration by: (i) adopting an inter-disciplinary approach and comparing concepts and paradigms from different academic and policy fields; (ii) elaborating a conceptual framework that shifts from the dominant focus on climate change and addresses migration as a response to gradual environmental changes, such as land degradation and natural resource depletion; (iii) producing new empirical data through a survey conducted on migrants from sub-Saharan Africa.

This thesis consists of a collection of articles and is structured in three chapters, each of which contains one articles/paper. The first two articles have been co-authored, peer-reviewed and published, while the third one has been done in collaboration with the Institute for Scientific Research of the Rabat University that administered the questionnaire in Morocco under the supervision of the author.

The first article is a chapter published in the book "*Migration, Risk Management and Climate Change: Evidence and Policy Responses*" published by Springer under the series Global Migration Issues in 2016. The title of the chapter is "*Remittances for adaptation: an 'alternative source' of international climate finance?"*. Bringing together literature on climate finance and remittances, the article analyze whether remittances could be considered as an 'alternative' source of adaptation finance in international climate negotiations. The underlying consideration on which this cross-disciplinary investigation is based is that motivation to remit is substantially different from the motivation to invest: migrant investors are distinguished from the traditional private sector because determinants for remitting might go beyond profit making and rates of return. On one side, key drivers for investing in areas of origin include family bonds and networks, and thus altruism, prestige, implicit co-insurance agreements and perspectives of return. On the other side, the need for adaptation investments is often concentrated in the water and agriculture sectors, as the livelihoods of most of the people in developing countries depend on these sectors. However, compared to the large investments in energy and transport

infrastructures required for mitigation, land-based sectors are far less attractive to 'traditional' private investors, particularly if they are in exposed disaster-prone areas. In such context, migrants might be the only potential contributors to finance adaptation. This article finds that remittances can meet a number of criteria', mostly because they relate to the motivation to invest in countries of origin and, thus, to some extents, to the willingness to protect and support families, friends and communities. Besides this special feature that remittances might have, these flows remains private flows and, as such, they respond to incentives when considered as stocks of money. The article has been written with the expert support of a specialist of climate finance that had co-authored the article. On this particular aspect, it is important to mention, as *a caveat*, that at the article was written and peer-reviewed, the Copenhagen Accord and the Cancun Agreements were the main reference documents in the climate negotiations.

The second article is a on "*Vulnerability and resilience in West Africa: understanding human mobility in the context of land degradation*" published as a Working Paper by KNOMAD's Thematic Working Group (TWG) on Environmental Change and Migration , a World Bank network of natural scientists and migration experts. This article reviews the evidence on land degradation induced migration in West Africa and explores the circumstances under which migration can actually increase the resilience of households in the face of climate and environmental change. Drawing from a case study selection based on geographical criteria and relevant geophysical processes, it identifies threshold scenarios caused by land degradation in which on-site adaptation is no longer suitable. The analysis focuses on rural systems, whose vulnerability depends on ability to adjust to changing to changing internal demands and external circumstances. With no attempt to quantify tipping points, the authors recognize that thresholds for slow-onset events in West Africa, can be drawn around reduced water availability, decreased land productivity and groundwater salinization. The article proposes a theoretical framework on "natural resource-based approaches to resilience" showing that, when a system become "inhabitable" for external circumstances, the internal demands is forced to change and migration remains the only plausible option for survival. This framework illustrates also how approaches to resilience change at different levels—both within and among ecosystems—and mobility choices are interlinked with (rather than being solely dependent upon) environmental stressors. A particular mix of environmental factors with economic, political, social, and cultural variables influences "diversification" (*ex ante*) and "response" (in season and *ex post*) coping and adaptive strategies. Finally, it recognizes that *tradeoff* between challenges of staying and opportunities of leaving are constituted by a number of key elements, such as: (i) remittances, (ii) availability of job opportunities elsewhere, (iii) availability of and access to resources elsewhere, (iv) information and network. This second article has been conceived with Marco Venier, a UN practitioner based in Dakar, which conducted interviews with government experts at national and regional level to frame the policy recommendations.

The third article, titled "*Environmental change and migration: the role of climatic and environmental conditions in the migration decision*", aims at discussing the nexus between climate/environmental change and migration by focusing on perception of the hazards and

motivations for migration from an individual's perspective. After introducing how literature has discussed the issue since the early modern theory on migration, the author describes common methods used to measure migration related to climate change and environmental degradation. In order to provide new empirical evidence, the author designed a survey targeting migrants already travelling along the Western Mediterranean route. The primary purposes of the survey were to (1) assess the main factors that determined the decision to leave the community of origin, including socioeconomic, security and climatic conditions ; (2) identify recurrent patterns across different categories of respondents, with particular regard to gender, area of origin (rural/urban), and education. Parts of the literature review done for this chapter have been further utilized for the Global Land Outlook published by the United Nations Convention to Combat Desertification (UNCCD) in June 2017. The author is quoted among the contributors to the publication. The survey was conducted in August 2017 in five Moroccan cities (Agadir, Casablanca, Fes, Rabat and Tangier) and collected more than 1000 interviews. The result of the survey confirmed that, in general, climate and environmental change are important determinants of the decision to migrate, even though concurring with other major motivations. In particular, they turned out to be the most important reasons to migrate for a non-negligible number of migrants. In order to determine whether there was a statistically significant difference in the perception of the climatic and environmental variables due to certain characteristics of migrants, the author recurred to used chi-squared tests. The outcomes of the statistical tests revel that climatic and environmental changes are mostly perceived by women as an important factor driving the decision to migrate. As expected, the Sahelian migrants also feel affected by drought and environmental difficulties.

The choice of the title of this thesis is mainly due to the fact that the author based most of the policy recommendations on her professional knowledge of the conditions of migrants in West Africa as well as of the policies to address land degradation/desertification and drought. Although the first article does not directly address land degradation issues and Africa, an important part of the literature on remittances was based on cases studies from the continent. Moreover, concerns about adaptation and climate-induced migration attract international attention mainly when they deal with short-term crises or impressive images of sinking islands, whereas land degradation and drought create distress migration and human suffering on a wider scale. Because livelihoods and household incomes in degraded areas are closely interconnected with migration, adaptation policies that do not consider remittances and other migration implications run a higher risk of failure and of impoverishing people whose livelihoods depend on the land.

CHAPTER 1

Remittances for Adaptation: An 'Alternative Source' of International Climate Finance?

Barbara Bendandi and Pieter Pauw

Abstract: Climate finance is a key issue at the UN climate negotiations, but explicit international funding possibilities for adaptation in developing countries remain limited. According to the recent Paris Agreement, climate finance will come from a '*wide variety of sources, instruments and channels'.* To the extent that these are understood, they do not seem to generate the USD 100 billion per annum that was repeatedly pledged by developed countries, and they flow to mitigation rather than adaptation. Remittances have potential to finance adaptation, because 1) the potential is huge and unexplored); 2) remittances directly reach to households, including in remote and vulnerable areas; 3) remittances are often employed for (climate-induced) disaster relief and sometimes also for investments in long-term adaptation strategies.

This chapter examines whether remittances *could* technically constitute a source of alternative adaptation finance for developing countries under the UN climate negotiations, whilst aware no definition exist of what a 'alternative' mean. It analyses empirical evidence from remittance literature against ten climate finance criteria from the UNFCCC Copenhagen Accord. Our analysis finds that remittances could match criteria such as 'adequate' and 'predictability'. However, 'improved access' can only be matched if developed and developing countries create the right incentives to reach out to potential diaspora investors. 'Transparency' is unlikely to be met. Whether remittances contribute to the USD 100 billion climate finance pledge is a controversial political decision, but in any case remittances can support adaptation at household and community level. Public climate finance could increase the potential of remittance for such purposes.

1. Introduction: Remittances and adaptation finance

Even the most stringent efforts to reduce greenhouse gas emissions cannot prevent climate change impacts in the next few decades, making adaptation essential (Klein, 2010).Developing countries are historically least responsible for the emissions that result in climate change, but most exposed to its impacts. Those most vulnerable to climate change will be the poorest people in migration-prone areas of developing countries (e.g. Ayers, 2011). The costs of adaptation in developing countries are difficult to assess, but were recently estimated in the order of hundreds of billions of US Dollars per year (UNEP, 2014).Explicit international funding possibilities for adaptation activities however remain limited in scale. The 2009 Copenhagen Accord of the United Nations Framework Convention on Climate Change (UNFCCC) recognized that substantially greater financial resources are needed to support mitigation and adaptation in developing countries. In this Accord and the subsequent Cancun Agreements, developed countries pledge to mobilize USD 100 billion per year for this purpose from 2020 onwards, coming from '*a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance'*(UNFCCC, 2010; §8).

The sources of adaptation finance are not well understood. And to the extent that they can be tracked, they do not seem to mobilize the billions of adaptation finance that are needed. Concerning public sources, for example, the Adaptation Fund is often considered to be progressive and innovative. Yet the predictability and sustainability of its future funding are uncertain as it partly depends on the development of the Clean Development Mechanism's market. (Horstmann & Chandani, 2011; 435). Its future had to be safeguarded through a public capital injection during COP19 in Warsaw. Developed and developing countries have now pledged financial resources for the newly established Green Climate Fund, which aims to spend 50% of its resources on adaptation, but its project pipeline still needs to be developed. Multilateral and Bilateral Development Banks are increasingly investing in adaptation, but the expenditure remains low compared to mitigation. The discussion on private sources of adaptation finance, or on private engagement in adaptation in general, is in its early stages (Pauw, 2014).It remains hard to even identify public-private adaptation projects, let alone study the effectiveness, replication or up-scaling potential of public-private adaptation interventions (c.f. Kato et al., 2014). Indeed, private financing for adaptation is difficult to track and seems minimal compared to private financing of mitigation (Buchner et al., 2012). From the language used in the Copenhagen Accord, it is clear that the 'additional source' is neither to be disbursed by the public sector, nor can it be labelled as 'private finance' (see Pauw & Pegels, 2013; 2). The Accord does however not clarify what exactly is meant with the third 'alternative source' of climate finance. In order to analyse whether remittances could be considered as an 'alternative' source of adaptation finance in international climate negotiations, this chapter brings together literature on climate finance and remittances.

Given remittances' increasing magnitude and potential to contribute to development, governments have already been employing policy measures to harness the remittance potential for investments with a long-term perspective (Aparicio and Mesenguer, 2011). Some literature shows that households that receive this type of support have also proven to be more resilient to external stressors including natural disasters (Yang, 2008; Mohapatra*et al*, 2012; Ebeke and Combes, 2013). A number of authors also proved that in times of environmental shocks, remittances have provided significant support to the most vulnerable parts of the society (Couharde and Generoso, 2015; World Bank, 2015; Quartey and Blankson, 2004). These finding are also confirmed by Maddison (2007) and King et al.'s (2014) that have shown the role of remittances in reducing exposure to floods by building more resilient homes or relocating to a safer area.

Migrant investors are distinguished from the traditional private sector because determinants for remitting might go beyond profit making and rates of return. Key drivers for investing in areas of origin include family bonds and networks, and thus altruism, prestige, implicit co-insurance agreements and perspectives of return (Straubhaar,2006). The 'tempered altruism' or 'enlightened self-interest' that often drive remittance behaviour (Lucas and Stark, 1985) makes diaspora investments particularly suitable for adaptation projects. The fundamental difference between individuals or groups either referred to as 'migrants' or 'the diaspora' lays in the

willingness of the act. While migration is voluntary, diaspora is forced, either by physical or economic factors. Moreover, one of the key characteristics of diaspora is summarized by the 'leaving home and staying in touch' attitude (CheSuh-Njwi, 2015). Throughout this chapter we will refer to the concept of diaspora for the importance of the need to move away from the places of origin and the links maintained with the family members or the ancestral community.

The need for adaptation investments is often concentrated in the water and agriculture sectors, as the livelihoods of most of the people in developing countries depend on these sectors. However, compared to the large investments in energy and transport infrastructures required for mitigation, land-based sectors are far less attractive to 'traditional' private investors, particularly if they are in exposed disaster-prone areas. The motivation to finance adaptation thus often needs other drivers than monetary returns.

In this context, the potential for remittances to play a role as an 'alternative source' of adaptation finance analysed for the following reasons: 1) the recorded volume of these flows to developing countries -expected to raise up to USD 516 billion in 2016 by the World Bank- has tripled ODA since 2013, which was USD 134.8 billion (OECD, 2014); 2) the direct connection with the household level often hard to be reached by public interventions; and 3) the motivation to remit, not only based on returns in profit but also on personal bonds, increasing the likelihood for remittances to be spent in remote areas, where the traditional private sector would not necessary invest and where need for adaptation measures might be higher.

This is, however, not enough to affirm that remittances could be an alternative source of adaptation finance contributing to the annual USD 100 billion pledge of developed countries. To identify whether remittances meet the UNFCCC's expectations of adaptation finance for developing countries, this chapter builds on ten climate finance criteria from the Copenhagen Accord and the Cancun Agreements as distilled by Pauw et al. (2015) and examines literature and existing empirical data on remittances against these criteria.

This chapter is structured as follows. The next section identifies the ten criteria for adaptation finance and a reference framework towards which recurring features of remittances will be analysed. By applying these criteria, section three then reviews key findings on the remittances and considers the motivation to remit and the key drivers that might lead to adaptation finance initiatives at individual, household and community level. Section four will analyse remittances as flows and, as such, their potential for being leveraged as investments in adaptation. Section five will discuss the role of public institutions in guaranteeing appropriate frameworks for remittances to be channelled in a 'transparent' and 'balanced' way towards adaptation actions.

2. Adaptation finance criteria

This section builds on ten criteria for adaptation finance that were identified and defined by Pauw et al (2015). They were elaborated for the purpose of this study, as provided in Table 1, which(i) lists the ten criteria that were identified for adaptation finance (predictable; sustainable; scaled up; provided with improved access; new and additional; adequate; prioritized to the most

vulnerable developing countries; mobilized by developed countries; and transparent balanced allocation between adaptation and mitigation),(ii) provides the climate negotiation context explaining how they were distilled from the Copenhagen Accord and the Cancun Agreements and(iii) introduces the angle under which remittances will be dealt to check if they can meet the criteria of adaptation finance and be therefore considered in all respects as an 'alternative source'.

Some of these criteria are partly based on longer standing work agreements under the UNFCCC. For example, criteria such as 'new and additional' and 'predictability' have been articulated again and again, not least in Article 4.3 of the UNFCCC (Müller, 2008; Horstmann & Chandani, 2011). For climate action–only potentially addressing finance- the Copenhagen Accord includes the additional criteria *'country-driven approach'* and *'based on national circumstances and priorities'* (UNFCCC, 2010; §11). Supplementary criteria are proposed by research and climate funds, for example for feasible, effective and efficient adaptation finance (e.g. van Drunen et al., 2009; Müller, 2008).

The identified criteria are based on two milestones in UNFCCC negotiations on climate finance: the 2009 Copenhagen Accord and the 2010 Cancun Agreements. The Copenhagen Accord declared to up-scale climate finance for developing countries with USD 30 billion of fast-start finance for the period 2010-2012 and with USD 100 billion per year from 2020 onwards; that the private sector would be one of sources of these financial resources; and started discussions on the Green Climate Fund. However, the Copenhagen Accord itself is a non-binding political declaration: it was brought forward by 114 Parties, but there was no consensus by the Conference of the Parties (COP). One year later, the 196 Parties to the UNFCCC transformed much of the Copenhagen Accords' content on climate finance into COP decision 95 to 97 of the Cancun Agreements, and therefore these are included in this chapter too.

Copenhagen Accord	**Cancun Agreements UNFCCC**	**Interpretation to analyse remittances**
Predictable (...) financial resources (...) to support the implementation of adaptation action in developing countries (§3) **Predictable** (...) funding (...) shall be provided to developing countries (§8)	Decision: (...), **predictable** (...) funding shall be provided to developing country Parties (§97)	Can recipients anticipate these flows and thereby be able to react and plan accordingly to their adaptation needs?
Sustainable financial resources (...) to support the implementation of adaptation action in developing countries (§3)	-	Are remittances a stable enough source of finance allowing for medium to long- term adaptation?
(...) funding as well as **improved access** shall be provided to developing countries (§8)	-	Do remittances provide direct access to funding?
Adequate (...) financial resources (...) to support the implementation of	Decision: (...) and **adequate** funding shall be provided to developing country	Could remittances contribute substantially to cover adaptation

adaptation action in developing countries (§3) **Adequate** funding (...) shall be provided to developing countries (§8)	Parties (§97)	costs in developing countries?
Scaled up (...) funding (...) shall be provided to developing countries (§8)	Decision: **scaled-up** (...) funding shall be provided to developing country Parties (§97)	Are remittances an increasing flow?
New and additional (...) funding (...) shall be provided to developing countries (§8) The collective commitment by developed countries is to provide **new and additional resources** (...) approaching USD 30 billion for the period 2010 - 2012 (...) (§8)	Decision: (...), **new and additional** (...) funding shall be provided to developing country Parties (§97) COP takes note of: (...) developed countries to provide **new and additional** resources (...) approaching USD 30 billion for the period 2010–2012 (§95)	Can remittances be recorded as new and additional to former ODA levels?
Funding for adaptation will be **prioritized for the most vulnerable developing countries**, such as the least developed countries, small island developing States and Africa (§8)	Decision: (...); funding for adaptation will be **prioritized for the most vulnerable developing countries**, such as the least developed countries, small island developing States and Africa (§95)	Do the most vulnerable developing countries receive relatively large share of remittances?
In the context of meaningful mitigation actions and transparency on implementation, developed countries commit to a goal of **mobilizing** jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries (§8)	COP recognizes: Developed country Parties commit, in the context of meaningful mitigation actions and transparency on implementation, to a goal of **mobilizing** jointly USD 100 billion per year by 2020 to address the needs of developing countries (§98)	Do developed countries create enabling environments to promote adaptation through remittances?
In the context of meaningful mitigation actions and **transparency on implementation**, developed countries commit to a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries (§8)	COP recognizes: Developed country Parties commit, in the context of meaningful mitigation actions and **transparency on implementation**, to a goal of mobilizing jointly USD 100 billion per year by 2020 to address the needs of developing countries (§98)	Are remittances a transparent flow? Are remittances transparent from the source to the final users?
The collective commitment by developed countries is to provide (...) resources approaching USD 30 billion for the period 2010 - 2012 with **balanced allocation between adaptation and mitigation** (§8)	Decision: new and additional resources (...) approaching USD 30 billion for the period 2010–2012, with a **balanced allocation between adaptation and mitigation** (§95)	Do remittances prioritize adaptation over mitigation?

Whilst transforming parts of the Copenhagen Accord in the Cancun Agreements, some minor differences were made. For example, the criteria 'sustainable' and 'improved access' are not included in the Cancun Agreements; and 'balanced' only refers to the 30 billion fast start finance period, which ended in 2012. This chapter however still analyses these three criteria, given that they remain important in international climate finance debates. Access modalities and the

balanced allocation are for example key concepts in the design of the Green Climate Fund (UNFCCC, 2012; Dec 3/CP.17).

3. Motivation to remit and invest in adaptation

The International Organization for Migration (IOM) defines remittances as monetary transfers that a migrant makes to the country or area of origin. Most of the time, they are personal cash transfers that can be invested, deposited or donated to a relative or a friend. Although the definition could be broadened further to include in-kind personal transfers and donations (IOM, 2009), this chapter focuses on financial remittances only both as private cash transfers and as donations to community projects with a potential to be used for adaptation finance.

Some studies find that remittances are driven by self-interest motives of the sender (Bettin et al., 2012). Others suggest that the altruism motive lead in an increase in remittances to compensate relatives for negative shocks (Agarwal and Horowitz, 2002).Starting from these considerations on the motivation to remit, this section discuss the potential for remittances to finance adaptation at community and household level and comply with the 'predictable', 'sustainable', 'improved access' and 'adequate' criteria.

Predictable. Although predictable funding is key for developing countries when formulating adaptation strategies and implementing activities (AMCEN, 2011; AGF, 2010), it is not further defined by neither the UNFCCC, nor in adaptation finance literature. In the Accra Agenda for Action (AAA, 2008), predictability is translated into donors strengthening budget planning, thus providing 1) full and timely information on annual expenditure; and 2) regular and timely information to partner countries on their rolling three- to five-year forward expenditure and/or implementation plans.

Analysing this criterion in terms of remittances' potential to comply implies looking beyond traditional donors and focus on private and alternative sources. To this end, 'predictability' is interpreted not as whether the amount of funding decreases or increases, but on whether recipients can anticipate on future adaptation finance, and plan accordingly.

In this context, remittances have proved to be a more reliable source of foreign currency than other capital flows to developing countries such as foreign direct investment and development aid (World Bank, 2005). This does not mean that they are not influenced by sudden factors such as economic crises in host countries (Frankel, 2011), but their fluctuations to exogenous is quite predictable.

For example, an increase of remittances can be also foreseen in case of economic crises, catastrophic weather events and natural disasters in migrant's origin countries. This shock-absorbing function is emphasized in early literature on the topic corroborating the hypotheses on the use money transfers as risk-spreading and co-insurance mechanisms at family level (Blue, 2004). Lately, this practice has been recognized as a strategy to 'help mitigate external vulnerabilities' and 'increase resilience' (Bettin, Presbitero and Spatafora, 2013).

Sustainable. This criterion is distinguished from 'predictability' and interpreted as constituted by two aspects: 1) it is replenishes (like a fund) or is self-generating; and 2) it is a stable or increasing flow of financial resources over time. In terms of remittances, the question is whether these are a stable source of finance allowing for medium to long-term adaptation.

In a case study on Morocco, De Haas and Plug (2006) found that bilateral per-capita remittance flows from destination countries only started to stagnate or decline after two decades from the onset of migration. Other studies suggest that migrant remittances tend to reach a peak approximately 15-20 years after migration (Fokkema and Groenewold, 2003). With these rates, remittances seem to be a more stable and sustainable source of income than more volatile ones, such as FDI or ODA (with disbursement planning up to four years).

Remittances can also be examined for their potential to foster investments with a long-term perspective, which is often crucial in adaptation. Adams et al (2008) describe how remitters' objectives are divided between the short-term (e.g. food consumption and health needs) and the long-term (e.g. reinforcements of assets and social position). Long-term goals also include income accumulation and increase of economically sustainable livelihood, reduction of exposure to external stresses, food security and more sustainable use of natural resources. As such, remittances have emerged as a key source of livelihood differentiation.

Moreover, these flows are also used to protect people from the destabilizing effects of absent or ill-functioning markets, failing state policies and a lack of state-provided social security (de Haas, 2007).For example, an empirical analysis by Giuliano and Ruiz-Arranz (2009)suggests that migrants compensate for the lack of development of local financial markets using remittances to ease liquidity constraints, channel resources toward productive investments and hence promote economic growth in the long-term.

Improved access should help to use finance more effectively and efficiently. In the context of adaptation, the ultimate goal of improved access is to reach the most vulnerable people. Concrete steps for direct access and enhanced direct access are taken by the Adaptation Fund and the Green Climate Fund (GCF).According to Ayers (2011), vulnerability to the global risk of climate change is locally experienced, which she calls the 'adaptation paradox'. Current governance of funding relationships is often accountable to contributors of climate finance rather than to the most vulnerable people that experience climate change impacts locally (ActionAid, 2007). Rather than a discussion on the institutional settings allowing for improved access, under this criterion this chapter thus focuses on whether the most vulnerable and poor have direct access to finance from remittances.

Although mobility has been recognized by the IPCC as a common strategy for climate change adaptation, it is well known that international migration requires a certain amount of resources and remains too costly for the poorest. Those who cannot afford to undertake travels abroad normally engage in internal migration sending remittances likewise to those left behind. The amount, though, is not comparable to international flows, because of the lower wages and currency. The distinction between internal and international remittances is however very

important for adaptation purposes, as those who migrates internally have more opportunities to visit their families and more control on the use of remittances at home as compared to those who have migrated internally.

Evidence exists that these flows are more likely to reach remote areas than private investments motivated by profit-generation. For example, in Ghana and Burkina Faso remittances are used to increase resilience in vulnerable rural areas by supporting adaptation within the farming sector, for instance through the purchase of agricultural inputs (Deshingkar, 2011).When 'improved access' is intended as 'easier access', including lack of intermediation, it is more straightforward to examine their impacts. For example, building infrastructure through ODA tend to be several time costlier than it would have been if it was funded by local resources, as foreign aid often requires hiring of international consultants (Acharya, 2003).The outcome of the 2015 Finance for Development conference, the Addis Ababa Action Agenda, commits to lowering the transaction costs of remittance flows. If this would be achieved, access to remittances will be even easier. Adequate. Literature generally interprets 'adequacy' in terms of quantity. For example, Action Aid (2007), Müller (2008), Christiansen et al (2012) and Flam and Skjaerseth (2009) refer to sufficiency to cover relevant costs or the inadequacy of adaptation funding compared to the estimated costs. Indeed, van Drunen et al (2008; 16-17) write that under the Convention, 'adequate (…) funds were meant to help developing countries meet the agreed full incremental costs'. The question is whether remittances could complement the resources allocated by traditional donors contributing to cover adaptation costs in developing countries.

According to the World Bank, the recorded annual flow of remittances (USD 516 billion) might be a significant underestimate: informal remittances are estimated to be higher in the range of 10 to 50% of recorded remittances (Ratha 2003, and El-Qorchiet al, 2003).When analysing remittances through their amount, it can be noted how they form a considerable part of the wealth of several countries. For instance, in Mexico remittances are the second largest source of revenues after oil exports (Aparicio and Mesenguer, 2011). In other countries in different parts of the world, remittances are a vital source of income: they amount to 48% of Tajikistan's GDP, 25% of Lesotho's and Nepal's, and 24% of Moldova's (World Bank, 2013).

In certain specific situations, a share of such flows can help to alleviate the impacts of climate change, for example to deal with natural disasters. As shown by the recent evidence in Haiti, it is possible to see that remittances can actually meet the needs for incremental funding better than foreign aid, which seems less sensitive to shocks (David, 2010). Remittances seem to have a stabilizing effect in most developing countries vulnerable to environmental changes: by providing a form of private insurance (*ex post* risk management strategy) and/or by promoting ex ante risk preparedness (*ex ante* risk management strategy). This hypothesis was tested by Combes and Ebeke (2011) on a large sample of developing countries (113) observed over the period 1980-2007. The results highlight that remittances dampen the marginal destabilizing effect of natural disasters, in particular where remittance ratios comprise 8% - 17 % of GDP. For remittances, adequacy is not only to be seen in terms of resource quantity, but also for their

capacity to effectively flow under particular circumstances, such as climatic risks preparedness and relief.

To summarize: although climate negotiations address adaptation finance at global and national levels and remittances' are not straightforward pledges to adaptation, to some extent they can be considered predictable and sustainable financial flows that can support the most vulnerable people. In fact, under certain circumstances (e.g. shocks or negative trends) literature shows that remittance- flows increased as an effect of the 'altruistic' motivation at the base of certain remit behaviours. This shows how complicated it is to apply criteria ensued by negotiations among states to decisions taken at individual, household and community level.

4. An 'alternative source' of adaptation finance

The ten climate finance criteria are clearly directed towards traditional public finance. In their paper, Pauw et al (2015) use them to analyse the potential to mobilize private finance for adaptation. In this chapter, remittances are discussed for their peculiarities in comparison to other international streams in view of possibly including them among the 'alternative' sources.

Scaling up climate finance means constantly increasing it over time, but the UNFCCC does not define by how much and how fast. The increase from the developed countries' USD 30 billion pledge for the period 2010-2012 (i.e. USD 10 billion per annum on average) to USD 100 billion per annum from 2020 onwards would be a ten-fold increase, or an additional 26% each and every year up to 2020. Concerning remittances, this chapter analyses to what extent the flows have the potential to be scaled up for adaptation purposes.

While developed countries can only be expected to scale up climate finance if they are confident that these monies will be spent wisely (AGF, 2010; 29), diaspora continue to remit regardless. As a matter of fact, the overall annual flow of remittances to developing countries has nearly tripled since 2000 and is also expected to continue at a rate of over 7 percent annually from 2012 to 2014 (Kebbeh, 2012).

Although remittances grow with around 8% per year (OECD, 2014), this amount cannot be compared with the necessary annual 26% increase of climate finance. And this potential, cannot be harnessed without the appropriate incentives (e.g. subsidies or tax relief) that make adaptation 'an opportunity', diaspora entrepreneurs will continue focusing on traditional sectors (retail, agriculture, etc.) to invest their extra-money.

'New and additional' means that climate finance should be new and additional to Official Development Assistance (van Drunen et al., 2008). It can however be discussed whether it should be 'new and additional' to existing, planned or targeted ODA expenditure at the time of the Copenhagen Accord (see Brown et al., 2010). As remittances are not related to a developed-country government budget, it goes without saying that remittances, if used for adaptation purposes, could be recorded as new and additional to former ODA levels. The challenge is to leverage these investments towards adaptation actions and to account for them. Many households

might contribute to adaptation without considering it that way (and not knowing that their actions could be supported by further aid devoted for that specific purpose).

Although migrant's financial transfers to their countries and areas of origin are undeniably increasing, it is well-known that only 5% of these flows are used for productive investments (World Bank). The amount that might be directed towards adaptation actions is thus most likely inferred within this small percentage. We are therefore speaking about a very small part of the huge sum mentioned as remittance flow. Moreover, for this share to be used for future adaptation plans, information is needed, attractive incentives have to in place and depends on the social and cultural context and personal orientations.

The importance of '*alternative' sources* is key in the discussions on how to attract new type investors. For this reason, enabling environments for attracting peculiar investments – done by nationals leaving abroad and targeting adaptation) need to be promoted by governments and their international partners. Remittances might be new and additional sources when the benchmark is the disbursed ODA. However, they cannot be considered as granted, as the direction of their use is very context-specific.

Prioritize the most vulnerable developing countries. Climate funds such as the Global Climate Change Alliance (GCCA), the Pilot Project on Climate Resilience (PPCR) and the Adaptation Fund were all designed to make decisions on country prioritisation and allocate funds based on levels of vulnerability, but they all have their own standards for doing so (Klein and Möhner, 2011). Altogether it remains unclear what 'prioritization' means in terms of, for example, financial flows or effort made. Of the total public adaptation finance that was approved so far, Climate Finance Update (2014) estimates that 32% flowed to Africa, 52% to LDCs, and 9% to SIDS; or, given the overlap, 60% to the three taken together. This hardly reflects a country-based prioritisation, considering that these three groups constitute 94 out of 140+ developing countries, and that 22% of these 94 countries have been excluded from public climate finance interventions so far. A prioritization based on a per capita basis would have very different outcomes, but this chapter analyses along to the UNFCCC outcomes, thus prioritizing on a per-country basis too. This chapter identifies whether the most vulnerable developing countries receive relatively large share of remittances, and installs a 60% threshold.

The share of all remittances received by today's middle-income countries has risen to an estimated 71% in 2013 from 57% in 2000. Although the share to low-income nations has doubled in those years, it remains a small proportion with 6% of the total (Connor et al, 2013). However, the economic importance of remittances is larger in poorer countries than in richer ones (c.f. Giuliano and Ruiz-Arranz, 2009).

Several countries SIDS have important share of GDP constitute by remittances, with the highest amounts in Samoa (23 percent) and Haiti (21 percent). Among the other most vulnerable groups, Nigeria (Africa) with $21 billion and Bangladesh (LDCs) with $14 billion are among the top recipient countries worldwide (World Bank, 2014).

Based on this data, it is impossible to establish a clear-cut connection between the amount of remittances and countries' vulnerability beyond the most vulnerable developing countries as defined by the UNFCCC.

Essentially dealing with the overall amount, the potential share to be invested in adaptation and the countries interested, these criteria go beyond the motivation to remit. Unlike ODA, the quantity of remittances is still growing. Like private investors, remitters respond to incentives to choose specific types of investments (including adaptation) over others (and over consumption). In this context, the role of donors -through e.g. targeted funds, budget support programmes and debt swaps- and developing country governments -through e.g. the provision of incentives and fiscal easing and the design of legal frameworks- is key to ensure that the right market mechanisms are in place to increase the share of remittances invested in adaptation, as discussed in the next section.

5. Channelling remittances towards adaptation: The role of governments

In the context of scarce public funds for climate adaptation, the government's role is pivotal in creating an enabling environment for entrepreneurial initiatives and in triggering new resources, including diaspora's investments to build resilience to climate change.

Mobilizing. What mobilising of climate finance entails is neither defined by the UNFCCC, nor in literature. This chapter interprets 'mobilizing' as a pro-active public intervention from developed countries, for example through domestic mobilisation of public climate finance, institution building, capacity building, and creating incentives to increase climate financing from other sources. In this chapter, we identify whether developed countries create enabling environments to promote adaptation through remittances.

The role of governments would be crucial in promoting positive incentives to invest remittances in adaption actions. This would internalize the remittances' positive externalities towards more e effective adaptation strategies as this would allow each recipient to make the best use of these resources based on his/her current and future resources and constraints. Without corrective actions from the government, these highly decentralized choices are likely to be inefficient as the optimal adaptation strategies imply the creation of public goods. To do that, a better outcome could only be achieved through a collective choice that can only be promoted by governments.

The increasing amount of remittances and the awareness of the effects that may have on migrants' countries of origin have led both host and home countries to react with a range of public policies. Developing countries with high rates of emigration have already offered incentives to attract and to invest remittances. For example, Senegalese Governmental agencies are promoting diaspora investments in government-run infrastructure projects by offering loans for development projects (Panizzon, 2008) and tax exemptions. Since 2008, the NGO FES (La Fondation des émigrés sénégalais) with support by the Ministry of Senegalese Abroad and by Spain, aims at channelling diaspora investments into Senegal (Scheffran et al, 2012).Another

example is the Mexican 3x1 Program for Migrants, where the: public sector triples the amount of money to encourage the potential investors to choose certain type of projects.

In order for investments to be 'mobilized', however, developed countries have to create a trigger and incentivize such types of investments. They should play an active role beyond employing the migrants. The authors did not find examples in literature. The solution probably lies in developing adequate institutional mechanisms that serve as a basis for cooperation between developed country governments, migrants and potentially international businesses that operate in both the host and the home country.

Transparency. Action Aid (2007) suggests that transparency goes beyond purposes (i.e. adaptation), amounts (i.e. USD 100 billion per year), and results of funding (i.e. meaningful), but also includes the governance structure and procedures at providers of financial resources. The Adaptation Fund indeed introduced transparency indicators in its overall management (Horstmann and Chandani 2011). Eventually, transparency on climate finance also means monitoring, reporting, and verification and tracking climate finance from source to final use (Buchner et al., 2011; van Drunen et al., 2009).

As such, transparency is essential to a results orientation and for accountability (Chaum et al, 2011; 2). Just like 'increased transparency in the use of international public finance would elucidate the current and potential role of public finance in leveraging pri¬vate finance, and would increase understanding of the effectiveness and success rates' (Brown and Jacobs, 2011; 7), transparency on public policies and co-finance aiming to secure or redirect remittances could help to leverage larger spending on adaptation. This will, however, not be easy. An array of unofficial and informal modes of sending money exists (from mailing cash or checks using postal service to the hawalards-brokers- scattered across cities, which function as private Remittance Service Provider) and many remain unmonitored (Biller, 2007).

In order to harness the potential for remittances towards adaptation finance, the regulatory community requires an approach that meets the goals of financial inclusion and financial transparency. Remittances could increase if legislative barriers and fiscal costs of financial transfers can be reduced; the latter can be facilitated by the introduction of more market players and modes of transmission, better provision of reliable information to migrants on the costs of transfer, and generally better and more credible supervision of the sector (Black, 2003). By lacking these conditions, remittances currently do not meet the criterion of transparency. The channels through which they flow are partly informal and not adequately addressed in terms of governance structures and regulations.

Balanced allocation between adaptation and mitigation' remains undefined by the COP,but upon their request (UNFCCC, 2012; Dec 3.8/CP.17), the GCF Board decided to 'aim for a 50:50 balance between adaptation and mitigation during the initial phase of the Fund' (Green Climate Fund, 2014; 6). So far, around 16% of the public climate finance flows to adaptation (Climate Finance Update, 2014); the amount of private adaptation finance is very hard to track but seems minimal compared to private mitigation finance (Buchner et al; 2011, 2013). Whether climate

finance should be balanced 50:50 between adaptation and mitigation is an open question, but in any case the finance for adaptation needs to increase (see e.g. Terpstra, 2013).

Remittances neither principally aim to address climate change, nor do they aim to balance between adaptation and mitigation. However, throughout the chapter we highlighted that remittances can help to increase resilience against climate stresses and that in case of emergencies and disasters, remitters will invest in immediate relief and rehabilitation. Whether this will be translated into adaptation finance and whether diaspora entrepreneurs will invest in long term projects related to adaptation will depend on how each government will set priorities for incentives allocation.

6. Conclusions

Although there is extensive literature on the impact of remittances on development, little research exists on their potential to support adaptation to climate change. There is a huge and unexplored potential: recorded remittances to developing countries are expected to increase up to USD 516 billion in 2016 (World Bank, 2014); even a small part of which could already be a substantial contribution to adaptation. Furthermore, remittances directly reach the local level, and thus potentially to those most vulnerable to climate change that are difficult to reach through existing channels of ODA and climate finance. And finally, remittances offer opportunities for both climate disaster relief and investments in long-term adaptation.

But rather than looking at whether remittances constitute effective financial means to address adaptation, this chapter addresses the question whether they could also constitute an alternative source of the annual USD 100 billion international climate finance from 2020 onwards, as was pledged by developed countries under the UNFCCC regime.

Whilst remittances already play a role in the adaptation decisions of hundreds of millions of remittance recipients across the world in a decentralized way, this is not uncontroversial: even if remittances could constitute an alternative source of climate finance, it is ethically questionable whether financial resources of poor migrants can substitute the (public) climate finance pledged by developed countries in Copenhagen. But in any case, this exercise helps to better understand what alternative climate finance sources could be. Based on empirical evidence from literature, this chapter thus identified to what extent remittances meet ten adaptation finance criteria as negotiated under the UNFCCC Copenhagen Accord and the Cancun Agreement (see Pauw et al., 2015).

This chapter finds that remittances can meet a number of criteria such as ‘adequate’, ‘sustainable’, ‘predictable’ and ‘improved access’, mostly because they relate to the motivation to invest in countries of origin and, thus, to some extents, to the willingness to protect and support families, friends and communities. It is a matter of personal connection, affection or altruism. Due to these special drivers, remitters are special ‘investors’ that are available to ‘trade off’ profit with wellbeing, development and, potentially, adaptation of those left behind in developing countries.

Besides this special feature that remittances might have, these flows remains private flows and, as such, they respond to incentives when considered as stocks of money. Under this lens, criteria such as 'new and additional', 'scaling up' and 'prioritize the most vulnerable developing countries' can be met, but, as any other private source, to be leveraged and channelled towards the aim, there is the need for targeted policies.

Finally, criteria such as 'mobilizing', 'transparency' and 'balanced allocation' are more complicated to be analysed for the remittance potential to finance adaptation, as they are designed for and typical for public finance. In contrast, remittances are driven by individual interests and market mechanisms and flow regardless to the compliance with these criteria. It is only governments' responsibility to orient them through effective regulations in an attempt for these criteria to be met.

In a first exploration, this chapter found that overall remittances insufficiently meet the ten adaptation finance criteria. Nevertheless, a share of remittances could still meet the criteria and clearly make a contribution not only to adaptation, but perhaps even to international adaptation finance. As a way general forward, the ten criteria in ongoing UN negotiations on climate finance could be altered in order to stimulate alternative sources of climate finance such as remittances. Whether a share of remittances will ever contribute to the mobilisation of the annual USD 100 billion of climate finance, and thus constitute 'international climate finance' is, in the end, a controversial political decision.

References

Adams Jr, R. H., Cuecuecha, A., & Page, J. (2008). The impact of remittances on poverty and inequality in Ghana. World Bank Policy Research Working Paper Series, Vol. (2008).

Acharya, S.R. (2003). Official Development Assistance (ODA) in Transport Sector: Challenges and Opportunities. Eastern Asia Society for Transportation Studies, 4, 1572-1586.

ActionAid (2007). Equitable adaptation finance: the case for an enhanced funding mechanism under the UN Framework Convention on Climate Change. ActionAid International, Johannesburg.

Adger, W. N., Kelly, P. M., Winkels, A., Huy, L. Q., & Locke, C. (2002). Migration, remittances, livelihood trajectories, and social resilience. Journal of the Human Environment, 31(4), 358e366

AGF (2010). Report of the Secretary-General's High-level Advisory Group on Climate Change Financing". United Nations, New York.

Agarwal, R., & Horowitz, A.W. (2002). Are International Remittances Altruism or Insurance? Evidence from Guyana Using Multiple-Migrant Households. World Development, Vol. 30, pp. 2033–44.

Aparicio, F. J., & Meseguer, C. (2012). Collective remittances and the state: the 3× 1 program in Mexican municipalities. World Development, 40 (1), 206-222.

Ayers, J. (2011). Resolving the Adaptation Paradox. Global Environment Politics 11(1), 62-88.

Barajas, A., Chami, R., Fullenkamp, C., Gapen, G. & Montiel, P. (2009). Do Workers' Remittances Promote Economic Growth? IMF Working Paper 09/153

Bettin, G., Lucchetti, R. & Zazzaro. A. (2012). Financial development and remittances: Microeconometric evidence. Economics Letters, 115, 184-186

Biller S. (2007). UICIFD Briefing No. 3: Remittances - Iowa City: University of Iowa Center for International

Black R. (2003). Soaring Remittances Raise New Issues. Migration Policy Institute. http://www.migrationpolicy.org/article/soaring-remittances-raise-new-issues. Accessed date February 2016

Blue, S.A. (2004). State policy, economic crisis, gender, and family ties. Determinants of family remittance to Cuba. Economic Geography. Vol.80., No. 1

Brown, J., Bird, N. & Schalatek, L. (2010). Climate finance additionality: emerging definitions and their implications. Policy Brief 2, Heinrich BöllStiftung and ODI.

Buchner, B., Herve-Mignucci, M., Trabacchi, C., Wilkinson, J., Stadelmann, M., Boyd, R., Mazza, F., Falconer, A. & Micale, V. (2013). The global landscape of climate finance 2013". CPI. Venice, Climate Policy Initiative

Buchner, B., Falconer, A., Hervé-Mignucci, M., Trabacchi, C., & Brinkman, M. (2011). The landscape of climate finance. Climate Policy Initiative, Venice.

Caravani, A., Bird, N. & L. Schalatek (2010). Climate finance fundamentals. Evolving global climate finance architecture. Heinrich Böll Stiftung and ODI, November 2010.

Christiansen, L., Ray, A.D., Smith, J.B., & Haites, E. (2012) Accessing international funding for climate change adaptation. Roskilde, DK: UNEP Risø Centre on Energy, Climate and Sustainable Development.

Chami, R., Fullenkamp, C. & Jahjah, S. (2003). Are Immigrant Remittance Flows a Source of Capital for Development? Washington: International Monetary Fund. IMF Working Papers 03/189.

CheSuh-Njwi, A. (2015). The 'Bush Faller', Akatarian, Bouger': Whatis the Differencebetween a Migrant and a Diaspora? The African Bulletin, 31 August 2015

Climate Finance Update (2014). http://www.climatefundsupdate.org/data (24.01.14)

Combes, JL., Ebeke, C. (2011). Do remittances dampen the effect of natural disasters on output growth

volatility in developing countries? CERDI, Etudes et Documents, E 2010.31

Connor, P., Cohn, D., & Gonzalez-Barrerra, A.(2013).Changing Patterns of Global Migration and Remittances - PEW Research Center 2013. Washington DC. Retrieved from www.pewresearch.org

Couharde, C., and Generoso, R.(2015) "The ambiguous role of remittances in West African countries facing climate variability", Environment and Development Economics, Vol. 20 No. 4, pp. 493-515.

David, A., (2010) How do international financial flows to developing countries respond to natural disasters? IMF Working Papers 10/166, International Monetary Fund.

De Haan, A., Brock, K., Carswell, G., Coulibaly, N., Seba, H., & Toufique, K. A. (2000). Migration and livelihoods: Case studies in Bangladesh. Brighton, Sussex: Ethiopia and Mali, IDS. IPCC.

De Haas, H. & Plug R., (2006). Cherishing the Goose with the Golden Eggs: Trends in Migrant Remittances from Europe to Morocco 1970-2004. International Migration Review, Vol. 40, No. 3, pp. 603-634.

De Haas, H., (2007). Remittances, Migration and social Development: A Conceptual Review of the Literature". Programme on Social Policy and Development, Paper No. 34. UNRISD, Geneva

Deshingkar, P., (2011). Are there examples of remittances being used to build local resilience to environmental change, especially through investment in soil and water conservation or broader agriculture? UK Foresight, SR13.

Driffield, N., & Jones, C. (2013). Impact of FDI, ODA and Migrant Remittances on Economic Growth in Developing Countries: A Systems Approach. European Journal of Development Research, 25(2)

Dustmann, C., & Kirchamp, O., (2001). The optimal migration duration and activity choice after re-migration, IZA Discussion Paper 266.

Easterly, W. (2001). The Elusive Quest of Growth. Cambridge: The MIT Press

Ebeke, C., & Combes, J-L., (2013), Do remittances dampen the effect of natural disasters on output growth volatility in developing countries? Applied Economics, 45, issue 16

Flåm, K. H., & Skjærseth, J. B. (2009). Does adequate financing exist for adaptation in developing countries? Climate Policy, 9(1), 109-114.

Frankel, J. (2011). Are bilateral remittances countercyclical? Open Economies Review, 22 (1), 1–16.

El-Qorchi, M., Maimbo, S., Wilson, J., (2003). Informal funds transfer systems: an analysis of the Informal Hawala System. Occasional Paper, vol. 222. International Monetary Fund, Washington, DC

Giuliano, P. & Ruiz-Arranz, M.(2009). Remittances, financial development and growth. Journal of Development Economics 90(1): 144–152.

International Organization for Migration (2009). IOM and Remittances. http://publications.iom.int/bookstore/free/iom_and_remittances.pdf. Accessed on Date February 2016

Kebbeh, O. (2012). Declining ODA, Resilient Remittances. World Bank's Blog http://blogs.worldbank.org/peoplemove/declining-oda-resilient-remittances. Accessed on February 2016

King, D., Bird, D. and Haynes, K. (2014), "Voluntary relocation as an adaptation strategy to extreme weather events", International Journal of Disaster Risk Reduction, Vol. 8, pp. 83-90

Klein, R. (2010). Linking adaptation and development finance: a policy dilemma not addressed in Copenhagen. Climate and Development, 2 (2010) 203-206.

Lopez-Cordova, E. (2006). Globalization, Migration and Development: The Role of Mexican Migrant Remittances, Washington, DC: Inter-American Development Bank, January 2006

Lucas, R., Stark, O. (1985). Motivations to Remit: Evidence from Botswana. Journal of Political Economy, Vol. 93, No. 5, pp. 901-918

Maddison, D.J. (2007), "The perception of and adaptation to climate change in Africa", World Bank Policy Research Working Paper, 4308.

Massey, D., & Parrado, E.,(1998). International migration and business formation in Mexico. Social Science Quarterly 79 (1), 1–20.

Mohapatra, S., Joseph, G. & Ratha, D. (2012). Remittances and natural disasters: ex-post response and contribution to ex-ante preparedness. Environment, Development and Sustainability, 14 (3), 365–387

Müller, B., (2008). International Adaptation Finance: The Need for an Innovative and Strategic Approach, Oxford Institute for Energy Studies

Organization for Economic Cooperation and Development – OECD (2014). Aid to developing countries rebounds in 2013 to reach an all-time high. Web release 08/04/2014, OECD website

Panizzon, M. (2008). Labour mobility: A win-win-win model for trade and development. The case of Senegal. Geneva Trade and Development Forum

Paulson, A., & Towsend, R., (2000). Entrepreneurship and financial constraints in Thailand. Working Paper. Northwestern University.

Pauw, W.P., Klein, R.J.T, Vellinga, P. & F. Biermann (2015). Private finance for adaptation: do private realities meet public ambitions? Climatic Change 134 (4), 489-503

Pauw, W. P. (2014). Not a panacea: private-sector engagement in adaptation and adaptation finance in developing countries. Climate Policy, 15(5), 583-603

Pauw, W.P. & Pegels, A. (2013).Private sector engagement in climate change adaptation in the least developed countries: An exploration. Climate and Development, 5(4), 257–267

Quartey, P. and Blankson, T. (2004), "Do migrant remittances minimize the effect of macro-volatility on the poor in Ghana?", available at: www.gdnet.org/pdf2/gdn_library/global_research_projects/macro_low_income/Quartey.pdf

Ratha, D. (2003). Workers' remittances: an important and stable source of external development finance. Global Development Finance 2003 — Striving for Stability in Development Finance Ch. 7.World Bank, Washington, DC, pp. 157–175

Ratha, D. (2007). Leveraging Remittances for Development, Development Prospects Group, World Bank

Sayan, S., & Tekin-Koru, A. (2010). Remittances, Business Cycles and Poverty: The Recent Turkish Experience. International Migration, 50, 151–176.

Scheffran, J., Marmer, E., & Sow, P. (2012). Migration as a contribution to resilience and innovation in climate adaptation: Social networks and co-development in Northwest Africa. Applied Geography, 33, 119–127.

Sierra K. (2011). The Green Climate Fund: Options for mobilizing the private sector, Climate & Development Network.

Straubhaar, T., & Vădean, F. P. (2007). International Migration Outlook 2006 - International Migrant Remittances and their Role in Development (Part III). OECD, Ed.. Paris.

Terpstra, P. (2013). Is adaptation short-changed? The imbalance in climate finance commitments. WRI Blog, 13.11.2013. http://www.wri.org/blog/adaptation-short-changed-imbalance-climate-finance-commitments. Accessed on 15 May 2015

Thagunna, K. S., & Acharya, S.(2013). Empirical Analysis of Remittance Inflow : The Case of Nepal. International Journal of Economics and Financial Issues, 3(2), 337–344.

UNEP (2014). The Adaptation Gap Report 2014. United Nations Environment Programme (UNEP), Nairobi

UNFCCC (2011). Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011. UNFCCC, Bonn

UNFCCC (2009b): Fact Sheet: Financing climate change action. Investment and financial flows for a strengthened response to climate change. Bonn, June 2009.

UNFCCC (2009a): Copenhagen Climate Accord. http://unfccc.int/resource/docs/2009/cop15/eng/l07.pdf

Whande W. & Reddy T. (2011). The governance of climate finance in Africa, Asia and Latin America: Some critical reflections, Institute for Security Studies Policy Brief No. 24, http://www.issafrica.org/uploads/No24Jun2011.pdf

Woodruff, C. & Zenteno, R. (2001). Remittances and micro-enterprises in Mexico, mimeo, University of California San Diego.

World Bank (2005). Global Development Finance 2005. World Bank, Washington, DC.

World Bank (2013) Developing Countries to Receive Over $410 Billion in Remittances in 2013. Press release, 2 October 2013: http://www.worldbank.org/en/news/press-release/2013/10/02/developing-countries-remittances-2013-world-bank. Accessed on 26 February 2016

World Bank (2014a): Remittances to developing countries to stay robust this year, despite increased deportations of migrant workers. press release, 11 April 2014 http://www.worldbank.org/en/news/press-release/2014/04/11/remittances-developing-countries-deportations-migrant-workers-wb. Accessed on 26 February 2016

World Bank (2014b): Migration and Remittances: Recent Development and Outlook. Migration and Development Brief 22.World Bank (2015), "Mainstreaming climate action within financial institutions five voluntary principles", Washington, DC

CHAPTER 2

Vulnerability and Resilience in West Africa: Understanding Human Mobility in the Context of Land Degradation

Barbara Bendandi and Marco Venier

Abstract: The loss of productive land is often one of the key drivers of human mobility. Land degradation might lead to increases in migration because of the need to diversify incomes, but it can also cause reduced mobility by eroding the financial or physical assets and capital required to finance migration. When on-site adaptation is either impossible or undesirable, migration allows people to modify their exposure to climate and environmental stressors. On one hand, temporary and circular labour migration, internal and international remittances, and family relocation are among the most common strategies used throughout history, and increasingly so in the past decades, to cope with harsh climatic variations, increasingly hostile natural environments, and natural disasters. On the other hand, land abandonment and out-migration can lead to further isolation and marginalization of both vulnerable rural populations (increasing their vulnerability if migration occurs in unplanned ways) and migrants who relocate toward areas of high environmental risk, such as resource-scarce or urban areas within insecure expanding cities. Based on existing evidence on the West Africa region, the research in this paper aims at gaining a better understanding of how land degradation interacts with drivers of migration by analysing the factors determining vulnerability at individual, household, and community levels, as well as those factors affecting capacities—whether inherent or acquired—and strategies that contribute to building resilience.

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1. Introduction

Slow-onset hazards are chronic events that gradually perpetuate their impacts on livelihoods and ecosystems, in contrast to severe sudden-onset events. Although the effects of gradual changes are less easy to perceive because they can only be measured over a long period, they tend to affect a larger number of people. Often characterized by incremental changes over time, land degradation and sea level rise are difficult to measure and predict with any level of precision because thresholds and recovery potential are uncertain (UNEP 2006).

Many would argue that there is no agreed-upon definition for land degradation, and it is often understood to be a subjective term or classification contingent upon the values and priorities of relevant stakeholders (Caspari et al 2014). The United Nations Convention to Combat Desertification (UNCCD) has defined it as the loss or reduction of biological or economic productivity and complexity to capture the most important dimensions of sustainable development (UNGA 2012), given that social and cultural benefits are linked to one or both types of productivity.

Considering that land is a main source of livelihoods in most developing countries, land degradation is a highly relevant factor influencing vulnerability and resilience—it affects individuals' daily lives, disrupting the basic survival assets of rural populations, particularly small-scale, resource-poor farmers. In response to circumstances where livelihoods or habitats are slowly eroded, land-dependent people are faced with varying choices for seeking new ways to ensure sufficient food for everyone.

According to Tschakert (2006), the concept of resilience originates in ecology and is used to define the capacity of a system to absorb sudden changes and disturbances while maintaining its function and control (Gunderson and Holling 2002). If adaptive capacity, that is, the capacity for renewal and reorganization and the element of learning in response to disturbance (Carpenter et al 2001), is a key element of resilience, vulnerability can be considered its flipside. Folke (2002) similarly defines vulnerability as declining or lost adaptive capacity that lowers the ability of social actors to absorb change.

With the current state of knowledge, proving that certain types of migration occur exclusively in response to slow-onset events is methodologically challenging. Although it is a multicausal phenomenon, populations have historically resorted to human mobility to reduce exposure to external stressors and cope with or adapt to the lack of resources (IOM 2014a). This view challenges the notion of vulnerable groups as "passive victims" and highlights people's strategic responses (Tschakert 2006) to adverse conditions, including depletion of land-based assets and unpredictability of climate variability. In rural contexts, resilience strategies help provide an understanding of and prediction of responses to slow changes and climate variability, as well as people's capacity to adapt to future changes (Burton et al 2002; Smit et al 2000).

West Africa is a case in point for both analysing vulnerability through the lens of slow-onset events and mapping resilience strategies that use migration as a response to changing conditions.

Broadly exposed to land degradation and vulnerable socioeconomic systems, the region features the highest intraregional mobility worldwide; 76 percent of migrants crossing national borders remained within the region in 2010 (UN DESA 2012). It is estimated that one West African out of three—about 100 million people—lives outside his or her village of birth (de Haas 2007). The high rate of human mobility is also due to the freedom of movement afforded to the citizens of the 15 member states of the Economic Community of West African States (ECOWAS).

The main purpose of this study is to analyse how land degradation influences vulnerable ecological systems, shaping decisions to undertake mobility as a means for increasing resilience at the individual, household, and community levels in selected countries in West Africa, such as Burkina Faso, Chad, Ghana, Mali, Nigeria and Senegal. To this end, the report focuses on vulnerability of smallholder systems to provide evidence that land degradation might cause threshold scenarios in which on-site adaptation is no longer suitable or desirable. Finally, while considering the limits of context-specific behaviours and conditions, the paper discusses resilience-driven mobility choices by taking a trade-off perspective on availability of and access to resources, institutional networks, and social capital.

The aim is to formulate recommendations policy makers can use to (1) recognize when mobility is a response to harsh environmental conditions and (2) foster resilience strategies that consider addressing local vulnerabilities, migration, or intermediate solutions.

Section 2 analyses threshold scenarios by discussing examples of increased vulnerability caused by recurring West African land degradation processes such as reduced water availability, decreased land productivity, and groundwater salinization. Several resilience strategies involving migration of one or more household members are presented in section 3 to provide an overview of different scenarios, including failure in adaptation. Section 4 discusses how to foster positive resilience strategies and address situations of increased vulnerability. The paper concludes by stating the need to provide appropriate incentives, such as access to credit and land tenure, conducive to developing solutions that reduce vulnerability (caused by the lack of assets necessary for survival or unsafe migration routes) and promote resilience.

Although the effects of land degradation in West Africa have been studied (Agrawal and Perrin 2009; Caspari et al. 2014; IPCC 2007; among others), the research on adaptation so far has predominantly emphasized technical and infrastructural adaptive strategies, and given only limited consideration to adaptation strategies, including mobility, used by the most vulnerable individuals and groups (Tschakert 2006). This paper attempts to fill this gap and complement existing adaptation studies by placing "mobility choices" at the center of the analysis.

Most of the studies on West Africa discuss either regional trends or local cases, often lacking reliable and comparable national-level data and analysis (Dow 2005; Sarr 2012; Warner and van der Geest 2013; Wouterse 2008). In light of the current state of the literature in the region, this analysis drew from a selection based on geographical criteria and relevant geophysical processes to infer possible recurring scenarios. The conceptual approach is based on the premise that

context-specific cases contain lessons for policy makers and can provide useful insights for possibly wider and systematic approaches.

2. West Africa: Vulnerable livelihood systems in degrading lands

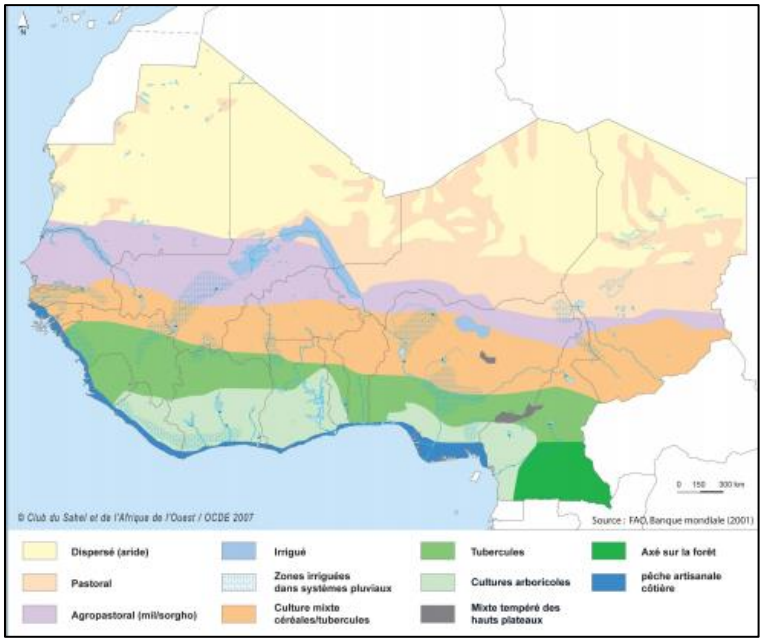
With the aim of understanding how land degradation influences the most vulnerable populations, this section examines different types of slow-onset events in West Africa, with a focus on identifying thresholds for habitability and survival.

Vulnerability as a measure of the degree to which an entity may be hurt or influenced has been applied to different contexts: food security, poverty, and natural and climate studies (Leichenko and O'Brien 2002). Within the climate literature, the most vulnerable are considered to be those who are most exposed to hazards, have limited adaptive capacity, and are least resilient (Bohle, Downing, and Watts 1994). At the individual and household levels, the degree of vulnerability might depend on a number of variables, such as lack of knowledge or skills (Warner and van der Geest 2013), low educational attainment (Van der Land and Hummel 2013), poverty, gender, age, ethnicity and religion. Social systems can also be made vulnerable by a combination of factors such as corruption, high inequality, civil and ethnic conflict, land privatization, and population growth (Niang et al. 2014).

For the purposes of investigating the thresholds of land degradation at a micro level (individuals, households, and communities), this study focuses on the vulnerability of rural systems. Like other systems, rural systems' levels of vulnerability depend on their ability to adjust to changing internal demands and external circumstances (Carpenter and Brock 2008). However, if a rural area's ecological resources are not resilient, conditions for ecosystem services and agriculture can deteriorate, and the vulnerability of the rural area increases (Schouten, van der Heide, and Heijman 2009).

Agriculture is often the main source of livelihoods for underprivileged people. While farming systems can be delimited with various levels of detail, the Food and Agriculture Organization's (FAO's) analysis of farming systems and poverty identifies 15 major systems in Sub-Saharan Africa, nine of which exist, to varying degrees, in the ECOWAS states (Dixon, Gulliver, and Gibbon 2001). These farming systems (map 1) are pastoral, arid land farming, agro pastoral millet/sorghum, cereal–root crop mixed, root crop, tree crop, coastal artisanal fishing, irrigation, and some irrigation in rain fed areas (Dixon, Gulliver, and Gibbon 2001).

Map 1 Farming systems in West Africa



Source : Club du Sahel et de l'Afrique de l'Ouest/OECD 2007

These systems depend on climate variability and have been exposed to repeated cycle of drought and floods has affected the region throughout the history (Mohamed, Duivenbooden, and Aboussalam 2002). As outlined by various reports of the Intergovernmental Panel on Climate Change, West Africa is expected to suffer tremendously from the impacts of temperature increases, decreased rainfall, and coastal erosion (IPCC 2007, 2014). However, the projections for the future are quite uncertain, with some models predicting a significant increase in rainfall, others a decrease, and others no significant change. For example, there is large consensus that one of the major climate change impacts in the region will be on rainfall, making it more variable and less reliable. However, rainfall change is projected to be 20 percent above or below average depending on which model is used (Sarr 2012).

Moreover, these changes have different effects in the different agro-ecological zones. In the Sahel, runoff coefficients have increased because of a deterioration of land cover; in the savannah, however, reduced rainfall has generally resulted in reduced river flow, although the decrease is much less than would be expected based on past observations (Oguntunde et al. 2006). In the Volta Basin, the main impact of the shifts in the rainy season is likely to be greater ground and surface water availability (van Giesen et al. 2008).

While recognizing the high level of uncertainty of the occurrence of future changes and their effects, thresholds for increased or unbearable levels of vulnerability caused by land degradation are investigated in the three most common processes affecting the systems of the region: (1) reduced water availability, (2) decreased land productivity, and (3) groundwater salinization.

2.1. Reduced water availability

Water supply problems inherently accentuate vulnerability, given that access to water is essential for maintaining good health and the ability to cope with other stresses (Dow 2005). West African countries are highly water interdependent: each one of them—with the exception of the Cape Verde islands—shares at least one transboundary river basin. Indeed, the region's major watercourses (the rivers Niger, Senegal, and Gambia) ensure the transfer of freshwater from wet to arid areas since they have their sources in high rainfall areas and flow through the Sahelian zone, which experiences chronic rainfall deficits (Niasse 2005). Compared with previous decades, since the early 1970s the mean annual rainfall has decreased by 10 percent in the wet tropical zone to more than 30 percent in the Sahelian zone, while the average discharge of the region's major river systems has dropped by 40–60 percent (Niasse et al. 2004).

One of the most commonly used indicators of water stress is per capita water availability (UNEP et al. 2000). When per capita availability drops below 1,700 cubic meters per year, water stress or the potential for disruptive water shortages can frequently occur. Water scarcity is a more serious situation, and is defined as per capita availability of less than 1,000 cubic meters per year, with severe consequences for food production, health, sanitation, economic development, and loss of ecosystems (Dow 2005).

Such low levels of water availability have become a crucial problem for West Africa, causing depletion of assets and impoverishment (Scheffran et al. 2012). The greater exploitation of water resources and the associated water scarcity coupled with the growing concern that future climate change will exacerbate the frequency, severity, and duration of drought events have drawn increased attention (Wilhite and Pulwarty 2005). Despite centuries of experience adapting to harsh natural conditions (Mertz et al. 2009), the vulnerability of these systems and their populations have become of great concern, bringing water scarcity and drought risk management to the forefront of different policy and security discussions.

2.2. Decreased land productivity

The issue of decreased land productivity and crop yields threatens the survival of a large number of individuals and livelihoods in the region. This phenomenon results from a combination of environmental and human stressors (Niang et al. 2014; Samimi and Brandt 2012). The loss of forest cover, increasing use of intensive cultivation practices, and natural hazards, such as drought, contribute to a decline in soil quality and fertility and an associated decline in ecological resilience as recovery from these traits becomes progressively difficult (Dow 2005).

For arid lands, pastoral, and agropastoral farming systems, drought is the major source of vulnerability. Poverty is widespread among households of the arid lands, pastoral, and agropastoral systems, but less diffused among those engaged in farming (Dixon, Gulliver, and Gibbon 2001). Less-well-off households with less productive land and fewer alternative income sources are more exposed to food insecurity.

Another issue related to reduced land productivity is pastoralism, generally concentrated in the northern arid and semi-arid regions. This practice is based on moving herds south during the dry seasons and back north during the rainy seasons. In the northern parts of Mali and Niger, overgrazing and trampling have reduced the vegetation cover and increased the potential for erosion. In drought circumstances, pastoralists travel farther with their herds, at times resulting in land conflicts with agriculturalists (Dixon, Gulliver, and Gibbon 2001). In addition, seasonal mobility is becoming harder to maintain as the amount of cultivated land is increasingly adding pressure on grazing areas (Dow 2005).

2.3. Groundwater salinization

An important stressor at play in the region is sea level rise, with its ensuing coastal erosion and groundwater salinization affecting agricultural livelihoods. Salinization of agricultural land, which is exacerbated by extraction of groundwater, lowers the productivity of the land and decreases freshwater security. A rise in sea level could also lead to permanent inundation of lands used for food production, along with changes to marine and freshwater ecosystems affecting fish populations and fish-dependent livelihoods (Foresight 2011).

This phenomenon is aggravated by the fact that coastal areas have the highest population concentrations and are frequently the most urbanized in West Africa (OECD 2008). Some 40 percent of West Africa's population is concentrated in coastal cities vulnerable to sea level rise, and the IPCC estimates that by 2020 more than 50 million people will inhabit the coast from the Niger delta in Nigeria to Accra (IPCC 2007).

Coastal erosion due to sea level rise has already begun to affect farmers through saltwater encroachment. The disruption of traditional ways of life creates further vulnerability for the entire population, sometimes leading its members to switch to monoculture. This dependence on a single crop puts households and communities at the mercy of irregular harvests (Cook and Vizy 2006). In Guinea Bissau, salt intrusion in the coastal land caused a need for crop substitution, which created further food insecurity and made populations more vulnerable to price fluctuations (Barry and others 2007).

According to Appeaning Addo et al. (2011), more than 200 meters of coastal land in Ghana could be lost around Accra by 2100. A large population and considerable private property and infrastructure will be at risk of gradual inundation and high tidal waves. With regard to health, coastal inundation may foster the spread of disease in the communities through the stagnant flood waters. Appeaning Addo et al.'s (2011) survey reveals that about 57 percent of the population in the area has suffered flood damage, mainly involving property losses and the displacement of people from their homes. Moreover, communities seem to be aware that the sea is rising and the beaches are eroding, which has caused a number of people to abandon their coastal communities, an accelerating trend that is expected to continue (Appeaning Addo et al. 2011).

When livelihoods are threatened beyond certain thresholds, families might have to choose to migrate in ways that increase vulnerability for both themselves and, in some cases, the populations in their destinations. If not appropriately addressed, these multiple challenges can generate further instability because migrants might cross paths with other groups in precarious situations. The literature shows how the increasing number of people periodically relocating could lead to tension over access to scarce resources such as water and productive land (Werz and Conley 2012).

2.4. Increased vulnerable conditions and unsafe paths: cases across the region

With no attempt to quantify tipping points, the three land-degradation scenarios discussed above describe settings characterized by prolonged and high exposure to hazards. Examples of how land degradation creates increased vulnerability prompting mobility and potential for unsafe conditions, clashes, and conflicts are plentiful across the region.

In certain cases land degradation only affects the livelihoods of a portion of the population, but at other times it can cause irreversible systemic consequences, thus increasing the vulnerability of entire communities. Rapid desertification is believed to have caused the abandonment of more than 200 villages in northern Nigeria: 1,350 square miles of the country's land is turned into desert each year, driving farmers and herders southward away from the Sahel (Brown and Crawford 2009).

With regard to possible conflicts caused by slow depletion of resources, Niasse (2005) describes how the Komadugu Yobe River Basin—a tributary of Lake Chad situated in northern Nigeria—has experienced severe impacts of climate change and variability. In addition, two upstream dams have diverted a substantial share of the river flow for domestic use and irrigation. In response to the significant decrease of the average annual flow, the middle and downstream states of Jigawa, Yobe, and Borno complained with more and more vehemence about the lack of fairness in apportioning the water between Kano (the upstream state) and other states on the river. The government of Nigeria had to establish an interministerial coordinating committee to deal with conflicting water demands and address the growing tensions in the basin. In the meantime, farmers from middle and downstream states engaged in "water warfare" by digging channels to deviate as much water as possible to their farms, which deeply disorganized the natural drainage of the whole basin.

The expansion of West African cities might be extremely dangerous for newcomers without established social networks. The number of inhabitants of West Africa more than tripled during the past 45 years, and the urban population increase tenfold over the same period. The issue of human mobility acquires renewed importance given that the ongoing tendencies toward population growth and urbanization are expected to continue (OECD 2006, 9–10). In addition to their exposure to precarious infrastructure, health hazards, and urban violence, an estimated 40 percent of new migrants arriving in Dakar throughout the past decade live in zones with high flood potential (Sakho and Dial 2010; McMichael, Barnett, and McMichael 2012; Foresight

2011). Moreover, rural northern populations in Nigeria exposed to desertification increasingly flee and move to cities and megacities like Lagos—home to more than 10 million people—where the connection between land degradation and the instability caused by insurgent or criminal groups seems to be at play. In this context, disaffected unemployed youth may have incentives to join groups involved in organized crime and illicit activities (such as drug cartels or even Boko Haram) (Werz and Conley 2012).

Other potential sources of increased vulnerability and tension come from changes in the routes of nomadic populations, caused by frequent drought. As shown by the case of the Peul Mbororo of Chad, some communities have to travel longer and unknown routes, rife with the risks of livestock theft and abduction of family members (IOM 2012, 51–53). For them, new patterns of mobility are the best available survival strategy, but this search exposes them to encounters and potential clashes with other populations who might not be willing to share their resources (Oppenheimer et al. 2014). The nomadic populations also played a central role in the 2007 Tuareg rebellion in Niger. In that case, drought added pressure to an already delicate economic and security situation, which facilitated the recruitment of disenfranchised youth by Al-Qaeda and other insurgent groups, prompting the government to deploy 4,000 troops (Werz and Conley 2012).

In places of origin, mass migration of working-age people could be the cause of agricultural de-intensification and ensuing land abandonment and degradation, negatively affecting those left behind (Foresight 2011; Hunter and Nawrotzki 2016). Evidence suggests that as a result of this lost labour, households are less able to halt land degradation (Foresight 2011). In Senegal, in the region of Linguère, which is situated in the northern part of the country, 80 percent of the population relies on agricultural activities that are coming under increasing pressure from land degradation and drought (van der Land and Fourier 2012). As a result, many are leaving the region, leading to further land degradation and decreased crop yields caused by the lack of labor induced by heavy outmigration (Romankiewicz and Doevenspeck 2015).

Both high mobility and the lack thereof can increase vulnerability. For example, in Ghana, where household members used to migrate only once a year during the dry season, increasing evidence points to the existence of a second migration cycle for a number of rural communities, taking place during the rainy season and thus reducing availability of local labor and exacerbating the problem of early depletion of home-grown food stocks (Rademacher-Schulz, Schraven, and Mahama 2014). In contrast, in Tougou, Burkina Faso, where farmers once used to migrate toward the cocoa plantations of Côte d'Ivoire, reduced mobility opportunities led to decreasing the number of daily meals as a mechanism to cope with diminished crop yields (Barbier et al. 2009; Warner and Afifi 2013). Analyses of migratory dynamics over extended periods in Senegal reveal that about two-thirds (62 percent) of rural people have never migrated and are chronically poor, leading to the conclusion that the rural chronically poor are sedentary (Fall and Cissé 2013, 193).

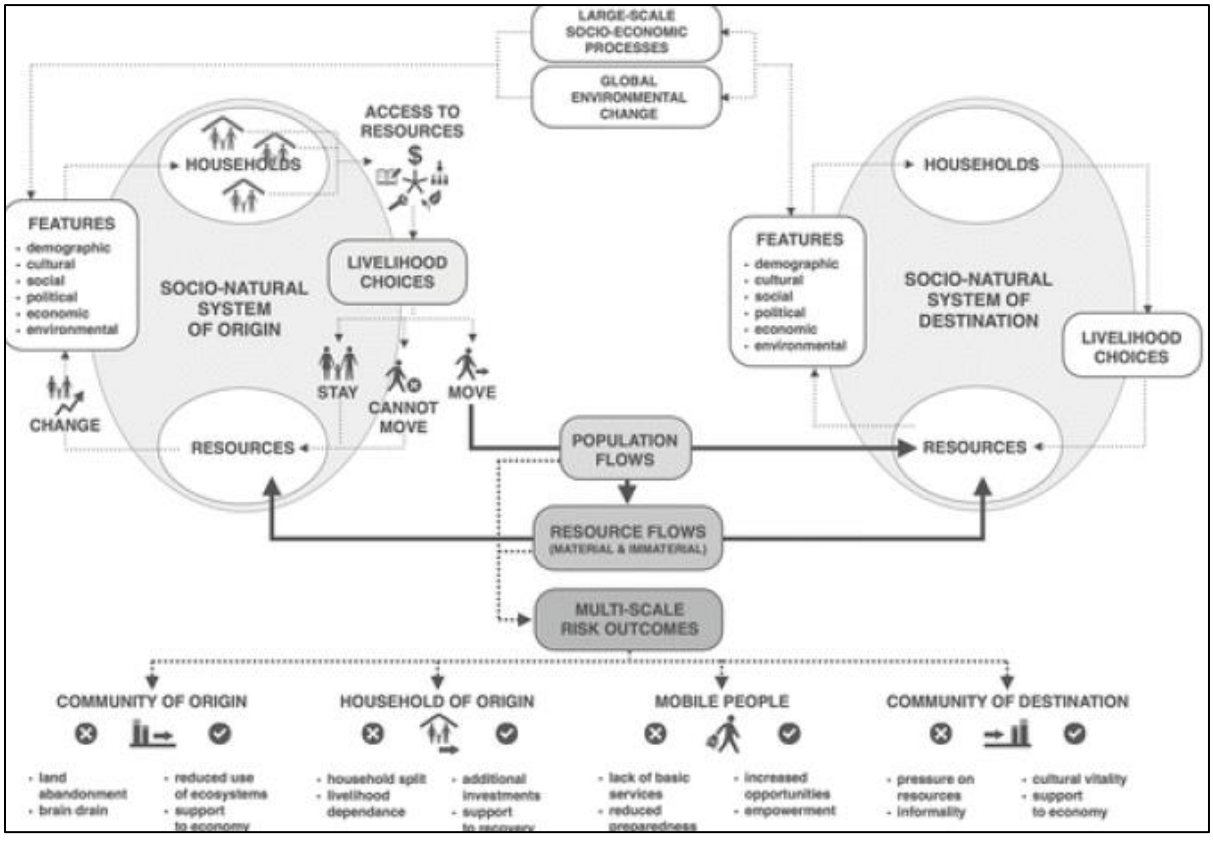
3. Resilient Pathways toward Adaptation

To build resilience, a set of strengths and resources are needed that must be coupled with a certain degree of self-organization and ability to learn while maintaining the system's structure and function (Nelson, Adger, and Brown 2007). Highly influenced by development and technology levels, along with social factors, these sets of assets and aptitudes that allow "societies to survive, flourish and maintain their quality of life" are addressed in the literature as coping and adaptive capacity (Nelson, Adger, and Brown 2007, 399) When on-site adaptation is not a cost-effective possibility, for example, the degree of land degradation makes rehabilitation too expensive, a change in location for either some or all members of the household is necessary to secure vulnerable livelihoods and achieve resilience.

3.1. A Theoretical Framework for Ecosystems and Mobility

The visual framework in figure 1 illustrates how deeply related the decision to undertake migration is with ecosystems, both in origin and destination places.

Figure 1 Risk impacts from human mobility between socio-environmental ecosystems



Source: Guadagno, 2016

This framework shows how approaches to resilience change at different levels—both within and among ecosystems—and mobility choices are interlinked with (rather than being solely dependent upon) environmental stressors. A particular mix of environmental factors with economic, political, social, and cultural variables (West, Roncoli, and Ouattara 2008) influences "diversification" (*ex ante*) and "response" (in season and *ex post*) coping and adaptive strategies.

Unlike sudden natural disasters, land degradation gives small-scale household producers the opportunity to reflect upon the multiple hazards they face, perceive positive and negative aspects of events, and assess their capacity to adapt to future change. Depending on a subjective assessment of risks and vulnerability, which are also related to availability of and access to natural resources, households make certain adjustments in their choices for production and consumption and decisions to remain or move. Coping strategies can be grouped into three broad categories: (1) ex ante risk management options, (2) in-season adjustment in response to specific shocks as they evolve, and (3) ex post risk management options that minimize the livelihood impacts of adverse conditions (Cooper et al. 2008). Among all possible responses and strategies, the framework in this paper focuses on mobility responses to perceived natural asset depletion and highlights the trade-off between the challenges of staying and the opportunities and challenges of leaving.

Mobility can take several forms, including internal, regional, and intercontinental migration; relocation (conserving the same livelihood in a different place or country); and short-term (less than 12 months; includes seasonal migration) and long-term migration. Decisions to undertake one of these options depends on a multiplicity of contextual factors, and different migration categories are often interlinked. While section 2 discussed vulnerability factors, this section focuses on drivers that lead individuals and households to a "trade-off" decision between remaining in their communities and localities of origin or seeking opportunities for resilience elsewhere.

a. Remittances. The availability of remittances as a potential source of resilience is undoubtedly a key determinant of decisions to migrate; remittances flows might either allow households to build capacity for on-site adaptation or finance future migration (Awumbila et al. 2014). Cross-border remittances are normally more substantial (on a per capita basis) than internal ones because of the stronger currencies and higher salaries provided in industrialized countries. International migrants' investments can provide employment opportunities that motivate both internal rural-urban and rural-rural migration (Tacoli 2011; Barrios, Bertinelli, and Strobl 2006).

b. Availability of job opportunities elsewhere during slack periods. Temporary mobility is generally undertaken by labor migrants over short distances, often circular (or seasonal), with migrants returning to their communities of origin at the end of the dry season. In areas where working-age people migrate internationally or to cities, the void in the labour force can in turn attract rural-rural migration from neighboring communities (Barrios, Bertinelli, and Strobl 2006; Tacoli 2011). This type of resilience strategy is expected to increase as environmental stressors

intensify (Tacoli 2011). Higher frequency of drought tends to strengthen short-cycle circulation more than longer-term migration (Findley 1994; Hunter and Nawrotzki 2016).

c. Availability of and access to resources elsewhere. As the impact of environmental stressors on livelihoods intensifies, temporary migration is replaced by permanent migration, often involving the entire household (Scheffran, Marmer, and Sow 2011). When resources in the places of origin are perceived as being irreversibly damaged, the availability of productive lands elsewhere can be an incentive for families to relocate. In this case, tenure is a key factor in the decision: lack of tenure security in places of origin and access to land rights in destination places are key determinants in migration decisions. Shifts in rules of access and entitlement may affect people's ability to count on these resources in coping strategies. Customary land tenure and usufruct rights systems help people cope by creating opportunities for temporary and seasonal migration, allowing the use of particular plants for food during periods of stress, and supporting other flexible opportunities for resource use (Dow 2005).

d. Information and networks. Migration requires a minimum level of information, contacts, and resources. Migrants' networks abroad may be a motivation and source of help for others to follow, especially in the occurrence of recognized shocks such as a prolonged period of drought. Most available evidence on the link between drought and migration points to reductions in international migration and increases in internal mobility (Findley 1994; Lilleør and van den Broeck 2011). Those moving as a consequence of decreased crop yields do not have the means to engage in expensive journeys and, for this reason, normally remain within a short distance of their places of origin (Goff, Zarin, and Goodman 2012).

3.2. Mobility Patterns in West Africa

Within Sub-Saharan Africa, West Africa has a long tradition of human mobility, which intensified particularly during the colonial period. After independence, this population mobility turned into labor migration for wage work. In recent times movement across national borders within West Africa has been facilitated by the ECOWAS, which also promotes the creation of a common market and the abolishment of all kinds of discrimination and seeks to guarantee the rights of residence, establishment, and free entrepreneurship for any citizen from any of the member states (Konseiga 2005). The Club du Sahel and the OECD undertook a regional study of the long-term prospects for West Africa, highlighting the three prevailing patterns of human mobility: (1) from north to south; (2) from inland to the coast; and (3) from rural to urban areas (Club du Sahel 1990).

Temporary and seasonal migration out of arid and semi-arid regions during dry seasons reduces pressures on food stores in the sending community and, in countries like Côte d'Ivoire, migrant labor is an important part of tree crop (for example, coffee or cacao) farming systems (Dow 2005). However, a growing number of academics have begun studying these phenomena for their potential to provide coping mechanisms and resilience to slow-onset events (McLeman and Smit 2006; Agrawal and Perrin 2009; Barnett and O'Neill 2012).

There are a variety of different manifestations of the above-mentioned types of mobility in West Africa, including movement across all distances—intercontinental, intraregional, and internal—and for all durations—permanent, temporary, and seasonal (Awumbila et al. 2014, 19).

Whether to build resilience to land degradation or to sea level rise, internal migration in West Africa is the most common type of mobility that occurs after worsening climatic conditions. Although a common resilience strategy in some countries, not all West African individuals and communities heavily affected by drought are keen on crossing national borders.

Precise figures about remittances are difficult to obtain because of the informality of most channels used in the region, characterized by weak or non-existent financial systems and a general distrust of formal channels. However, the African Development Bank estimates that in 2014, remittance inflows to the ECOWAS region may have reached as much as US$ 26 billion accounting for 3.2% of the region's GDP (AFDB, 2015). The magnitude of these transfers, which make West Africa the second recipient sub-region on the continent, reflects the size of the West African diaspora, estimated at 9.1 million people in 2011, or 2.6% of the population of the region. As outlined in a recent assessment of labour migration within the ECOWAS region, anecdotal evidence suggests that a portion of remittances flows is allocated to investments in agricultural land, equipment, and small-scale businesses that benefit the entire community (Awumbila et al. 2014). Evidence from Ghana and Burkina Faso suggests that remittances are used to increase resilience in vulnerable rural areas by supporting adaptation within the farming sector, through, for instance, investments in livestock (Deshingkar 2011; Wouterse 2008).

While a sizeable portion of migration flows in West Africa are characterized by seasonal or occasional return to the place of origin, some migrants choose to permanently relocate within their host countries and communities. Among the successful cases of indefinite relocation, that of Mauritanians settling in Senegal and Mali after the severe drought in 1983–85 is significant. Some 12,000 Mauritanians still reside in Mali, and they are essentially self-supporting through agricultural activity, growing maize, peanuts, and other crops and enjoying the same rights and access to public services as the nationals (World Bank Group 2014).

A gender approach to mobility patterns caused by environmental stressors in West Africa is not easy to establish because it is mostly based on cultural features rather than on migration drivers themselves. For instance, during the dry season, Niger exhibits long-established patterns of internal mobility dominated by young men migrating south and returning to their land during the rainy season (Mounkaïla 2002), while women are often left behind. This pattern at times results in decreasing yields because of a lack of labor in the fields (Warner and Afifi 2013; Ober 2014). In contrast, Senegal features cases of successful adaptation in which internal seasonal movements are composed of a majority (roughly 60 percent) of women (van der Land and Fourier 2012).

In terms of policy approaches, West African countries seem to have quite widely recognized the links between migration and climate change. In fact, 8 out of the 10 West African countries considered by Sward and Codjoe (2012) discuss drought-induced migration in their National

Adaptation Programs of Action, pointing to the predominantly internal dimension of the phenomenon. Indeed, among the countries most affected by drought in the region, Burkina Faso, Ghana, Niger, and Senegal have all experienced important amounts of internal mobility (Coulibaly-Tandian and Sakho 2014; Jonsson 2010.)

Although some countries, such as Rwanda and Uganda for instance have taken steps to recognize the importance of rehabilitating lands and promoting diaspora investment schemes, a clear connection between the two issues seems not to be in place so far (Sward and Codjoe 2012). Although ECOWAS is the only regional union in Africa allowing free movement across borders for its citizens, country-level policies have not promoted migration as a possible solution for fostering adaptation and growth and addressing vulnerability in areas where land is no longer productive.

West Africa is a resource-filled region with an unbalanced distribution of natural assets throughout its different agro-ecological areas. Many associate the challenges of the region with those of the Sahel, disregarding the savannah zones, where interesting re-greening experiments, aimed at rehabilitating land through sustainable reforestation practices have been put in place. Van Giesen et al. (2008) document that because of increased levels of river flow and groundwater recharge, extension of irrigated agriculture into the dry season is possible through better exploitation of groundwater in shallow aquifers. For example, he suggests that construction of small reservoirs to locally supply rural populations with water for irrigation, cattle, household use, and fisheries could be feasible in some parts of West Africa, not only in semi-humid areas. These reservoirs can be found in semi-arid areas around the world. The most significant positive socioeconomic aspect of small reservoir development is that they allow for productive use of labour in the dry season and partly reduce large seasonal migration fluxes from the countryside to the larger cities.

4. Policy recommendations and roads ahead

By analysing the causes of vulnerability at the individual, household, and community levels, this study sheds light on the interconnected factors at play in the environment-migration nexus. Indeed, in some cases the possibility of on-site adaptation exists, but it seems to hinge on the provision of rights and incentives, such as access to land and access to credit, that are not available to a large portion of exposed West African communities. When these are absent, mobility can be either an avenue for adaptation, or a coping strategy that ensures short-term means for survival and revenue diversification.

Although the abilities and choices of these individuals and households depend on their level of exposure to environmental stressors -which interact with socioeconomic, political, and cultural factors to determine their vulnerability- it is the trade-off between perceived threats and offered opportunities that determines decisions to stay or migrate. The question is, where are these opportunities for resilience and livelihood diversification offered: on-site, in the next habitable and productive area, or internationally?

All decisions are context dependent and are influenced by perceptions of hazards and of opportunities. The decision to undertake migration as a coping strategy is the result of free choice and of aspirations for a safer and better life. The challenges associated with migrating are sometimes associated with the conditions of journeys and (the lack of) opportunities in places of destination.

The role of policy makers is to attenuate the negative consequences of migration and promote the enabling conditions for these paths to be less exposed to further threat by offering opportunities for building resilience. Decision makers and policy makers should consider the following aspects while shaping their interventions:

- Migration has historically been part of West African society. "No migration" is not an option: migration will continue to occur, and policies that try to inhibit migration in the context of environmental change are more likely to ultimately lead to difficult situations of increased vulnerability (Foresight 2011).
- A very high percentage of West African livelihood systems are land dependent (agriculture, water management, cattle herding, forestry, and so on).
- If journeys are undertaken in desperate conditions, the issues at stake are the loss of human lives and assets (including abandoned lands at risk of irreversible degradation) as well as insecurity during transit and at destinations.
- Migration is an adaptation strategy, as recognized by the IPCC 5th Assessment Report of 2014, and as such can be supported by the financial structures and funds devoted to adaptation that will be available for developing countries' governments.

West African governments and their partners should take advantage of the current debate to define adaptation frameworks and to shape policies and interventions that consider mobility to be part of the solution for reducing vulnerability and building resilience at individual, household, and community levels.

Therefore, a number of general recommendations can be issued to orient local, national, and supranational authorities toward rethinking migration and adaptation in the context of land degradation and climate change.

1. **Map available land**. Land might not be available where migration originates; however, shortening migration paths can contribute to reducing vulnerability. For instance, the Directorate General for Senegalese Abroad signed an agreement with the governmental agency for agricultural development and employment, ANIDA (*Agence Nationale d'Insertion et de Développement Agricole*), to reserve 25% of the land rehabilitated for migrants (Thiam 2013). To do so, available lands had to be accurately mapped by considering existing tenure rights, estimated rehabilitation costs as well as political engagement both at national and local level.

2. **Increase labour opportunities in rural and land-based sectors**, in recognition that failure to adapt in cities is sometimes due to the lack of required skills. Urban unemployed are often former land workers. Empirical findings based on surveys in Sierra Leone and Nigeria conducted by Byerlee et al (1977) support the potential for reducing the rural exodus while increasing growth and employment in rural areas. The evidence assembled in these studies indicates that by (i) granting adequate product pricing and salaries, (ii) promoting agriculture and rural small-industries (that employs labour in agricultural slack periods), and (iii) disseminating the right technologies would reduce rural-urban migration.

3. **Provide incentives and access to credit**. Credit for agriculture is high risk, especially in drought-prone areas. Senegal has already begun to provide guarantee funds to banks and financial institutions for absorbing these risks and promoting access to credit schemes with particularly low interest rates for investment in agriculture. Different funds, such as the *Fonds de Garantie pour les Investissements des Sénégalais de l'Extérieur* (FOGARISE) and the *Fonds d'Appui aux Investissements des Sénégalais de l'Extérieur* (FAISE), have prioritized members of the diaspora among the potential beneficiaries of these credit schemes (IFAD, 2016). Further efforts have to be made to find a way to also include internal migrants and ECOWAS citizens.

4. **Increase consideration of transnational networks**. Remittances of international migrants are sometimes used to finance journeys of families and friends (Gerdes, 2007). Some of these journeys are through regular channels, but others occur in highly unsafe conditions. Engaging members of the diaspora, who are generally wealthier and have more entrepreneurial capacity than their relatives seeking to leave, by offering investment opportunities in their countries of origin might help reduce irregular migration.

5. **Provide access to land tenure and land rights**. Tenure and land rights are important factors for attracting both investment and labour to safe and productive areas. A number of countries in West Africa are currently undertaking land reforms: Benin, Burkina Faso, Cote d'Ivoire, Mali and Mauritania (World Bank 2015). The new land tenure systems ought to address the increasing trends of rural-rural and rural-urban migration and then ensuing labour availability issues and potential risks of additional vulnerability.

6. **Research**. Efforts to integrate the social science dimension into the preponderant physical science approach in the adaptation research community should be increased; that is, resilience-driven mobility solutions should be supported and situations of further vulnerability should be prevented by basing efforts on sound social and anthropological evidence. Further questions for research are where are the thresholds that lead people to unsafe paths and increased conditions of vulnerability, and what are the trade-offs between leaving and staying?

In conclusion, one of the main neglected problems in West Africa is labour scarcity where the capitalization of agriculture is low. Where labour migration is key not only for economic development but also for household resilience, governmental policies should facilitate migration by taking into account the degree of land degradation, specific seasonal effects as well as expected drought. For example, such policies could provide better agricultural opportunities where land can still be rehabilitated and facilitate circular migration programs from rural areas and neighbouring countries. In other words, the enabling conditions for the capitalization of agriculture should include increasing employment opportunities and migration, based on the evidence that mobility will always be an adaptation strategy, when needed. The best option for governments to address these issues and avoid perceiving them as security concerns would be to provide incentives for shorter migration paths and land rehabilitation, creating win-win opportunities for those who stay, those who leave, and those who receive.

References

African Development Bank. 2015. "Remittances from West Africa's Diaspora: financial and social transfers for regional development". http://www.afdb.org/en/blogs/measuring-the-pulse-of-economic-transformation-in-west-africa/post/remittances-from-west-africas-diaspora-financial-and-social-transfers-for-regional-development-14614/. Accessed on 09/06/2016

Agrawal, A., and N. Perrin. 2009. "Climate Adaptation, Local Institutions and Rural Livelihoods." In Adapting to Climate Change: Thresholds, Values, Governance, edited by W. N. Adger. Cambridge: Cambridge University Press.

Appeaning Addo, K., L. Larbi, B. Amisigo, and P. K. Ofori-Danson. 2011. "Impacts of Coastal Inundation Due to Climate Change in a CLUSTER of Urban Coastal Communities in Ghana, West Africa." Remote Sensing 3 (12): 2029–50.

Awumbila, Mariama, Yaw Benneh, Joseph Kofi Teye, and George Atiim. 2014. Across Artificial Borders: An Assessment of Labour Migration in the ECOWAS Region. ACPOBS/2014/PUB05. Brussels: ACP Observatory on Migration.

Barbier, B., H. Yacoumba, H. Karambiri, M. Zorome, and B. Some. 2009. "Human Vulnerability to Climate Variability in the Sahel: Farmers' Adaptation Strategies in Northern Burkina Faso." Environmental Management 43: 790–803.

Barrios, Salvador, Luisito Bertinelli, and Eric Strobl. 2006. "Climatic Change and Rural-Urban Migration: The Case of Sub-Saharan Africa." CORE Discussion Papers 2006046, Université catholique de Louvain, Center for Operations Research and Econometrics (CORE).

Barry, B.-S., E. G. E. Creppy, E. Gacitua-Mario, and Q. Wodon. 2007. Conflict, Livelihoods, and Poverty in Guinea Bissau. Washington, DC: World Bank.

Barnett, J., and S. J. O'Neill. 2012. "Islands, Resettlement and Adaptation." Nature Climate Change 2: 8–10.

Bohle, H. G., T. E. Downing, and M. J. Watts. 1994. "Climate Change and Social Vulnerability: Toward a Sociology and Geography of Food Insecurity." Global Environmental Change 4 (1): 37–48.

Brown, O. and A. Crawford. 2009. "Climate Change and Security in Africa. A Study for the Nordic-African Foreign Ministers Meeting". Institute for Sustainable Development.

Burton, I., S.Huq, B. Lim, O. Pilifosova and E.L. Schipper, 2002. "From impacts assessment to adaptation priorities: the shaping of adaptation policy." Clim. Policy, 2, 145-159

Carpenter, S. R., and W. A. Brock. 2008. "Adaptive Capacity and Traps." Ecology and Society 13 (2): 40.

Carpenter, S. R., B. Walker, J. M. Anderies, and N. Abel. 2001. "From Metaphor to Measurement: Resilience of What to What?" Ecosystems 4 (8): 765–81.

Caspari, T., S. Alexander, B. ten Brink, and L. Laestadius. 2014. "Review of the Global Assessments of Land and Ecosystem Degradation and Their Relevance in Achieving the Land-Based Aichi Biodiversity Targets." Technical report prepared for the secretariat of the Convention on Biological Diversity. UNEP/CBD/COP.

Club du Sahel et de l'Afrique de l'Ouest/OECD. 2007. http://www.oecd.org/fr/csao/publications/42464831.jpg.

Club du Sahel. "1990. West African systems of production and trade in livestock products." Technical Paper d/90/351: Paris: OECD/CILSS.

Cook, K. H., and E. K. Vizy. 2006. "Coupled Model Simulations of the West African Monsoon System: 20th and 21st Century Simulations." Journal of Climate 19: 3681–793.

Cooper, P. J. M., J. Dimes, K. P. C. Rao, B. Shapiro, B. Shiferawa, and S. Twomlow. 2008. "Coping Better with Current Climatic Variability in the Rain-Fed Farming Systems of Sub-Saharan Africa: An Essential First Step in Adapting to Future Climate Change?" Agriculture, Ecosystem and Environment 126 (1–2): 24–35.

Coulibaly-Tandian, O. K., and P. Sakho. 2014. "Cas du Senegal." In Impact des changements environnementaux sur les migrations humaines : Etude de cas : Sénégal et Côte d'Ivoire, edited by M. T. Thiam and J. Crowley. Rapport d'Étude de l'Institut des Sciences de l'Environnement (ISE), Université Cheikh Anta Diop, United Nations Educational, Scientific and Cultural Organization (UNESCO).

de Haas, H. 2007. "The Myth of Invasion: Irregular Migration from West Africa to Maghreb to the European Union." International Migration Institute, Alexandria, Egypt.

Deshingkar, Priya. 2011. "Are There Examples of Remittances Being Used to Build Local Resilience to Environmental Change, Especially through Investment in Soil and Water Conservation or Broader Agriculture?" UK Foresight Scientific Review 13, U.K. Government Office for Science.

Dixon, J., A. Gulliver, and D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. Rome: FAO; Washington, DC: World Bank.

Dow, K. 2005. "Vulnerability Profile of West Africa." Poverty and Vulnerability Programme, Stockholm Environment Institute, Stockholm.

Fall, Abdou Salam, and Rokhaya Cissé. 2013. "Migratory Dynamics over Half a Century in Senegal: A Longitudinal Perspective over Four Generations." International Relations and Diplomacy 1 (3): 189–201.

Findley, Sally E. 1994. "Does Drought Increase Migration? A Study of Migration from Rural Mali during the 1983–1985 Drought." International Migration Review 28 (3): 539–53.

Folke, K. 2002. "Social-Ecological Resilience and Behavioral Responses." Interdisciplinary Centre for Research on Natural Resources and the Environment, Stockholm University.

Foresight. 2011. "Migration and Global Environmental Change." Final Project Report, the Government Office for Science, London.

Goff, L., H. Zarin, and S. Goodman. 2012. "Climate-Induced Migration from Northern Africa to Europe: Security Challenges and Opportunities." Brown Journal of World Affairs 43 (2).

Guadagno, L. 2016, forthcoming. "Human Mobility in a SocioEnvironmental Context: Complex Effects on Environmental Risk", Springer

Gunderson, L. H., and C. S. Holling, eds. 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Washington, DC: Island Press.

Hunter, Lori M., and Raphael Nawrotzki. 2016. "Migration and the Environment." In International Handbook of Migration and Population Distribution, edited by Michael J. White, 465–84. New York: Springer.

IOM (International Organization for Migration). 2012. International Dialogue on Migration : Climate Change, Environmental Degradation and Migration. Geneva: International Organization for Migration.

———. 2014a. IOM Outlook on Migration, Environment and Climate Change. Geneva: International Organization for Migration. http://publications.iom.int/bookstore/free/MECC_Outlook.pdf.

———. 2014b. Migration, Environment and Climate Change: Evidence for Policy (MECLEP) GLOSSARY. Geneva: International Organization for Migration.

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

Jonsson, G. 2010. "The Environmental Factor in Migration Dynamics: A Review of African Case Studies." International Migration Institute, James Martin 21st Century School, University of Oxford.

Leichenko, R., and K. O'Brien. 2002. "The Dynamics of Rural Vulnerability to Global Change: The Case of Southern Africa." Mitigation and Adaptation Strategies for Global Change 7 (1): 1–18

Lilleør, H. B., and K. van den Broeck. 2011. "Drivers of Migration and Climate Change in LDCs." Global Environmental Change 21 (Suppl 1): S70–S81.

McLeman, R., and B. Smit. 2006. "Vulnerability to Climate Change Hazards and Risks: Crop and Flood Insurance." Canadian Geographer 50 (2): 217–26.

McMichael, C., J. Barnett, and A. J. McMichael. 2012. "An Ill Wind? Climate Change, Migration, and Health." Environmental Health Perspectives 120 (5): 646–54.

Mertz, O., C. Mbow, A. Reenberg, and A. Diouf. 2009b. "Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel." Environmental Management 43:804-816.

Mertz, O., C. Mbow, J. Nielsen, A. Maiga, D. Diallo, A. Reenberg, A. Diouf, and others. 2010. "Climate Factors Play a Limited Role for Past Adaptation Strategies in West Africa." Ecology and Society 15 (4): 25.

Mertz, O., C. Mbow, A. Reenberg, L. Genesio, E. F. Lambin, S. D'haen, M. Zorom, et al. 2011. "Adaptation Strategies and Climate Vulnerability in the Sudano- Sahelian Region of West Africa." Atmospheric Science Letters 12 (1): 104–8.

Mohamed, B. N., V. Duivenbooden, and S. Aboussalam. 2002. "Impact of Climate Change on Agricultural Production in the Sahel-Part 1. Methodological Approach and Case Study for Millet in Niger." Climate Change 54 (3): 327–48.

Mounkaïla, H. 2002. « De la migration circulaire à l'abandon du territoire localdans le Zarmaganda (Niger). » Revue européenne des migrations internationales 18.2.

Nelson, Donald R., W. Neil Adger, and Katrina Brown. 2007. "Adaptation to Environmental Change: Contributions of a Resilience Framework." Annual Review of Environment and Resources 32: 395–419.

Niang, I., O. C. Ruppel, M. A. Abdrabo, A. Essel, C. Lennard, J. Padgham, and P. Urquhart. 2014. "Africa." In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

Niasse, M. 2005. "Climate-Induced Water Conflict Risks in West Africa: Recognizing and Coping with Increasing Climate Impacts on Shared Watercourses." Prepared for an international workshop on "Human Security and Climate Change," Asker, Norway, June 21–23.

Niasse, M., A. Afouda and A. Amani. 2004. Reducing West Africa's Vulnerability to Climate Impacts on Water Resources, Wetlands and Desertification: Elements for a Regional Strategy for Preparedness and Adaptation. IUCN, Gland, Switzerland and Cambridge, UK. Xviii + 66pp.

Ober, K. 2014. "How the IPCC Views Migration: An Assessment of Migration in the IPCC AR5." TransRe Fact Sheet No. 1, Department of Geography, University of Bonn.

OECD (Organisation for Economic Co-operation and Development). 2006. International Migration Outlook. Paris: OECD Publishing.

———. 2008. "Climate and Climate Change." In Atlas on Regional Integration in West Africa. Sahel and West Africa Club (SWAC) and Organisation for Economic Co-operation and Development (OECD), and Economic Community of West African States (ECOWAS). www.atlas-westafrica.org.

Oguntunde, P. G., J. Friesen, N. van de Giesen, and H. G. Savenije. 2006. "Hydroclimatology of the Volta River Basin in West Africa: Trends and Variability from 1901 to 2002." Physics and Chemistry of the Earth 31 (18): 1180–88.

Oppenheimer, M., M. Campos, R. Warren, J. Birkmann, G. Luber, B. C. O'Neill, and K. Takahashi. 2014. "Emergent Risks and Key Vulnerabilities." In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

Rademacher-Schulz, Christina, Benjamin Schraven, and Edward Salifu Mahama. 2014. "Time Matters: Shifting Seasonal Migration in Northern Ghana in Response to Rainfall Variability and Food Insecurity." Climate and Development 6 (1).

Reilly, J. M., and D. Schimmelpfenning. 1999. "Agricultural Impact Assessment, Vulnerability, and the Scope for Adaptation." Climate Change 43 (4): 745–48.

Martin Doevenspeck. 2015. "Climate and Mobility in the West African Sahel: Conceptualising the Local Dimensions of the Environment and Migration Nexus." In Grounding Global Climate Change: Contributions from the Social and Cultural Sciences, edited by H. Greschke and J. Tischler. Dordrecht: Springer.

Sakho, Papa, and Fatou Binetou Dial. 2010. “Cadre general des migrations senegalaises.” Robert Schuman Centre for Advanced Studies.

Samimi, C., and M. Brandt. 2012. “Environment and Migration in the Sahel.” In Climate Change, Environment and Migration in the Sahel: Selected Issues with a Focus on Mali and Senegal, edited by D. Hummel, M. Doevenspeck, and C. Samimi, 20–36. MICLE Working Paper 1. Frankfurt: Migration, Climate, and Environment.

Sarr, Benôıt. 2012. “Present and Future Climate Change in the Semi-Arid Region of West Africa: A Crucial Input for Practical Adaptation in Agriculture.” Atmospheric Science Letters 13 (2): 108–12.

Scheffran, J., E. Marmer, and P. Sow. 2011. “Migration as a Resource for Resilience and Innovation in Climate Adaptation: Social Networks and Co-Development in Northwest Africa.” Applied Geography 33 (April): 119–27.

Scheffran, J., M. Brzoska, J. Kominek, P. M. Link, J. Schilling. 2012 “Climate Change and Violent Conflict.” Science 18 May 2012: Vol. 336, Issue 6083: 869-871.

Schouten, M., M. van der Heide, and W. Heijman. 2009. “Resilience of Social-Ecological Systems in European Rural Areas: Theory and Prospects.” Paper prepared for presentation at the 113th EAAE Seminar “The Role of Knowledge, Innovation and Human Capital in Multifunctional Agriculture and Territorial Rural Development.” Belgrade, Republic of Serbia, December 9–11.

Smit, B., I. Burton, R.J.T. Klein, and J. Wandel, 2000. “An anatomy of adaptation to climate change and variability.” Climatic Change, 45, 223-251

Sward, J., and S. N. A. Codjoe. 2012. “Human Mobility and Climate Change Adaptation Policy: A Review of Migration in National Adaptation Programmes of Action (NAPAs).” Research Program Consortium Working Paper 6, Migrating out of Poverty, University of Sussex, Brighton.

Tacoli, C. 2011. “Not Only Climate Change: Mobility, Vulnerability and Socio-Economic Transformations in Environmentally-Fragile Areas of Bolivia, Senegal and Tanzania.” International Institute for Environment and Development, London.

Tschakert, P. 2006. “Views from the Vulnerable: Understanding Climatic and Other Stressors in the Sahel.” Global Environmental Change 17 (3–4): 381–96.

UN DESA (United Nations Department of Economic and Social Affairs). 2012. “Migrants by Origin and Destination: The Role of South-South Migration.” Population Facts 2012/3, UN DESA, New York.

UNGA, 2012 “The future we want”. United Nations General Assembly Resolution 66/288 http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288

UNEP (United Nations Environment Programme). 2006. Global Deserts Outlook. Nairobi: United Nations Environment Programme Division of Early Warning and Assessment.

———.2000. World Resources 2000-2001. Washington, D.C.: WRI, World Resources Institute.

UNFCCC (United Nations Framework Convention on Climate Change). 2011. “Decisions Adopted by the Conference of the Parties.” United Nations Framework Convention on Climate Change, Decision 1/CP.16.: The Cancun Agreements: Outcome of the Work of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention.

van der Land, Victoria, and Joel Fourier. 2012. “Focus Senegal.” In Climate Change, Environment and Migration in the Sahel: Selected Issues with a Focus on Mali and Senegal, edited by D. Hummel, M. Doevenspeck, and C. Samimi. MICLE Working Paper 1, Frankfurt.

van der Land, Victoria, and Diana Hummel. 2013. "Vulnerability and the Role of Education in Environmentally Induced Migration in Mali and Senegal." Ecology and Society 18 (4): 14.

van Giesen, N., W. Andah, M. Andreini, B. Barry, G. Jung, H. Kunstmann, W. Laube, P. Laux, and J. Liebe. 2008. “Adapting to Climate Change in West Africa.” Paper prepared for Expo Zaragozo 2008.

Warner, K., and T. Afifi. 2013. “Where the Rain Falls: Climate Change, Food and Livelihood Security and Migration.” United Nations University Institute for Environment and Human Security, Tokyo.

Warner, K., and K. van der Geest. 2013. “Loss and Damage from Climate Change: Local-Level Evidence from Nine Vulnerable Countries.” International Journal of Global Warming 5 (4): 367–86.

Werz, M., and L. Conley. 2012. Climate Change, Migration and Conflict in Northwest Africa. Washington, DC: Center for American Progress.

West, Collin Thor, Carla Roncoli, and Frederic Ouattara. 2008. "Local Perceptions and Regional Climate Trends on the Central Plateau of Burkina Faso." Land Degradation and Development 19 (3): 289–304.

Wilhite, D. A., and R. S. Pulwarty (2005) “Drought and water crises: Lessons learned and the road ahead” in Drought and Water Crises: Science, Technology, and Management Issues: 389– 398.

World Bank Group. 2014. “Forced Displacement of and Potential Solutions for Internally Displaced Persons (IDPs) and Refugees in the Sahel: Burkina Faso, Chad, Mali, Mauritania, and Niger.” Washington, DC: World Bank.

Wouterse, F. S. 2008. “Migration, Poverty and Inequality. Evidence from Burkina Faso.” Discussion Paper 00786, International Food Policy Research Institute, Washington, DC.

CHAPTER 3

Environmental Change and Migration: the Role of Climatic and Environmental Conditions in the Migration Decision

Abstract

The interconnection between climatic and environmental change and migration are mediated by social, economic, political, and demographic processes. Yet, while there is a burgeoning literature on climate change and migration, the role of individual perception in the decision to migrate is widely understudied. This paper provides an overview of general migration theories and of how the area of study on the nexus environment-migration has emerged in the literature. After summarizing the common methods used by researchers to measure climate and environmental degradation-induced migration, the author reports the findings of a survey conducted on migrants in transit in Morocco. The more than 1000 interviews collected in 5 transit centers in the country confirmed that, in general, climate and environmental change are important determinants of the decision to migrate, even though concurring with other major motivations. In particular, they turned out to be the most important reasons to migrate for a non-negligible number of migrants.

1. Introduction

The interrelations between migration and environmental change have been investigated since late nineteenth century, when environmental stressors have been mentioned among the factors influencing the migration decision-making process as part of the first theories of migration (Piguet, 2013). However, migration literature has almost completely disregarded the environmental factors for the entire subsequent century until when the First IPCC Assessment Report highlighted the single most significant impact of climate change could have on human migration (McTegart et al 1990).

In the literature, migration is generally defined as a permanent or semi-permanent change in place of residence (Lee 1966). Temporal or spatial patterns are commonly used to describe it: seasonal, temporary, or indefinite/permanent (Gonzalez 1961), while rural-urban, rural-rural, inter-urban, etc. According to the International Organization for Migration, one in seven people in the world is a migrant (Ionesco et al 2017). Of the 200 million international migrants currently found worldwide, only 4 million per year migrate to distant countries (UNDESA 2015). By looking at the official figures, it becomes clear that most cases of migration occur within national borders and most international movement takes place between neighboring countries. Another common category used to describe migration relates to the degree of freedom that an individual has when making a decision to migrate. In this case, scholars distinguish between voluntary or forced migration. Often, migration choices are neither completely voluntary nor completely involuntary. While in less developed regions, where rural populations depends on natural resources, mobility is an important component of adaptation to climate change (McLeman 2014).

This paper aims at discussing the nexus between climate/environmental change and migration by focusing on perception of the hazards and motivations for migration from an individual's perspective. It begins with an overview of the main migration theories highlighting how the environment has been considered among drivers the migration decision-making. After introducing the common methods used in this new research field, the paper identifies surveys as the most suitable method of obtaining reliable information on the role of environmental drivers on migration. In the second part, the paper describes the design and implementation of the survey conducted to investigate the main reasons why migrants moving on the Western Saharan route decided to leave their community, including lack of work opportunities, safety conditions and environmental changes. It then summarizes the main results of the data collected through survey in Morocco. The main findings suggest that households do perceive important changes in the climate, and that many households are being affected by extreme weather events resulting in losses in income, crops, and livestock. Finally, while climate and environmental change is not today the main driver of migration flows, it does appear to contribute to these flows. Finally, the qui-squared tests performed revealed that women, rural and Sahelian migrants are those that consider climatic and environmental as the key determinant of their decision to migrate.

2. The climate/environment change and migration nexus in the literature

Literature on the interaction between migration and global environmental change dates to the late XIX century. Georg Ravenstein (1889) was one of the firsts to consider environmental and climatic factors as one of the determinants of the decision to migrate. After this first interest on the drivers, the environment has disappeared from the literature on migration for many decades. For most of the following century migration was studies as a demographic process and explained as a flow across labor markets, in line with the classical economic theory (Molloy et al 2011, Rabe and Taylor 2012).

Borjas is one of the leading authors of this school that studies the subject from the fundamental assumption that migration is purely driven by wage difference. From this perspective, scholars analyzed the impacts in the countries of destination to understand whether migrant flows reduce labor market opportunities for the natives (Card 2009) and try to describe the impacts of diversity on the societal structure of the receiving countries (Dustmann 2015).

Contrary to common belief, authors like Boeri (2009) and Card et al (2012) provide evidence that regular migrants are not a net fiscal burden to natives, and prove that concerns on composition of neighborhoods, schools, and workplaces are 2-5 times more important than economic concerns over wages and taxes. Others, like Ottaviano et al (2016), demonstrate the positive impacts of migration by examining its relations with imports, exports and productivity of service. Their research on firms in the United Kingdom revealed that immigrants increase overall productivity in service-producing firms, reduce the extent of country-specific offshoring, and increase country-specific exports, implying an important role in reducing communication and trade costs for services.

Interestingly, while the bulk of migration literature focuses on the impacts of low-skilled workers on the labor markets in countries of destination, Moretti (2012) studies the effects of emerging knowledge-based economics in the United States on the location of jobs and proves that the more education a person has, the more mobile he or she is, which is a contrast to earlier periods of migration, when it was the least educated who migrated. In the last decades, the research on the effects of migration on countries of origin is also increasing. This type of research addresses the welfare of the remaining residents by examining in particular the role of remittances and of return migration on development and the brain-drain problem (Djajic et al 2012, Djajic 2014, Wahba 2015, Hausmann and Nedelkoska 2017).

With the attention shift to movements of people in developing countries, the environmental factors become more evident, as the wage difference can clearly not explain all the increasing drivers of migration flow. The environment became particularly relevant when scholars started to analyze the decisions to move away from the area of origin as a way to diversify risks and reduce exposure to shocks or uncertainty. This explanation helped to understand the behavior of many farmers and herders in developing countries. In West Africa, for example, many population do not move do pursuit higher wages, but to diversify and reduce risks due to seasonal climate variability (Barbier et al 2009). With the emphasis on risk diversification, migration starts to be consider as response to the depletion of natural resources (Scoones 1998) and as strategy to increase adaptive capacity (Scheffran et al 2012).

The International Organization for Migration (IOM 2009) coined a definition of environmental migrants that comprehends all the possible dimension of this phenomenon, from temporary to permanent, from voluntary to forced, from internal to international migration:

> *"Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive change in the environment that adversely affects their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad."*

The nexus between environment, development and migration has been first explored at the beginning of the twentieth century by several German and American researchers that have been called, a posteriori, 'environmental determinists' (Gemenne 2011a). These authors believed that environmental conditions like temperatures and water availability can determine where people live, as well as influence their productivity and economic wealth (Huntington 1924). Afterwards, the academic interest in environmental migration dropped until late 1970s when researchers started to study the impacts of natural disasters. While trying to explain the difference between displacements in least developed countries like Bangladesh, as opposed to temporary relocations to prosperous locations like Florida, scientists began to use the concept of 'vulnerability' (Burton et al 1978). They understood that vulnerability of particular livelihoods not only depends on "exposure," but also serves to provide sensitivity to environmental risks and the ability to cope with them, and that both these outcomes also depend on social, economic and political factors (Burton 1997).

When the first assessment report of the IPCC (McTegart et al 1990) recognized the dangers of climate change on migration, social scientists started to use the concept of vulnerability forged by natural scientists and apply it to the migration theories (McLeman 2014). As a result, a number of scholars began to look at migration as a way to adapt to the environmental changes (Tacoli 2009, Black 2011), forging the paradigm that dominates recent research on the nexus climate-change migration. In this conceptualization, migration is considered a function of environmental stress exposure, population sensitivity and adaptive capacity. These variables are also influenced by social, economic, political and cultural processes that, in specific terms, are determinants, such as household incomes, access to labor markets and social networks, as shown in the conceptual framework elaborated in the "Foresight Project on Global Environmental Migration" (Figure 1), carried out by the UK Government Office for Science (2012).

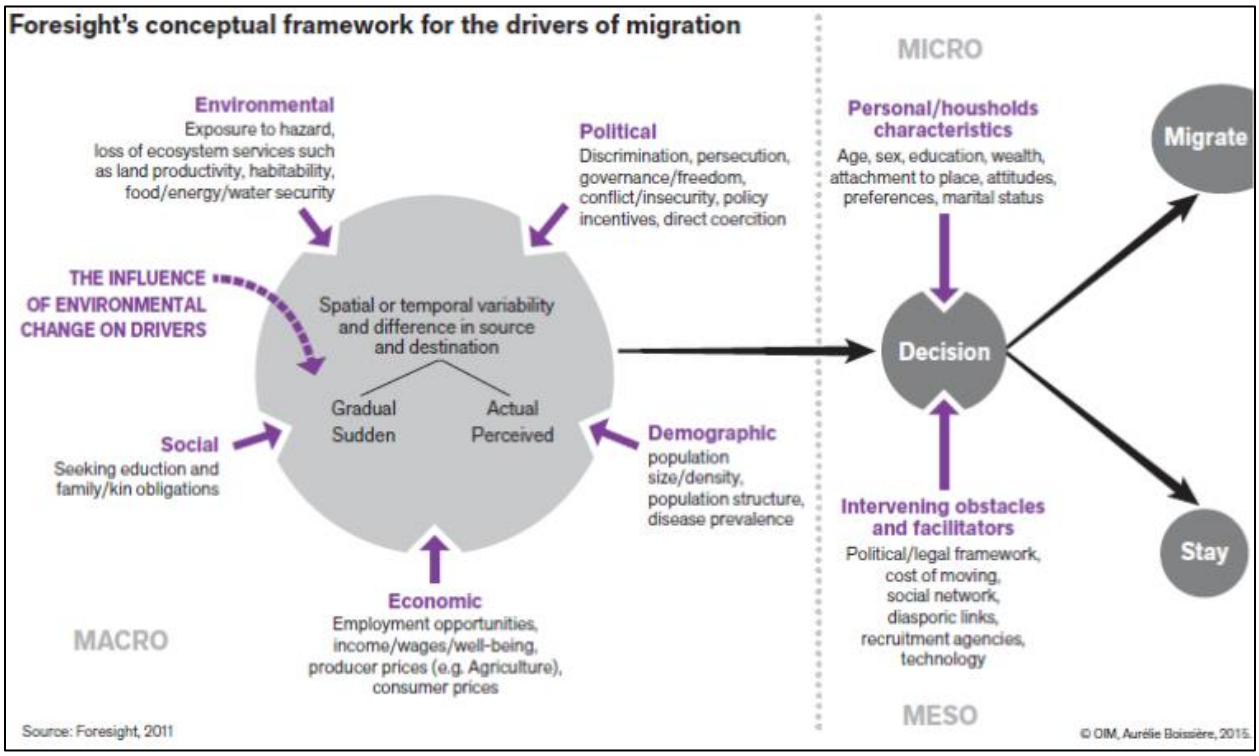


Figure 1: Foresight's conceptual framework for the drivers of migration (2011)

As shown in Figure 1, an individual's or family's decision to migrate is influenced by different drivers operating at micro-, meso-, and macro-scales. The micro-level refers to local determinants, such as income, size of the family, age, etc., while the meso-level refers to factors like the social network or the liquidity to pay for the trip. It is at macro-level that that the decision to migrate is influenced by forces that are beyond the control of individuals, households and communities. In this conceptual framework, environmental change is depicted as the element that may alter the whole system. As a consequence, migration decisions are influenced by it, but only after its impacts have been filtered through the macro-, meso-, and micro-level factors.

In the last decade, scientists have agreed on the following points with regard to the interconnection between migration and the environment in the context of climate change: (i) migration decision-making is always complex and researchers should be careful in establishing any direct relationships between climatic and environmental stressors and migration (Afifi, 2011; Bettini, 2013; Piguet, 2012; Wrathall, 2012); (ii) migration can be framed as both a failure to adapt to climate change, but it can also be considered an adaptation strategy (Bardsley and Hugo, 2010; Black et al., 2011; McLeman and Smit, 2006; Tacoli, 2009); climate-induced migrants are not an additional determinant of civil conflicts and civil wars in receiving areas (Cattaneo and Bosetti, 2016).

Despite these points of convergence and the increasing number of theoretical and empirical publications on migration and environmental changes, the knowledge base remains uncertain (Milan et al. 2015). Different disciplines and techniques have been deployed to address this complex nexus. Next chapter provides an overview of common research methods used to measure and map migration induced by environmental change.

3. Measuring migration induced by environmental changes

From a methodological perspective, it is possible to assess forced migration and displacement related to fast-onset events, such as natural disasters, but it is fairly complicated to provide estimates of migration associated with slow-onset events, such as land degradation, sea level rise or change in average climatic conditions. As discussed in the previous chapter, migration in the context of environmental change is rarely a simple push-pull phenomenon. Rather, individual migration decisions are influenced by a range of economic, social, political and environmental factors operating at macro, meso, and micro scales. Isolating one of these determinants to define the nature of its influence on a migrant's decision to move is extremely difficult.

A challenge for measuring environmental migration is finding reliable data. The most common sources of migration data are censuses, household registration documents and surveys (Fussell et al 2014). However, censuses often lack statistics on migration and rarely record the individuals' motivations for migration. A common method that has been used by researchers to identify possible environmental "signals" in migration pattern is to combine environmental datasets with existing census data comparing the timing of changes in environmental conditions with the timing of migration movements of individuals and households (Fussell et al 2014). Similar methods have been used to measure the influence of droughts on migration in Burkina Faso (Henry et al 2004) and the effects of rainfall variability on migration in Mexican drylands (Nawrotzki et al 2013).

A method used to visualize the spatial and temporal connections is to combine environmental and population data in geospatial models. These models do not aim at demonstrating causality. Rather, their main goal is to illustrate assumed associations between factors and identify areas for further research or for informing policy decisions. Other techniques seek to estimate the likelihood of particular migration outcomes under specific environmental scenarios. Kniveton et

al (2011) used agent-based modelling techniques to replicate interactions between climate, socio-economic processes and migration in Burkina Faso for the period 1970 – 2000 and to simulate migration flows up to 2060. Running simulations on existing data about climatic influences on migration patterns and making projections of how the different factors interact, the authors were able to forecast potential migration patterns for Burkina Faso under a variety of future climate scenarios.

Other scholars have tried to determine the climatic determinants through econometric models. For example, Bohra-Mishra et al (2014) conducted a micro-level study to simultaneously investigate the effects of variations in temperature and precipitation along with sudden natural disasters to infer their relative influence on migration. Using data on over 7 000 households collected over the fifteen-year period, the researchers tested the effects of temperature along with precipitation on migration decisions. They run an empirical model which predicts annual probability of migration due to the effects of random multi-year variations in temperature, precipitation and disasters measured over the period that coincides with the period for which migration is observed. According to their findings, of all of the environmental factors, temperature had the most significant effect on migration.

Contrary to the bulk of the existing literature, Coniglio and Pesce (2015) investigated the nexus between climate shocks and international migration by employing a "macro-approach." They also considered the importance of timing the shocks by computing measurements of climate anomalies that occur in rainy and dry seasons. Through this experimental method, the authors found out that the direct effect of climatic shocks is likely to be related to the impacts that past events might have had on the expected or potential income streams.

Another set of methods requires gathering information through surveys, questionnaires, interviews or focus groups. The results of these investigations are generally case studies, from which the researchers try to infer both specificities and more general interactions with migration behaviors in relations to climate and environmental factors. One of the challenges of collection data directly from the public is linked to the complex temporal and spatial dimensions of migration. For example, it is very problematic to conduct adaptation assessments with migrants, because tracking respondents that change their place of residence makes difficult collecting pre- and posttreatment data. One alternative involves surveying households about family members who moved to another location (Dillon, Mueller, and Salau 2011).

In general, it can be concluded that empirical field work is the most ideal method to assess the relationship between environment/climate change and migration, because it allows verifying if real-life population patterns are consistent with datasets, and if the motivation to migrate, as described by migrants, is consistent with the inferences derived from statistical models.

4. Methodology

Despite the challenges, the empirical literature seeking to estimate the effects of environmental change on migration has been growing rapidly. Most of these surveys assess population

responses after the occurrence of an environmental disaster. For example, Roncoli et al. (2001) surveyed households after a severe drought in Burkina Faso in the 90s and Di Falco et al. (2012) that surveyed 1,000 households in the Nile Basin of Ethiopia to investigate strategies to adapt to climate change.

In her review on the latest attempts to analyze environmentally induced migration, Millock (2015) found that most of the surveys conducted in the field of geographical and social sciences provide a lot of information on local conditions, but they remains largely descriptive without statistical analysis of data. Another methodological concern that she raises regards the data used as explanatory variables to measure environmental change, which often do not match perfectly the timing of migration.

Moreover, most household surveys so far have focused on "sending areas", while information on the perceptions of people that have already migrated are broadly lacking. Existing literature is thus mainly discussing the inclination to migrate rather than the determinants of the decision to migration. Another concern associated to the household surveys approach to assess the relationship between climate and environmental change, perceptions and migration relates to the fact that the migration behavior of some members of a household may not reflect those of the entire household. For instance, the decision making process of a household that decides to send one person to a different location may be different from the one of a household that decides to migrate all together.

In order to fill these gaps in the literature, the author has designed a survey to be conducted on migrants already travelling along the Western Mediterranean route with the aim of assessing the role played by climate and environmental conditions on the decision to migrate (ex post). The primary purposes of the survey were to (1) assess the main factors that determined the decision to leave the community of origin, including socioeconomic, security and climatic conditions ; (2) identify recurrent patterns across different categories of respondents, with particular regard to gender, area of origin (rural/urban, Sahelian/non-Sahelian countries), and education.

The Western Mediterranean route is one of the trans-Saharan routes used by African migrants that are trying to reach Europe through irregular channels. For a decade, cooperation between Spain and Morocco has kept the number of migrants who use this route comparatively low. However, in the first six months of 2017, there has been a steady increase in irregular migration from the African continent, especially from West Africa. According to Frontex (2017), the number of irregular border crossings detected in the Western Mediterranean almost tripled compared with the same period last year, reaching the highest migrations flow on this route since 2009. As shown in Figure 2, West Africans reach Morocco via coastline or through the Sahara.

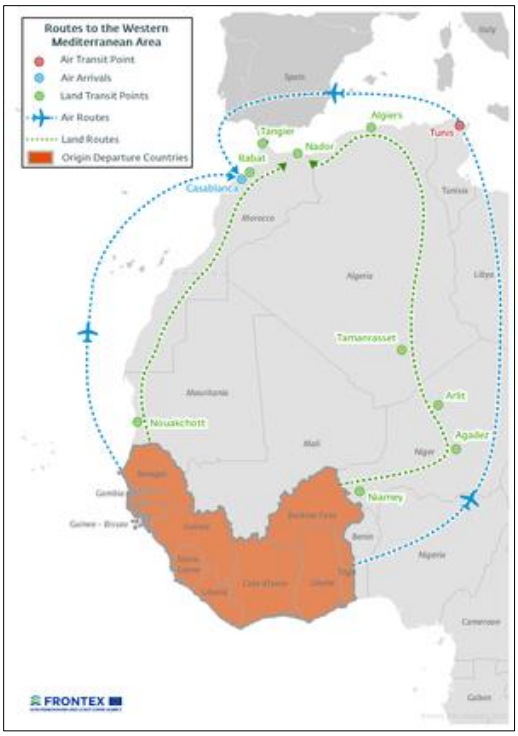


Figure 2: Routes to the Western Mediterranean Area
(source: Frontex, 02/08/2017)

West Africa Sahel is one of the poorest and most environmentally degraded regions in the continent, and is considered one of the world's most vulnerable regions to climate change, as temperature increases are projected to be 1.5 times higher than in the rest of the world (IPCC 2007). In this region, climate vulnerability is exacerbated by the high dependence on rain fed agriculture, rapid population growth, and chronic humanitarian crises due to recurrent drought, flooding, food insecurity, epidemics, and violent conflict. In such a context, forced migration and displacement are major concerns, yet the empirical evidence on the impacts of climate and environmental change on migration remains limited.

While designing the survey, the author was conscious that very few studies had distinguished internal from international migration while assessing the effects of climatic and environmental changes. In a study on Ecuador, Gray (2009) analyzed the different outcomes in terms of local, internal and international migration by studying the responses to mean annual rainfall and harvest fluctuations. He found that international migration is the least influenced by environmental events, but also that land ownership increased the probability of migrating abroad. Based on these findings, the author has decided to investigate anyway the impacts of environmental and climatic factors on international migration, including some questions on land tenure. Studying migration responses to warming trends across 115 countries, Cattaneo and Peri (2017) found that in middle-income economies higher temperatures increased migration rates to urban areas and to other countries. These results of both studies confirm the hypothesis of wealth being important in financing long-distance migration (Millock 2015).

4.1 Survey implementation and questionnaire

The survey was conducted in August 2017 in five Moroccan cities (Agadir, Casablanca, Fes, Rabat and Tangier) through the collaboration with the Institute for Scientific Research of the Rabat University. The field research team included six people (two men and four women): four Moroccan PhD students and two migrants from Cameroun working in Morocco.

Geographic areas	Questionnaires	
Centre (city of Fez)		200
Nord (Tangier and surroundings)		200
Atlantic coast (Rabat and Casablanca)	Rabat : 200 + Casablanca : 203	403
South (Agadir and surroundings)		200
Total		**1.003**

Table 1: Sample collection by city

The team conducted 200 individual interviews with migrants in each city, with the total sample of 1003. Surveyed migrants were identified through simple random sampling. The only criteria considered for the interview was to be a "sub-Saharan migrant in Morocco", independently from gender, age and migration history.

The same survey questionnaire was implemented in each of the five cities. The survey conducted has two main limitations: (i) the different methods used to collect the data, due to the fact that the survey team members operated in different cities and, in some cases, the data were obtained through face-to-face interviews, while, in others, migrants have been requested to fill the form by themselves; (ii) the questionnaire did not foresee questions on the duration of the stay in Morocco, as a results it was not possible to identify specific environmental events in the countries of origin that might have influenced the decision to leave.

The questions were designed using of a number of previous surveys conducted on the migration-environment nexus (Warner and Afifi 2014, The World Bank 2014, IOM 2016). However, since those field researches targeted households in migration-prone areas –and not migrants directly – and aimed at assessing aspects beyond the motivation to migrate, such as coping mechanisms and adaptation strategies, most of the questions have been substantially revised.

The survey questionnaire was conceived to gauge quantifiable trends on the importance of climate and environmental change against other key determinants. Therefore, the questions proposed consider some of the major concerns of the West African region, such as employment conditions, the security challenges and environmental hazards. Most of the questions are formulated in a way to be, to some extents, connected to impacts of climate change and natural resource degradation.

The questionnaire includes 4 sections, with the first one designed to gather background information on the respondent, including composition of household. Session a. (12 questions) requests information on key characteristics of migrants, including age, sex, type of origin location (rural or urban), marital status, household size and previous out-migration of household

members. Each of these factors may be reciprocally associated with migration and useful when attempting to capture the key push and pull factors, for example pressure to leave by the household (push factor) or familiar network abroad (pull factor).

Section b. (8 questions) aims at collecting data on the level of education achieved and employment status before departure. A couple of questions on the sector of employment were also intended to understand if the respondent was working on natural-resource based sectors and if they owned the land, in case they worked in agriculture.

Session c. (8 questions) looks at the possible security threats that could have pushed migrants away from their community, for instance war, political instability, conflicts between ethnic groups, competition over the use of natural resources, terrorism/extremist groups. Two questions also investigate if the eventual conflicts witnessed were related to natural resource depletion, such as tensions among pastoralists and farmers for access to land and water.

Session d. focuses on migrants' perceptions of extreme weather events and the impact of adverse events on their livelihood. First, migrants are asked if they have noticed any changes in the last dry and rainy season, with the potential changes identified in the questionnaire including more erratic rainfall, less or more rain, more frequent droughts, floods, or sandstorms, among others. Next, migrants are asked if they witnessed changes in their environment—these would include livestock losses, crop failures, less fertile land, and so on, and if this affected them directly. Each session ends asking if the issues discussed contributed to the decision to migrate. A final question summarizes all the factors addressed in the previous questions and asks the main reason for leaving and requests to quantify the weight of each factor: lack of employment, insecurity, uncultivable land and environmental events and family network/pressure.

An important caveat regards formulation of the questions on climate change perception. As recognized by The World Bank (2011), it is much easier to assess perceptions of recent climate patterns, such as last rainy or dry season, and weather shocks rather inquire directly than climate change. As a matter of fact, climate change is difficult to be observed by non-experts, as it relates to the distribution of variables, such as temperature and rainfall, over a long period of time (30 years at least). The implication is that the results of the survey do not provide clear new evidence on the direct relationship between climate change and migration *per se*, but the results that contribute to the evidence on the impact of perceptions of recent climate change and weather shocks on migration. Moreover, considering that previous evidence already proved the complexity of perceiving environmental change as a primary cause of migration, the questionnaire also explicitly inquire about potential losses and damages that might have captured the attention of the interviewees. The questionnaire is included in Appendix A.

4.2. From method to results

The field research produced 1003 randomly surveyed questionnaires collected at Agadir, Casablanca, Fes, Rabat and Tangier – the main cities along the Western Mediterranean route in

Morocco through which migrants usually transit or where they become stranded in their way to Europe.

4.2.1 Characteristics of the sample

Most of the interviewees comes from urban areas (71.5 per cent) and belong to 23 different nationalities, mostly from francophone Africa, with 80 per cent coming from Ivory Coast, Mali, Cameroon, Senegal and Guinea Conakry. Some of the nationalities seemed to have changed in the last ten years. According to the last available survey conducted in 2007 (De Bel-Air 2016), Nigerians were the best represented nationality (16 per cent), followed by migrants from Mali and Senegal (13 per cent each), from Congo (10 per cent), the Ivory Coast (9 per cent), Cameroon (7 per cent), and Guinea and Gambia with 5 per cent each. The change of the nationalities might be due to the new political situation in Libya that greatly increased the number of migrants in the Central Mediterranean route, where most of the Nigerians and Gambians can now be found (Frontex, 2017).

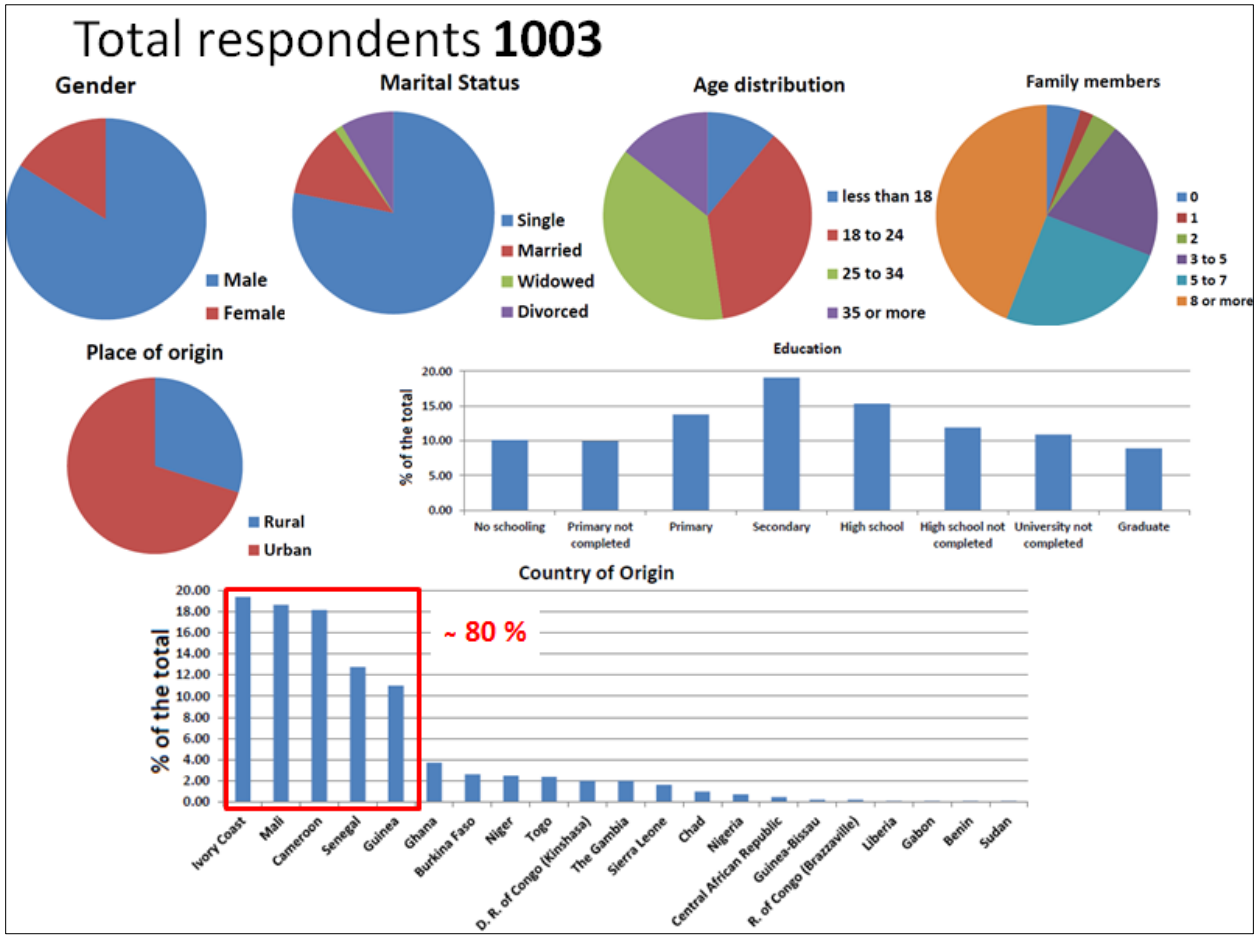


Figure 3: General characteristics of the sample

As shown in Figure 3, the great majority of the respondents are male (84 per cent), single (78.2 per cent) and aged between 18 and 34 years (74.7 per cent: 36.7 per cent are aged between 18 and 24; 38 per cent between 25 and 34). These results are very similar to those reported by the 2007 survey (80 per cent males; 66 per cent in the age group 25-34, 82 per cent unmarried).

The educational profile of the respondent is quite diverse: only 10 per cent never went to school, 10 per cent did not finish the primary school. From a gender point of view, the number of girls that didn't finish the primary school is higher that the number of boys (16.3 per cent versus 11.2 per cent). 20 per cent attended the secondary school and more than 15 per cent finished the high school. Finally, 20 per cent attended the university, of which only 8.9 per cent obtained a diploma. Compared to the previous survey, the educational profile of the migrants increased in the last 10 years. In 2007 the illiterates made up one-third of the survey sample and only 16 per cent were university graduates. The relatively high number of people with a secondary education can be interpreted as a sign of the "brain-drain" phenomenon that is severely affecting the African continent. This result also confirms Moretti's theory (2012), according to which the trends are changing and, contrarily to earlier periods, the people that migrate are increasingly the more educated.

A certain number of migrants came from large households: 44 per cent has 8 or more family members, 25 per cent from 5 to 7 members and 20.3 per cent from 3 to 5.

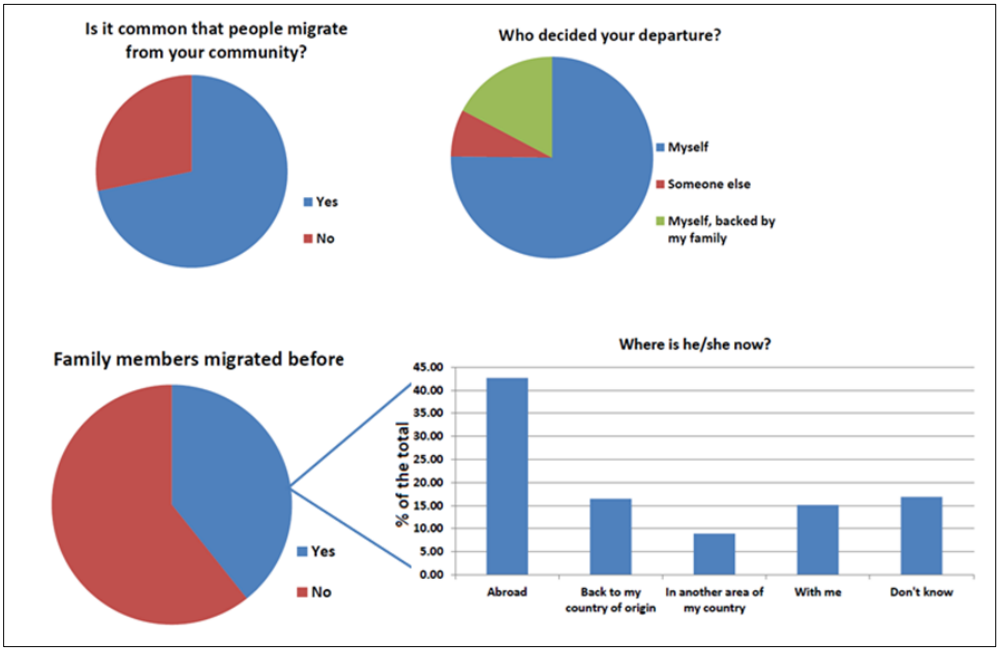


Figure 4: Household migration history

Although 71.5 per cent responded that migration is a common practice in their community, only 39.5 per cent of the respondents had a family member that migrated before them. Among these, 42.5 per cent went abroad, 16.5 per cent returned to their country of origin, 9 per cent migrated

to another area of the country, 15 per cent are travelling with one of their family members and 17 per cent do not have information about the relative that migrated before them (Figure 4).

The pie chart in Figure 4 (right hand side) also shows that, for the three quarter of the migrants interviewed in the survey, the decision to migrate was a personal decision, not influenced by others, while for 17 per cent was a choice supported by the family and only in 8 per cent of the cases was a decision made by of someone else.

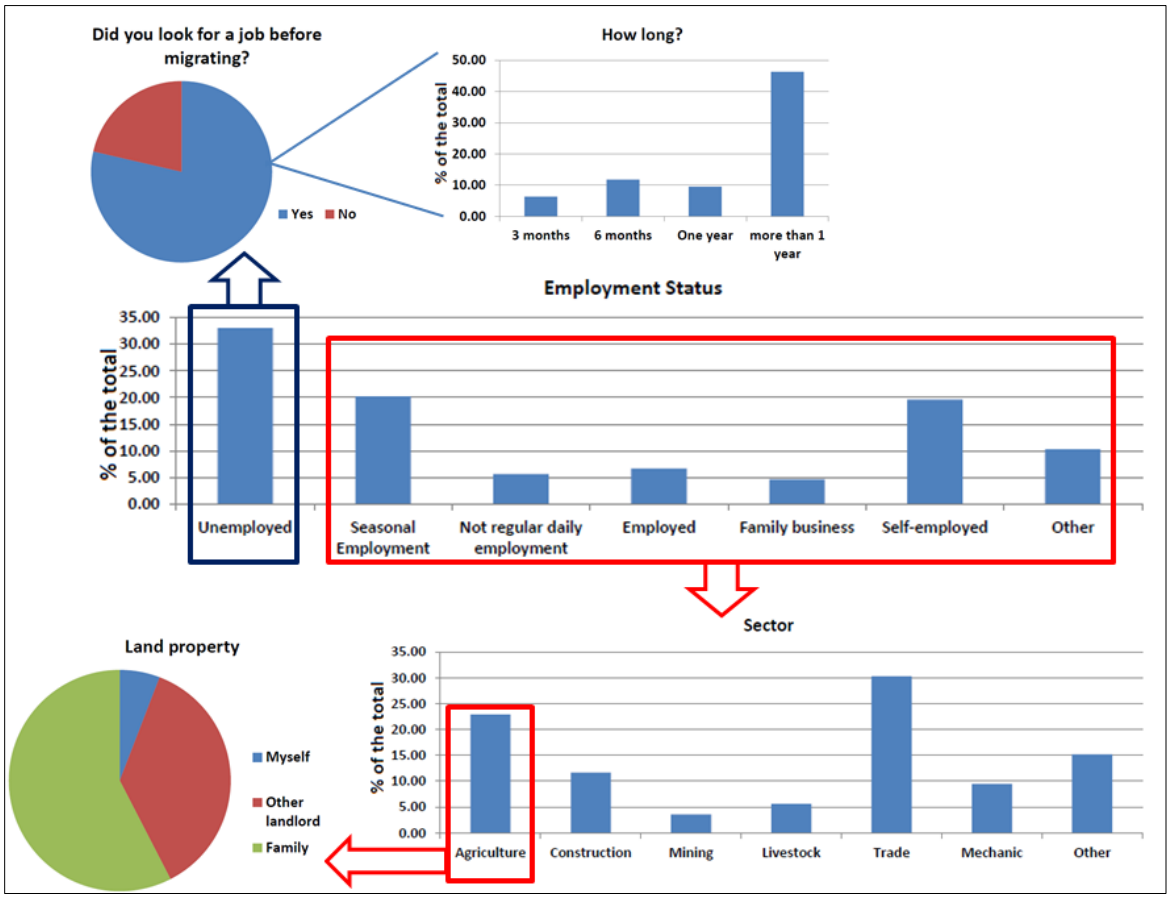


Figure 5: Employment conditions

One third of the respondents declared to be unemployed at the moment of the departure: among the 63.5 per cent those looking for a job before migrating, 46.4 per cent have been searching for employment for over a year. Among the other two thirds who were employed, more than 20 per cent had a seasonal job and 19.6 per cent were self-employed, 5.7 per cent were employed, but not on a regular basis and 4.6 per cent we working in the family business. 30.3 per cent were engaged in commerce 22.9 per cent – in agriculture and 11.7 per cent in construction.

Among those working in agriculture, the vast majority did not own the land: for 26.1 per cent of the respondents the land was owned by the family and for 16.6 per cent by other landlords. As more than half of the interviewees (54.6 per cent) did not answer to the question on land tenure,

the data collected did not allow confirming the findings of Gray (2009) on the increased probability of international migration due to land ownership.

4.2.2. Reasons to migrate

Not surprisingly, the lack of opportunities is considered as a key determinant of decision making to migrate by more than 80 percent of the respondents, as illustrated in Figure 6.

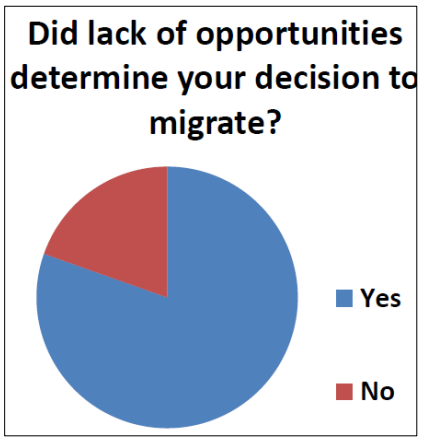


Figure 6: Importance of employment opportunities

Safety is also an important determinant in the decision. As illustrated by Figure 7 and in line with the perception of unsafety in the community mentioned in previous questions, 55.5 per cent of the interviewed confirmed that safety conditions determined their decision to migrate.

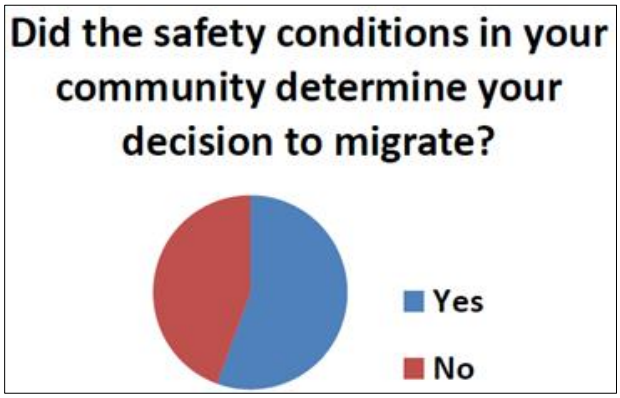


Figure 7: Importance of safety conditions

Figure 8 shows that 61.6 per cent of respondents answered that they felt unsafe in their community. Among those, the main perceived source of unsafety were political instability (30.5 per cent), war (24.5 per cent), ethnic conflicts (20.10 per cent), terrorism or extremism (14.5 per cent), conflict over natural resources (4.6 per cent) and other threats (5.8 per cent).

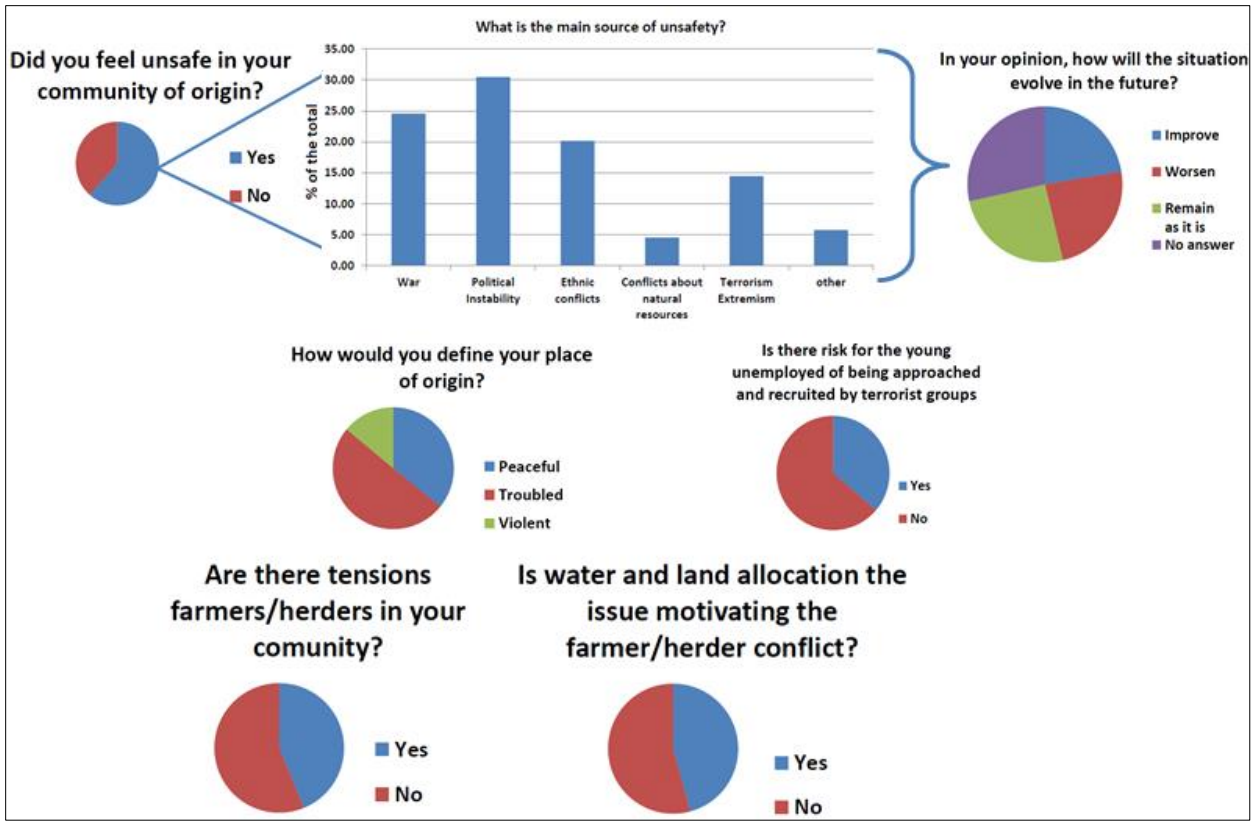


Figure 8: Perception of the security conditions

More than half of the respondents choose to define their place of origin as "troubled," while more than one third considers it "peaceful" and only 14 per cent would describe it as a "place of violence." The perception of the permanence of the situation was not uniform: 25.2 per cent responded that the situation will not escalate, 23.9 per cent are convinced that it will worsen, while 22.4 per cent were confident that it will improve. Interestingly, despite the small percentage of the interviewees recognizing conflict over natural resources as the reason for unsafety, 43.8 per cent of respondents answered that their community experienced conflicts between farmers and herders and 45.8 per cent of the respondents stated that water and land allocations are at the source of these tensions.

Although lack of employment opportunity is largely the main driver of the decision to migrate (74.4 per cent), followed by security concerns (30 per cent), climate and environmental problems play a significant role: for 9.1 per cent of the migrants, natural hazards are the main reason for leaving, and for 18.1 per cent, they played an important role. Regarding the loss of land productivity the evidence is weaker, but equally non-negligible: 6 per cent of the respondents recognized that they are the main determinant of their migration choice, and for 10 per cent of them, it has contributed a lot (Figure 9). The difference between the two factors can be explained by the fact that the effects incremental environmental changes - such as land degradation- on migration are generally more difficult to isolate from other drivers, especially the socioeconomic

ones. Furthermore, these results are consistent with the chart on rural-urban origins in Figure 3 that shows that only 29 per cent of the respondents come from rural areas.

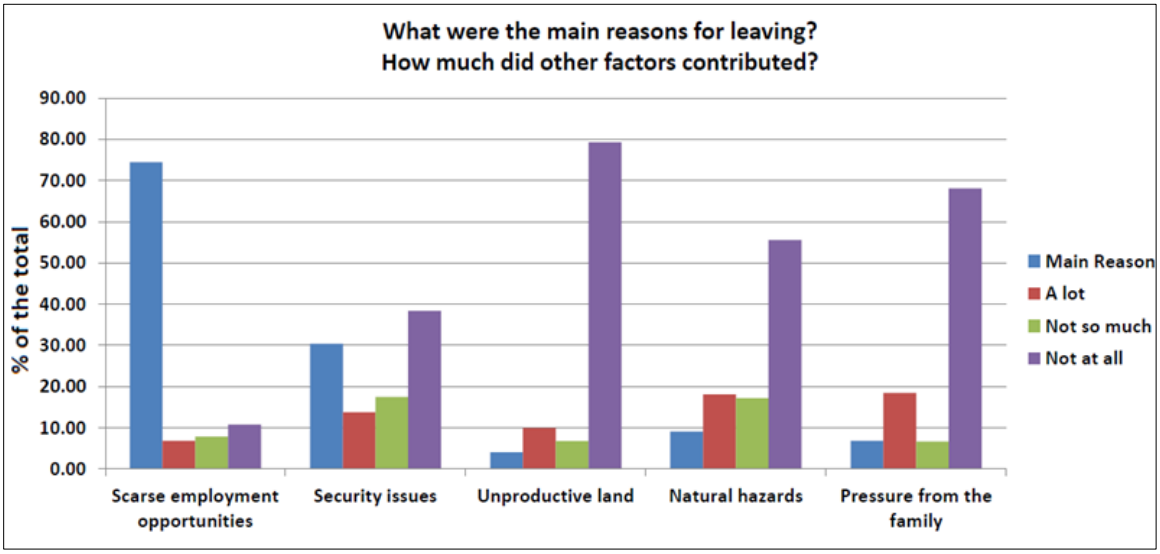


Figure 9: Main determinant on the decision to migrate

4.2.3 Relevance of climatic factors on migration

The last part of the survey inquired the migrants on specific events and phenomena that affected their lives before departure. Figure 10 shows that 38.3 per cent of interviewees were hit by extreme meteorological events, such as heavy rainfall and flash flooding or inundation. These extreme events have had severe impacts on a relatively high number of interviewees, which might have contributed to their decision to migrate: 23.8 per cent lost their jobs, the family of 17.2 per cent lost part of the crop, 13.1 per cent had to send a family member to seek employment elsewhere and 12.8 per cent had to sell possessions or livestock.

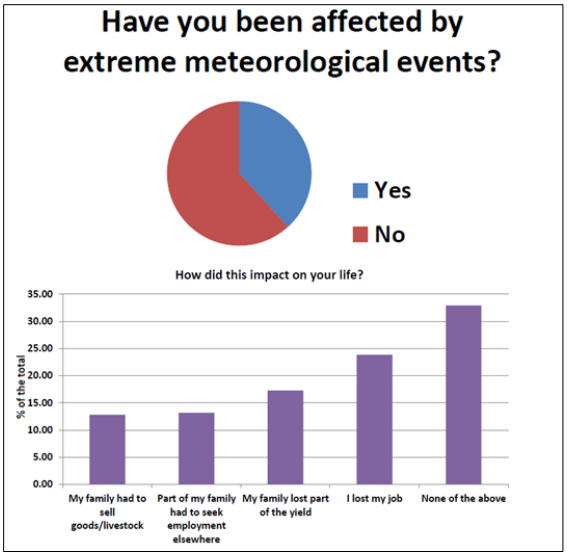


Figure 10: Influence of extreme meteorological events

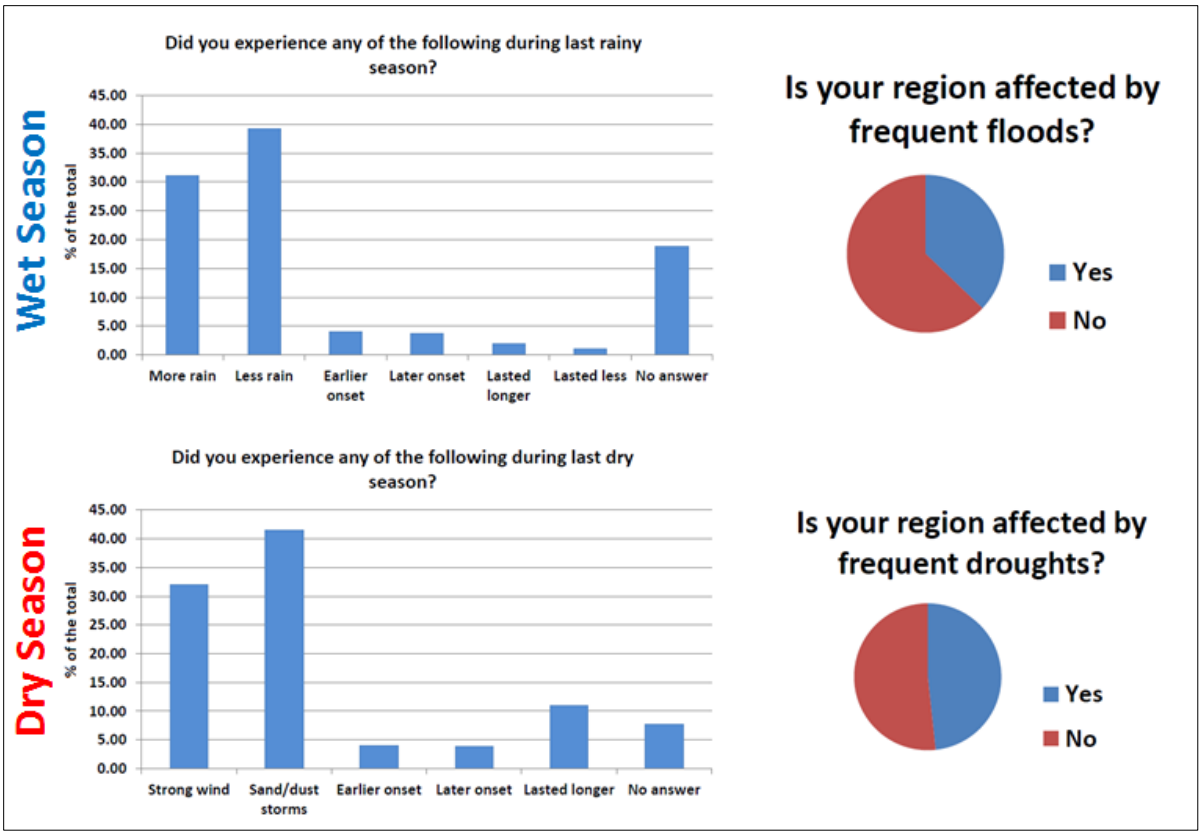


Figure 11: Perception of the role of environmental events

Changes in climate patterns have also been perceived by a significant number of migrants: during the last rainy season, 39.1 per cent of the respondents have noticed a decrease of rains, while during the last dry season, 41.4 per cent of the respondents said to have experienced sand and dust storms and 32 per cent experienced strong winds (Figure 11). The chart on the right-hand shows that almost half of the respondent came from a drought prone area (48.1 per cent), while those coming from an areas exposed to floods are 37.1 per cent.

A noteworthy percentage of the migrants declared that they have witnessed the following negative impacts of natural disasters, as illustrated in Figure 12: 23.4 per cent observed diminishing crops due to drought, 20.4 per cent noticed declining river flow or lake level and 18.3 per cent remarked on livestock losses. Others have witnessed damages to houses (18.6 per cent) or loss of crops (15.1 per cent) due to floods. While most of interviewees have stated that they observed the natural phenomena, 41.4 per cent of the interviewees declared that they had been affected directly. Among these, 29.9 per cent suffered crop loss due to drought, 23.2 per cent lost livestock, while more than one third were affected by floods that damaged their houses (20.6 per cent) or crops (16.1 per cent).

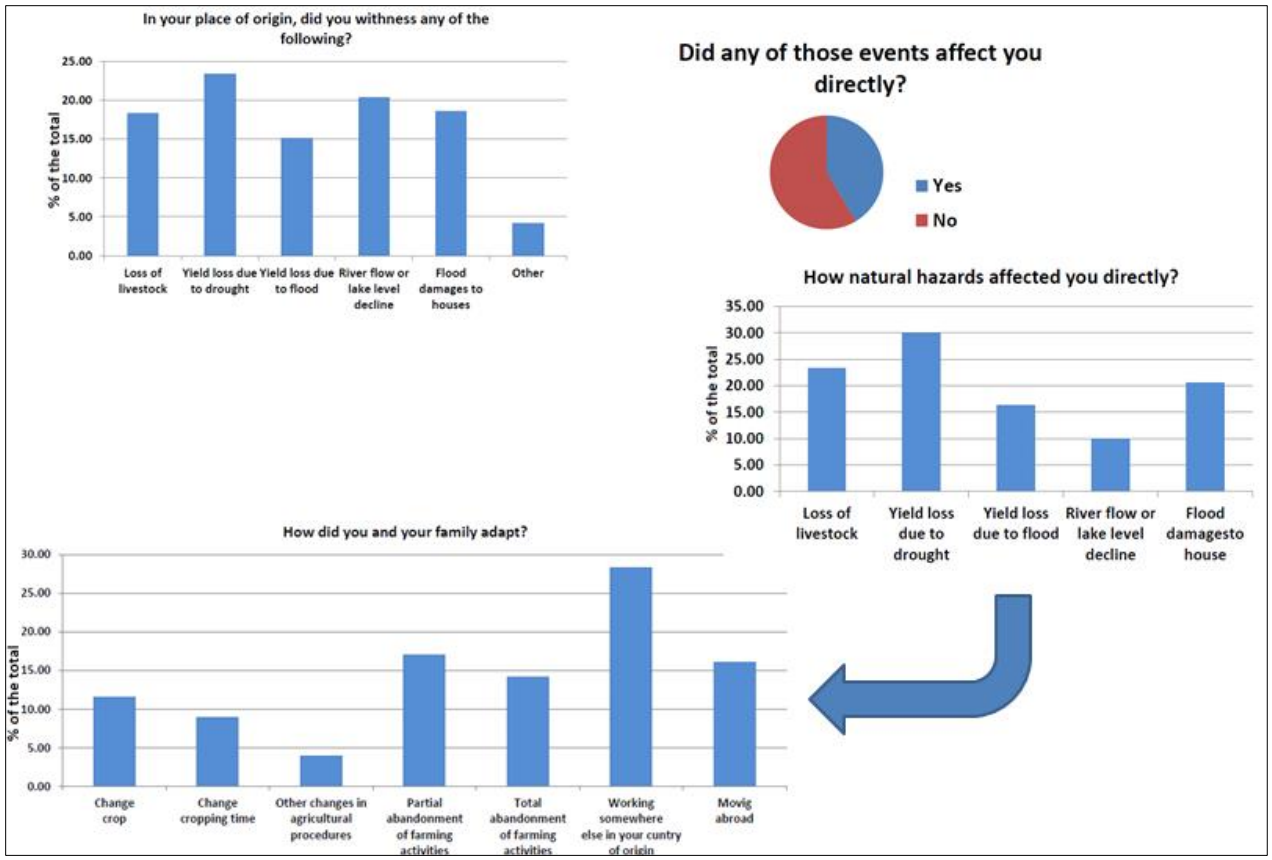


Figure 12: Impacts of natural hazards and adaptation

When asked how the family coped with these changes, 28.3 per cent of the respondents answered that they went to work in another part of their country, 17 per cent answered that they had to partially abandon the farming activities while 14.1 per cent were forced to give up farming altogether, 16 per cent moved abroad, 11.5 per cent switched to different crops and 8.9 per cent adjusted the schedule of their agricultural practices (Figure 12).

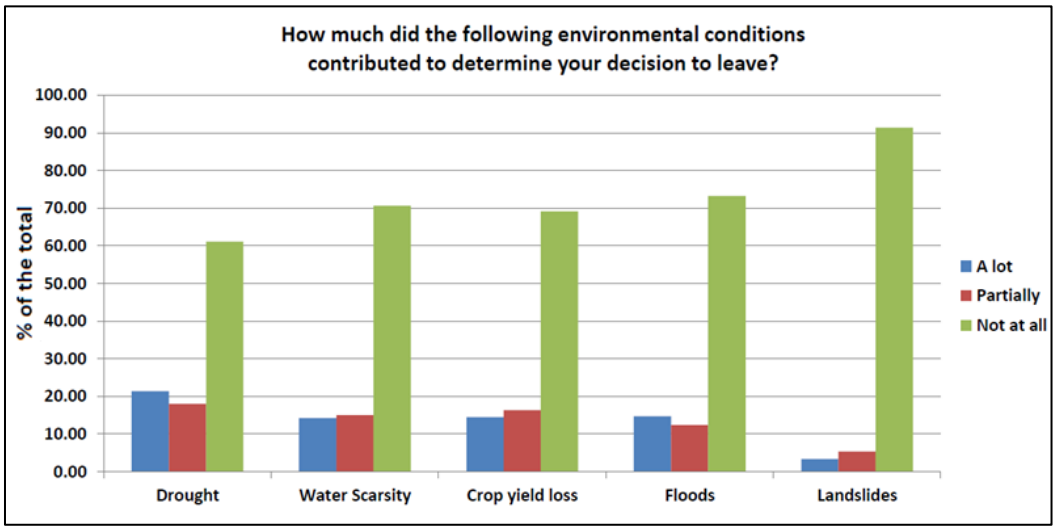


Figure 13: Role of the environmental change in the decision to migrate

Figure 13 shows that a remarkable number of respondents mentioned that different aspects of the environmental change played a major role in the decision to migrate:

- drought is considered very important for 21.4 per cent of the respondent and part of the reason to leave for 18 percent;
- water scarcity was a crucial driver for 14.2 per cent of the migrants and a partial determinant for 15 percent of them;
- declining agricultural productivity was a key cause for 14.5 percent and a part of the problem that induced migration for 16 percent of the respondents;
- floods was mentioned by 14.7 percent of the migrants as a major factor and by 12.3 percent as a partial one;
- landslides was the least influencing factor, with only 3.4 percent of the respondents considering it very relevant and 5.3 percent partially relevant.

4.2.3 Study of the statistically significant diversity

In order to determine whether there was a statistically significant difference in the perception of the climatic and environmental variables due to certain characteristics of migrants, the author recurred to used chi-squared tests. These tests enabled to compare observed and expected frequencies of those answers indicating the crucial role of the climatic and environmental drivers with the origin, age, education and gender variables and establish whether these variables were "different enough" to be considered statistically significant.

The first set of tests considered the numbers of respondents to the question “How much did the following environmental conditions contributed to determine your decision to migrate?” that indicated “drought” (a lot/partially/not at all) and compared them with the following variables

a) origin: rural or urban
b) age: <18, 18-24, 25-34, 35+
c) education: primary school, secondary school, high school but not diploma, college but not degree, graduate
d) gender: male/female
e) country of origin: Sahelian (Burkina Faso, Chad, Mali, Senegal) and non-Sahelian (others)

The statistical tests revealed that there are no significant differences related to age and education, while the origin and gender variables resulted statistically significant in determining the perception of climatic and environmental change, as follows:

- the migrants from *rural areas* that considered that drought has contributed “a lot” to their decision are 37 per cent;

- the migrants from *urban areas* that considered that drought has contributed "a lot" to their decision to migrate are 16.6 per cent;
- the *women* that considered that drought has contributed "a lot" to their decision to migrate are 33.6 per cent;
- the migrants coming from *Sahelian countries* that considered that drought has contributed "a lot" to their decision are 34.4 per cent;
- the migrants coming from *non- Sahelian countries* that considered that drought has contributed "a lot" to their decision are 17.6 per cent;
- the migrants coming from *Sahelian* countries that considered that drought has contributed "*not at all*" to their decision are 40.43%;
- the migrants coming from *non-Sahelian* countries that considered that drought has contributed "*not at all*" to their decision are 66.61%.

Based on the first results, the second set of tests further analyzed the numbers of respondents that indicated "environmental difficulties" to the question "What was your main reason for leaving?" and compared them with the a) origin: rural or urban, and b) gender: male or female

A significant frequency in the responses was found for:

- the migrants coming from *rural areas* that considered environmental difficulties as the *main reason* for leaving (21.6 per cent);
- the migrants coming from *rural areas* that considered that environmental difficulties did *not contributed at all* to their decision to leave (38.6 per cent);
- *women* that considered that environmental difficulties influenced *a lot* their decision to leave (26.7 per cent).

The outcomes of the statistical tests revel that climatic and environmental changes are mostly perceived by women as an important factor driving the decision to migrate. As expected, the Sahelian migrants also feel affected by drought and environmental difficulties. Although significant results emerged also by the answers of other non-Sahelian migrants, the percentage of Sahelians declaring to be highly affected by the impacts of climate change was higher. The high percentage of those Sahelians and non-Sahelians that declared that drought is not relevant "at all" in their decision to migrate is to be expected, considering the high number of respondents coming from urban areas.

The most controversial aspect emerged by the tests seems to be the diversity of the answered of migrants with rural origins. As a matter of facts, in the first set of tests more than one third of the migrants with rural origins indicated that the increased drought frequency was a crucial factor determining their decision to migrate. This data was confirmed by the second set of tests identifying a significant number of rural migrants (21.6 per cent) considering environmental difficulties as the main cause of migration. These results are however balanced by another significant number of rural migrants (38.6 per cent) responding that environmental changes had no influence at all.

Literature on the subject confirms and provides some answers for this behavior, as discussed in the next session.

5. Discussion

With over 70 per cent males, single and aged between 18 and 34 years old, the characteristics of the sample reflects the main profile of the migrants on the trans-Saharan migration routes. A difference between the migration flow compositions of the Central Mediterranean route and the sample collected on the Western Mediterranean route (across Gao in Mali - Agadez in Niger - Tamanrasset in Algeria or Tripoli in Lybia) is that the migrants interviewed in Morocco declared to come from urban areas, while IOM Niger registers mainly youths with a rural background (IOM Niger 2014 and 2017).

Against these results, it is interesting to note that, although the great majority of the respondents to the survey conducted in Morocco are from urban centers, the number of migrants that mentioned environmental events as a factor that influences their migration decision is relatively high. A similar result was obtained by Veronis and McLeman (2014) that conducted a research on the causes of migration from several sub-Saharan African countries to Canada. They found that urban migrants have described environmental change as being a secondary factor influencing their decision to migrate because their countries of origin experienced persistent deforestation, land degradation, and consequent internal migration.

Unfortunately, the questions on the origin of the migrants in the survey did not allow understanding some important aspects of the past migration experience, such as whether the region of origin coincide with the region of birth. This partly could explain why there is a significant diversity on the important role of environment and climate change was also found in the answers of the migrants coming urban areas. Evidence exists that environmental migrants generally move first from rural to urban areas and, only if this attempt is not successful, they move abroad (Ionesco et al, 2017). As a consequence of this omission in the questionnaire, the declared origin of migrants maintains a certain degree of ambiguity with particular regard to the rural or urban provenance, confirmed by the results of chi-squared tests.

Literature also confirms that, in some cases, rural migrants do not feel affected by environmental changes. Cattaneo and Masetti (2015) found that in Nigeria and Ghana climate has no significant impact on the propensity to migrate in non-farm households.

In general, there is a growing consensus in the literature on the fact that the role of environmental and climatic factors is smaller than the effects of socioeconomic variables (Black 2011; Foresight 201; Carr 2005). It has also to be considered that the nexus climate/environment and migration is more difficult to perceive when the changes are slow, such as land degradation. These types of changes are less easy to isolate from other socioeconomic factors, such as increased poverty or lack of livelihood means. This difficulty was already present since the first studies as witnessed by a survey done in 1939 for the US government on migrants arrived in California from the Great Plains, a drought-stricken area (Holzchuh 1939). Most of the

interviewees answered that they migrated because they were looking for employment, despite the fact that they were coming from areas where drought had been taking place and although they had been labelled as 'drought refugees' in the government statistics (Rowell 1936).

The same issue was remarked in a more recent study Ginnetti and Franck (2014) that created a systems dynamic model to identify conditions under which East African pastoralists were likely to be displaced by droughts. In conducting their study, the authors researched on the number of people typically displaced in past events and they found that in UNHCR statistics of millions of Somalis displaced between 2009-2012, less than 1% cited environmental reasons for moving despite they had to face severe drought conditions.

The fact that the great majority of respondents indicated lack of job opportunities as the main reason determining their decision confirm the evidence that most environment degradation-associated migration occurs not under conditions of absolute distress, but of diversification. As the migrants interviewed correspond to the most common profile in the Sahel (coming from countries experiencing severe climate and environmental issues, belonging to large households, irregularly employed or unemployed), it is a common practice that households try to generate new income sources and reduce their exposure to environmental and non-environmental risks and hazards (Abdelali-Martini and Hamza 2014, McLeman 2014, Foresight 2011, Scheffran et al 2012).

According to the results of the survey conducted by Henry et al (2003), when migrants come from regions, like the Sahel, where land degradation is high and/or where precipitation is especially variable, these and other environmental factors determine the migration decision process; whereas when migrants come from areas where such factors are not quite so acute, economic considerations determine migration decisions.

Summing the answers of those mentioning environmental factors as (central or partial) determinants to the decision of migrate, the total achieves 30 percent of the respondents in most of the cases, with women and people from Sahelian and rural origins declaring that the importance of the environmental factors are as key drivers of their decision to migrate. This information is crucial to understand under which circumstances environmental factors dominate the migration decision.

The results on the women's major sensitiveness to climatic and environmental changes confirm the data reported by IOM (2014). According to their experiences, unequal gender distribution of roles and responsibilities and unequal access to resources may make women more vulnerable than men to the impacts of climate change. In developing countries, women are more exposed to natural resource depletion because they they tend to be poorer and less educated than men and thus face social, economic, and political barriers that limit their coping and adaptive capacities.

6. Conclusions

The goal of this paper was to contribute to a better understanding of migrants' perceptions of climate change and environmental degradation, as well as extreme weather events and their impact on the decision to migrate. The main finding confirm that, although a range of other factors are at play and the great majority of migrants left their community of origin in West Africa because of the scarce employment opportunities, environmental and climatic factors do play a role in driving migration. The empirical research conducted in Morocco suggests that a significant number of migrants do perceive changes in climate and environment, particularly women, migrants with rural origins and people coming from Sahelian countries. The most detected environmental changes that influenced their decision relates to the increased frequency of drought and to the losses related to extreme weather events.

From the findings of this paper, some suggestions and potential considerations for policy- and decision-makers might be made. A first important one concerns the need for further research and more policy consideration about the linkages between land degradation and migration. Although this paper has highlighted the rapid development in scientific understanding of this phenomenon in recent years, many gaps in knowledge still exist, particularly on the migration consequences of longer term climatic and environmental changes. To do this, a wider and more diverse set of empirical evidence is needed as most of the existing studies come from a small number of relatively well-studied locations and in many cases this is simply because there is data available for these locations.

References

Abdelali-Martini, M. & Hamza, R., 2014. How do migration remittances affect rural livelihoods in drylands? Journal of International Development, 26(4), pp.454–470

Afifi, T., 2011. Economic or environmental migration? The push factors in Niger, Int. Migrat., 49, pp. 95–124

Barbier, B. et al., 2009. Human Vulnerability to Climate Variability in the Sahel: Farmers' Adaptation Strategies in Northern Burkina Faso. Environmental Management, 43(5), pp.790–803

Bardsley, D. K. and Hugo, G. J., 2010. Migration and climate change: examining thresholds of change to guide effective adaptation decision-making, Populat. Environ., 32, pp. 238–262

Bettini, G., 2013. Climate barbarians at the gate? A critique of apocalyptic narratives on 'climate refugees', Geoforum, 45, pp. 63–72

Black, R., 2011. Climate change: Migration as adaptation. Nature, 478, pp.447–449

Boeri, T., 2009. Immigration to the Land of Redistribution. LEQS Paper No. 5. Available at SSRN: https://ssrn.com/abstract=1550909 or http://dx.doi.org/10.2139/ssrn.1550909

Bohra-Mishraa,P., Oppenheimera, M. & Solomon M.H, 2014. Nonlinear permanent migration response to climatic variations but minimal response to disasters. PNAS 2014 111 (27) 9780-9785

Borjas, G., 1987. Self-Selection and the Earnings of Immigrants. The American Economic Review, Vol. 77, No. 4 (Sep., 1987), pp. 531-553

Burton, I., 1997. Vulnerability and adaptive response in the context of climate and climate change. Climatic Change, 36(1-2), pp.185–196

Burton, I., Kates, R.W. & White, G.F., 1978. The environment as hazard, New York: Guilford Press

Coniglio, N. D. & Pesce, G., 2015. Climate variability and international migration: an empirical analysis. Environment and Development Economics, Cambridge University Press, vol. 20(04), pp. 434-468

Card, D., 2009, Immigration and Inequality, NBER Working Paper No. 14683Card, D., Dustmann, C. and Preston, I., 2012. Immigration, Wages, and Compositional Amenities", Journal of European Economic Association. Volume 10, Issue 1

Cattaneo, C. and Bosetti, V., 2016. Climate-induced International Migration and Conflicts, MITP: Mitigation, Innovation and Transformation Pathways 249351, Foundation Eni Enrico Mattei (FEEM)

Cattaneo C. and Massetti E., 2015. Migration and Climate Change in Rural Africa. Working Papers 2015.29, Eni Enrico Mattei Foundation

Cattaneo, C. and Peri, J., 2016. The migration response to increasing temperatures, Journal of Development Economics, Elsevier, vol. 122 (C), pp 127-146

Carr, E. R., 2005. Placing the Environment in Migration Environment, Economy, and Power in Ghana's Central Region. Environment and Planning vol. 37 (5), pp. 925–46

De Bel-Air F., 2016. Migration Profile: Morocco. Migration Policy Centre Policy Brief. European University Institute

Di Falco, S., Yesuf, M.,, Kohlin G., Ringler, C., 2012. Estimating the impact of climate change on agriculture in low-income countries: household level evidence from the Nile Basin. Environ. Resour. Econ. 52(4), pp.457–78

Dillon, A., Mueller, V., Salau, S., 2011. Migratory responses to agricultural risk in northern Nigeria, American Journal of Agricultural Economics, vol. 93(4), pp 1048-1061

Diajic, S., 2014, Temporary Migration and the Flow of Savings to the Source Country, Review of Development Economics, vol. 18: 162-176

Djajic, S., Michael, M.S., Vinogradova, A., 2012, Migration of Skilled Workers: Policy Interaction between Host and Source Countries, Journal of Public Economics, vol. 96: 1015-1024

Dustmann, C., 2015, Migration. Economic change, social challenge, Oxford University Press

El-Hinnawi, E. 1985. Environmental Refugees. Nairobi, UNEP

Ehrlich, P.R. & Holdren, J.P., 1971. Impact of Population Growth. Science, 171(3977), pp.1212–1217

Foresight: Migration and Global Environmental Change, 2011. Final Project Report, London. Available at: http://www.bis.gov.uk/assets/bispartners/foresight/docs/migration/11-1116-migration-and-global-environmental-change.pdf

Frontex, 2017, http://frontex.europa.eu/feature-stories/focus-on-western-mediterreanean-route-frontex-in-spain-HxYm0E (last access : 24/09/2017)

Fussell, E., Hunter, L.M. & Gray, C., 2014. Measuring the Environmental Dimensions of Human Migration: The Demographer's Toolkit. Global Environmental Change, 28, pp.182–191

Gemenne, F., 2011. How They Became the Face of Climate Change: Research and policy interactions in the birth of the "environmental migration" concept. In E. Piguet, A. Pecoud, & P. de Guchteneire, eds. Migration, Environment and Climate Change. Cambridge: Cambridge University Press, pp. 225–259

Ginnetti, J. & Franck, T., 2014. Assessing drought displacement risk for Kenyan, Ethiopian and Somali Pastoralists, Geneva, Norwegian Refugee Council/Internal Displacement Monitoring Centre. Available at: http://www.internal-displacement.org/assets/publications/2014/201405-horn-of-africa-technical-report-en.pdf

Gonzalez, N., 1961. Family Organization in Five Types of Migratory Wage Labor. American Anthropologist, 63(6), pp.1264–1280

Gray, C., 2009. Environment, land, and rural out-migration in the southern Ecuadorian Andes. World Dev. 37(2), pp. 457–68

Gray, C. & Wise, E., 2016. Country-specific effects of climate variability on human migration. Climatic Change, 135(3), pp.555–568

Hampshire, K., 2002. Fulani on the move: Seasonal economic migration in the Sahel as a social process. The Journal of Development Studies, 38(5), pp.15–36

Hausmann, R. and Nedelkoska L., 2017. Welcome Home in a Crisis: Effects of Return Migration on the Non-migrants' Wages and Employment, Working Paper, Center for International Development, Harvard UniversityHenry, S., Boyle, P. & Lambin, E.F., 2003. Modelling inter-provincial migration in Burkina Faso, West Africa: the role of sociodemographic and environmental factors. Applied Geography, 23, pp.115–136

Henry, S. et al., 2004. Descriptive Analysis of the Individual Migratory Pathways According to Environmental Typologies. Population and Environment, 25(5), pp.397–422

Holzschuh, A., 1939. A study of 6655 migrant households receiving emergency grants

Homer-Dixon, T., 1991. On the threshold: Environmental changes as causes of acute conflict. International Security, 16(2), pp.76–116

Huntington, E., 1924. Civilization and climate 3rd ed., New Haven: Yale University Press

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate change: Impacts, Adaptation and Vulnerability, Cambridge University Press, Cambridge, UK

IOM (International Organisation for Migration), 2009. Migration, Environment and Climate Change: Assessing the Evidence. Geneva

IOM, 2014. Migration Environment and Climate Change Outlook, Gender brief 13. Geneva

IOM, 2016. Assessing the Climate Change-Migration Nexus through the Lens of Migrants. The case of the Republic of Mauritius. Geneva, MECLEP working papers

IOM Niger Apercu, Janvier 2017 www.globaldtm.info/fr/niger

IOM Niger, 2014. Sur la route des migrants au Niger Janvier-Septembre 2014. Profil des migrants des centres de transit de Dirkou et Arlit

Ionesco D., Mokhnacheva D., Gemenne, F., 2017. The Atlas of Environmental Migration. International Organization for Migration (IOM), Routledge

Jacobson, J., 1988. Environmental Refugees: A Yardstick of Habitability. WorldWatch Paper. Washington (DC): WorldWatch Institute

Lee, E., 1966. A theory of migration. Demography, 3(1), pp.47–57

Kniveton, D., Smith, C. & Wood, S., 2011. Agent-based model simulations of future changes in migration flows for Burkina Faso. Global Environmental Change, 21(S1), pp.S34–S40

McLeman, R. and Smit, B., 2006. Migration as an adaptation to climate change, Climatic Change, 76, pp. 31–53

McLeman, R.A., 2014. Climate and human migration: Past experiences, future challenges, Cambridge: Cambridge University Press

McTegart, W.J., Sheldon G.W., and Griffiths D.C., 1990. Impacts Assessment of Climate Change. Report of Working Group II. Edited by Intergovernmental Panel on Climate Change. Canberra: Australian Government Publishing Service

Mendelsohn, R. et al., 2007. Climate and Rural Income. Climatic Change, 81(1), pp.101-118

Milan, A., Gioli, G. & Afifi, T., 2015. Migration and global environmental change: methodological lessons from mountain areas of the global South, Earth Syst. Dynam., 6, pp. 375-388

Millock, K., 2015. Migration and Environment, Annual Review of Resource Economics 7, 35-60

Molloy, R., Smith, C.L. & Wozniak, A., 2011. Internal Migration in the United States. Journal of Economic Perspectives, 25(3), pp.173–196

Moretti, E., 2012. The New Geography of Jobs, Houghton Mifflin Harcourt (HMH)Nawrotzki, R.J., Riosmena, F. & Hunter, L.M., 2013. Do Rainfall Deficits Predict U.S.-Bound Migration from Rural Mexico? Evidence from the Mexican Census. Population Research and Policy Review, 32(1), pp.129–158

Neumann, K. & Hermans, F., 2015. What Drives Human Migration in Sahelian Countries? A Meta-analysis. Population, Space and Place

Ottaviano, G. I.P., Peri, G, and Wright G. C., 2016. Immigration, Trade and Productivity in Services: Evidence from UK Firms, CEP Discussion Paper No 1353

Piguet, E. 2010. Linking Climate Change, Environmental Degradation, and Migration: A Methodological Overview. Climate Change 1 (4), pp. 517–24.

Piguet, E., 2012.Migration: The drivers of human migration, Nat. Clim. Change, 2, pp. 400–401

Piguet, E., 2013. From "primitive migration" to "climate refugees": The curious fate of the natural environment in migration studies. Ann. Assoc. Am. Geogr., 103, pp. 148–162

Rabe, B. & Taylor, M.P., 2012. Differences in Opportunities? Wage, Employment and House-Price Effects on Migration. Oxford Bulletin of Economics and Statistics, 74(6), pp. 831–855

Rain, D., 1999. Eaters of the dry season: circular labor migration in the West African Sahel, Boulder, CO: Westview Press

Ravenstein, E.G., 1889. The Laws of Migration. Journal of the Royal Statistical Society, 52(2), pp.241–305

Roncoli C, Ingram, K., Kirshen, P., 2001. The costs and risks of coping with drought: livelihood impacts and farmers' responses in Burkina Faso. Clim. Res. 19:119–32

Rowell, E.J., 1936. Drought Refugee and Labor Migration to California in 1936. Monthly Labor Review, 43(6), pp.1355–1363

Scheffran, J., Marmer, E. & Sow, P., 2012. Migration as a contribution to resilience and innovation in climate adaptation: Social networks and co-development in Northwest Africa. Applied Geography, 33, pp.119–127

Scoones, I., 1998. Sustainable rural livelihoods: a framework for analysis. IDS Working paper no. 72, Brighton

Tacoli, C., 2009. Crisis or adaptation? Migration and climate change in a context of high mobility. Environment and Urbanization, 21(2), pp.513–525

The World Bank, 2014. Climate Change and Migration: Evidence from the Middle East and North Africa

United Nations Convention to Combat Desertification, 2017. Global Land Outlook.

United Nations, Department of Economic and Social Affairs, Population Division, 2015. World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP.241., New York. Available at: https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf.

Veronis, L. & McLeman, R., 2014. Environmental influences on African migration to Canada: Focus group findings from Ottawa-Gatineau. Population and Environment, 36(2), pp.234–251

Wahba, J., 2015. Who benefits from return migration to developing countries?, IZA World of Labor 2015: 123

Warner, K. & Afifi, T., 2014. Where the rain falls: Evidence from 8 countries on how vulnerable households use migration to manage the risk of rainfall variability and food insecurity. Climate and Development, 6(1), pp.1–17

Wrathall, D. J., 2012: Migration amidst social-ecological regime shift: The search for stability in Garifuna villages of northern Honduras, Human Ecol., 40, pp. 583–596

CONCLUSION

As a collection of articles on the nexus environment/climate-migration, this thesis does not have the ambition of covering review all the aspects related to this complex interaction. It rather aims at providing a modest contribution to overcome the fragmented approach that has impeded the development of comprehensive policies so far. By identifying a potential area where climate policies can support migration associated resilience strategies, the author intended to give an example of how operating "out of the silos" of the sectorial approach, more resources could be leveraged.

Overall, the policy debate on environmental migration is dominated by alarmist perspectives that have cemented the perception that migration due to environmental causes is a forced migration and risks to become a humanitarian disaster. By focusing on slow onset events, like land degradation in Africa, this elaboration has tried to shift the focus from the catastrophic events to the livelihood strategies that have characterized for century to copying strategies of millions of farmers and pastoralists in the Sahel.

The results of the survey conducted confirms that the adverse effects of climate change end environmental degradation are so intertwined with the lack of income opportunities that migrants themselves often are not able to distinguish environmental causes by economic ones. Assuming future migration responses to land degradation behave in ways comparable to those at present, it is reasonable to expect that there will be increased migration within and out of Africa as a result of climate change, in the absence of interventions to reduce and reverse land degradation.

In this perspective, the key question that migration policies have to start considering is when migration should be treated as a risk to be managed and mitigated, and when it should be treated as an opportunity to increase resilience and thus be facilitated or even encouraged. After all, enabling communities in sending areas to better leverage the potential benefits of migration and increase their adaptive capacity is often a better alternative than their progressive displacement. The effective economic insertion of migrants in other more productive location leads to opportunities for the sending communities, particularly thanks to the transfer of remittances. Without a facilitating environment though, remittances are too often turned into pure consumption and the accumulation of non-productive assets.

Appendix A

Root Causes of Migration

Survey

SECTION a: Family network	
1. Name of respondent*: *Respondent may remain anonymous. The respondent may create an alias and use it consistently	
2. Sex	☐ M ☐ F
3. Country and region of origin	
4. Which type of area are you coming from?	☐ Rural ☐ Urban ☐ Other _____
5. Age	☐ Under 18 ☐ 18 - 24 ☐ 25 – 35 ☐ Over 35
6. Age at departure	☐ Under 18 ☐ 18 – 24 ☐ 25 – 35 ☐ Over 35
7. Marital Status	☐ Single, never married ☐ Married ☐ Widowed ☐ Divorced ☐ Separated
8. Number of family members in your country of origin	
9. Have any other members of your family migrated before you?	☐ Yes ☐ No
10. If yes, where are they now?	☐ At home ☐ Abroad ☐ In another area of my country ☐ I don't know

SECTION a: Family network	
11. Who made the decision for you to leave?	☐ Me ☐ Someone else ☐ Me,but I was supported by others in my family
12. Is migration a common practice in your community of origin?	☐ Yes ☐ No

SECTION b: Education and employment	
1. Which level of education have you achieved?	☐ No schooling completed ☐ Primary School ☐ Secondary School ☐ High School ☐ High school but no diploma ☐ College but no degree ☐ Graduate
2. What was your employment status before leaving your country?	☐ Unemployed ☐ Seasonal employment ☐ Different sources of employment with irregular income ☐ Paid employment with regular income ☐ Family business (i.e farm or other) ☐ Self-employed ☐ Other, specify _____
3. In which sector where you employed?	☐ Agriculture ☐ Livestock ☐ Construction ☐ Retail ☐ Mining ☐ Other, specify_____
4. If you worked in agriculture, who own land?	☐ Yes ☐ No
5. If no, who owned the land?	☐ Me ☐ My family ☐ Another landlord ☐ Not applicable

6. If you were unemployed, did you look for a job before leaving?	☐ Yes ☐ No ☐ Not applicable
7. If yes, for how long?	☐ 3 months ☐ 6 months ☐ 1 year ☐ More than 1 year ☐ Not applicable
8. Do you consider that the lack of employment opportunities has influenced your choice of leaving?	☐ Yes ☐ No

SECTION c: Security conditions	
QUESTION	**ANSWER**
1. Did you feel unsafe in your region of origin?	☐ Yes ☐ No
2. If yes, why? **(Multiple responses are possible)**	☐ War ☐ Political instability ☐ Conflicts between ethnic groups ☐ Competition over the use of natural resources (land or water) ☐ Terrorist/extremist groups ☐ Other,specify_____
3. If your region has security problems, how do you think the situation will evolve in the near future?	☐ Improve ☐ Become worse ☐ No changes ☐ Not applicable
4. Are there tensions between farmers and herders in your region of origin?	☐ Yes ☐ No ☐ I don't know
5. If yes, are these conflicts related to land or water use or both?	☐ Yes ☐ No ☐ Not applicable
6. How would you describe your region of origin?	☐ Peaceful ☐ Troubled ☐ Violent
7. Do you think that in your region of origin young unemployed people are at risk of being approached by terrorist groups who want to recruit them?	☐ Yes ☐ No ☐ I don't know
8. Did the security conditions in region contribute to your decision to leave?	☐ Yes ☐ No

SECTION d: Environmental causes	
1. Is your household and/or economic activity affected by extreme weather conditions?	☐ Yes ☐ No
2. How did it affect your household and/or economic activity?	☐ My family had to sell goods/cuttles ☐ A parte my family had to look for a job somewhere else ☐ I lost my job ☐ Not applicable
3. Did you experience any of the following during the last rainy season?	☐ More rain ☐ Less rain ☐ Started earlier ☐ Started later ☐ Lasted longer ☐ Lasted shorter
4. Does your region experience frequent droughts?	☐ Yes ☐ No
5. Did you experience any of the following during the last dry season?	☐ Strong winds ☐ Sand/ dust storms ☐ Started earlier ☐ Started later ☐ Lasted longer ☐ Lasted shorter
6. Does your region experience frequent floods?	☐ Yes ☐ No
7. In your region of origin, did you witness any of the following events?	☐ Loss of livestock ☐ Loss of crops/harvest due to drought ☐ Loss of crops/ harvest due to flood ☐ Decline in river flows or lake water levels ☐ Loss of home due to floods ☐ Other, specify
8. Did any of these events affect you directly?	☐ Yes ☐ No
9. If yes, which of these events affected you directly? (Multiple responses are possible)	☐ Loss of livestock ☐ Loss of crops/harvest due to drought ☐ Loss of crops/ harvest due to flood ☐ Decline in river flows/ lake water levels ☐ Loss of home due to floods

SECTION d: Environmental causes	
10. How did you or your family adapt to the new conditions?	☐ Change in crop types ☐ Change in cropping time (e.g. change in sowing dates) ☐ Other changes in land management/farming practices (specify) _____ ☐ Partial abandonment of farming activity ☐ Total abandonment of farming activity ☐ Work elsewhere in country of origin ☐ Work elsewhere abroad
11. How much the following environmental/ weather conditions contributed to your choice to leave?	- Drought ☐ A lot ☐ Partially ☐ Not at all - Decline in water resources ☐ A lot ☐ Partially ☐ Not at all Decline in crop yeald ☐ A lot ☐ Partially ☐ Not at all - Floods ☐ A lot ☐ Partially ☐ Not at all - Landslides ☐ A lot ☐ Partially ☐ Not at all

12. Finally, what was/were your main reason(s) for leaving? How much did other factors contributed?	- Scarse of work opportunities in country of origin ☐ Main reason ☐ A lot ☐ Not so much ☐ Not at all - Insecurity (war, conflicts, tensions, etc.) ☐ Main reason ☐ A lot ☐ Not so much ☐ Not at all - Uncultivatable land

	☐ Main reason ☐ A lot ☐ Not so much ☐ Not at all - Environmental difficulties (drought,floods, etc.) ☐ Main reason ☐ A lot ☐ Not so much ☐ Not at all - Inspired by family members/ someone else ☐ Main reason ☐ A lot ☐ Not so much ☐ Not at all

Appendix B

Chi-squared tests

1) Variables:
   a. numbers of respondents to the question "How much did the following environmental conditions contributed to determine your decision to migrate?" that indicated "drought" (a lot/partially/not at all)
   b. origin: rural or urban

Contingency table

Drought	**A lot**	**Partially**	**Not at all**	**Total**	**%**
Rural	99	50	118	267	30.87
Urban	99	112	387	598	69.13
Total	198	162	505	865	100.00
%	22.89	18.73	58.38	100.00	
Not Responding		**138**			

Expected frequency

Drought	**A lot**	**Partially**	**Not at all**
Rural	61.11676	50.00462	155.8786
Urban	136.8832	111.9954	349.1214

Diversity

Drought	**A lot**	**Partially**	**Not at all**
Rural	23.48193	4.28E-07	9.20453
Urban	10.48441	1.91E-07	4.109715

Degree of freedom

Row	**Column**	**DoF**
2	3	2

Critical value

5%	**1%**
5.991	9.21

Significant results

Drought	**A lot**	**Partially**	**Not at all**
Rural	1%	no	5%
Urban	1%	no	no
Drought	**A lot**	**Partially**	**Not at all**
Rural	99	50	118
Urban	99	112	387

Interpretation

- 37.08% rural choose 'a lot'
- 44.19% rural choose 'not at all'
- 16.56% urban choose 'a lot'

2) Variables:
   a. numbers of respondents to the question "How much did the following environmental conditions contributed to determine your decision to migrate?" that indicated "drought" (a lot/partially/not at all)
   b. age: <18, 18-24, 25-34, 35+

Contingency table

Drought	**A lot**	**Partially**	**Not at all**	**Total**	
<18	18	16	37	71	8.00
18-24	73	83	208	364	40.99
25-34	88	51	205	344	38.74
35+	24	18	67	109	12.27
Total	203	168	517	888	100.00
	22.86	18.92	58.22	100.00	
Not Responding		**112**			

Expected frequency

Drought	**A lot**	**Partially**	**Not at all**
<18	16.23086	13.43243	41.33671
18-24	83.21171	68.86486	211.9234
25-34	78.63964	65.08108	200.2793
35+	24.91779	20.62162	63.46059

Diversity

Drought	**A lot**	**Partially**	**Not at all**
<18	0.192835	0.490783	0.454973
18-24	1.253178	2.901364	0.072636
25-34	1.11415	3.046613	0.111271
35+	0.033805	0.333286	0.197405

Degree of freedom

Row	**Column**	**DoF**
4	3	6

Critical value

5%	**1%**
12.592	16.812

Significant results

Drought	**A lot**	**Partially**	**Not at all**
<18	no	no	no
18-24	no	no	no
25-34	no	no	no
35+	no	no	no

3) Variables:
   a. numbers of respondents to the question "How much did the following environmental conditions contributed to determine your decision to migrate?" that indicated "drought" (a lot/partially/not at all)
   b. education: primary school, secondary school, high school but not diploma, college but not degree, graduate

Contingency table

Drought	**A lot**	**Partially**	**Not at all**	**Total**	
No school	46	18	43	107	13.33
Primary school	36	21	66	123	15.32
Secondary school	33	36	119	188	23.41
High school but not diploma	22	19	66	107	13.33
College	27	27	93	147	18.31
College but not degree	6	12	39	57	7.10
Graduate	10	14	50	74	9.22
Total	180	147	476	803	100.00
	22.42	18.31	59.28	100.00	
Not Responding		**197**			

Expected frequency

Drought	**A lot**	**Partially**	**Not at all**
No school	23.98506	19.5878	63.42715
Primary school	27.57161	22.51681	72.91158
Secondary school	42.14197	34.41594	111.4421
High school but not diploma	23.98506	19.5878	63.42715
College	32.95143	26.91034	87.13823
College but not degree	12.77709	10.43462	33.78829
Graduate	16.5878	13.5467	43.8655

Diversity

Drought	**A lot**	**Partially**	**Not at all**
No school	20.20666	0.128707	6.578703
Primary school	2.576485	0.102178	0.655177
Secondary school	1.983191	0.072909	0.512571
High school but not diploma	0.164288	0.017639	0.104365
College	1.074902	0.000299	0.39432
College but not degree	3.59463	0.234835	0.803884
Graduate	2.616324	0.015168	0.857896

Degree of freedom

Row	**Column**	**DoF**
7	3	12

Critical value

5%	**1%**
12.592	**16.812**

Significant results

Drought	A lot	Partially	Not at all
No school	no	no	no
Primary school	no	no	no
Secondary school	no	no	no
High school but not diploma	no	no	no
College	no	no	no
College but not degree	no	no	no
Graduate	no	no	no

4) Variables:
   a. numbers of respondents to the question “How much did the following environmental conditions contributed to determine your decision to migrate?” that indicated “drought” (a lot/partially/not at all)
   b. gender: male or female

Contingency table

Drought	**A lot**	**Partially**	**Not at all**	**Total**	**%**
Male	159	151	445	755	84.64
Female	46	17	74	137	15.36
Total	205	168	519	892	100.00
%	22.98	18.83	58.18	100.00	
Not Responding		**108**			

Expected frequency

Drought	**A lot**	**Partially**	**Not at all**
Male	173.5146	142.1973	439.2881
Female	31.48543	25.80269	79.71188

Diversity

Drought	**A lot**	**Partially**	**Not at all**
Male	1.214151	0.544928	0.074269
Female	6.691123	3.003073	0.409294

Degree of freedom

Row	**Column**	**DoF**
2	3	2

Critical value

5%	**1%**
5.991	9.21

Significant results

Drought	**A lot**	**Partially**	**Not at all**
Male	no	no	no
Female	5%	no	no
Drought	**A lot**	**Partially**	**Not at all**
Male	159	151	445
Female	46	17	74

Interpretation

- 33.58% women responded ‘a lot’

5) Variables:

a. numbers of respondents to the question "How much did the following environmental conditions contributed to determine your decision to migrate?" that indicated "drought" (a lot/partially/not at all)
b. country of origin: Sahel or non-Sahel

Contingency table

Drought	**A lot**	**Partially**	**Not at all**	**Total**	**%**
Sahel	97	71	114	282	33.61
Non-Sahel	98	88	371	557	66.39
Total	195	159	485	839	100.00
%	23.24	18.95	57.81	100.00	
Not Responding		**85**			

Expected frequency

Drought	**A lot**	**Partially**	**Not at all**
Sahel	65.54231228	53.44219309	163.0154946
Non-Sahel	129.4576877	105.5578069	321.9845054

Diversity

Drought	**A lot**	**Partially**	**Not at all**
Sahel	15.09843157	5.768411919	14.73797764
Non-Sahel	7.644089233	2.920452713	7.461597296

Degree of freedom

Row	**Column**	**DoF**
2	3	2

Critical value

5%	**1%**
5.991	9.21

Significant results

Drought	**A lot**	**Partially**	**Not at all**
Sahel	1%	no	1%
Non-Sahel	5%	no	5%
Drought	**A lot**	**Partially**	**Not at all**
Sahel	97	71	114
Non-Sahel	98	88	371

Interpretation

- 34.4% of the people from Sahelian countries consider drought 'a lot'
- 40.43% of the people from Sahelian countries consider drought 'not at all'
- 17.59% of the people from non-Sahelian countries consider drought 'a lot'
- 66.61% of the people from non-Sahelian countries consider drought 'not at all'

6) Variables:

a. number of respondents that indicated "environmental difficulties" to the question "What was your main reason for leaving?"
b. origin: rural or urban

Contingency table

Env. diff.	**Main reason**	**A lot**	**Partially**	**Not at all**	**Total**	**%**
Rural	56	56	47	100	259	29.67
Urban	40	86	116	372	614	70.33
Total	96	142	163	472	873	100.00
%	11.00	16.27	18.67	54.07	100.00	
	Not Responding		**127**			

Expected frequency

Env. diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Rural	28.48109966	42.12829324	48.35853379	140.0320733
Urban	67.51890034	99.87170676	114.6414662	331.9679267

Diversity

Env. Diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Rural	26.58920776	4.567577596	0.03816522	11.44428455
Urban	11.21596875	1.926714328	0.01609901	4.82747508

Degree of freedom

Row	**Column**	**DoF**
2	4	3

Critical value

5%	**1%**
7.815	11.345

Significant results

Env. Diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Rural	1%	no	no	1%
Urban	5%	no	no	no
Env. Diff.		**A lot**	**Partially**	**Not at all**
Rural	56	56	47	100
Urban	40	86	116	372

Interpretation

- 21.62 % of rural migrants consider environmental difficulties as main reason
- 38.61 % of rural migrants consider environmental difficulties 'not a all'
- 6.51% of urban migrants consider environmental difficulties as main reason

7) Variables:
   c. number of respondents that indicated "environmental difficulties" to the question "What was your main reason for leaving?"
   d. gender: male of female

Contingency table

Env. diff.	**Main reason**	**A lot**	**Partially**	**Not at all**	**Total**	**%**
Male	18	36	24	57	135	14.97
Female	81	114	146	426	767	85.03
Total	99	150	170	483	902	100.00
%	10.98	16.63	18.85	53.55	100.00	
	Not Responding		**98**			

Expected frequency

Env. diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Male	14.81707317	22.45011086	25.44345898	72.28935698
Female	84.18292683	127.5498891	144.556541	410.710643

Diversity

Env. Diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Male	0.683739837	8.178110865	0.081890353	3.233732416
Female	0.120345343	1.439432812	0.014413556	0.569170634

Degree of freedom

Row	**Column**	**DoF**
2	4	3

Critical value

5%	**1%**
7.815	11.345

Significant results

Env. Diff.	**Main reason**	**A lot**	**Partially**	**Not at all**
Male	no	5%	no	no
Female	no	no	no	no
Env. Diff.		**A lot**	**Partially**	**Not at all**
Male	18	36	24	57
Female	81	114	146	426

Interpretation

- 26.67 % of women consider environmental difficulties 'a lot'

Appendix C

Reviewer Comments and Responses

Reviewer # 1 comments	Responses by the author
On chapter 3	
1) The author says that "provides an overview of the general migration theories". In fact the literature on migration theory is vast and the work only sums up a small part. In this regard, we refer to all the literature on Borjas, Dustmann, Moretti, Card, Djajic, Boeri, Ottaviano and Peri, to name but a few.	1) Reference to all the authors suggested by the reviewer has been included in the sub-section 2. *The climate/environment change and migration nexus in the literature* (p.49-50).
2) Also reference specifics are missing on the search. For example, Cattaneo, C. & Peri, J., 2016. "The migration response to increasing temperatures"; Cattaneo, C. & Emanuele M., 2015. "Migration and Climate Change in Rural Africa"; Cattaneo, C. & Bosetti, V., 2016. "Climate-induced International Migration and Conflicts" ; Millock, K., 2015" Migration and Environment, "Annual Review of Resource Economics 7, 35-60"	2) All the suggested references have been included and discussed in session 2 (The climate/environment change and migration nexus in the literature) and session 4 (Methodology) and session 5 (Discussion).
3) About sampling: • Respondents are individuals who have already emigrated (ex post their choice) who speak English and / or French. • The immigrants are on average very young, as is shown by the graphs. What reflections can be made about the "education" of these individuals? What issues arise in reading the results? • With regard to migration, there have been extreme events that may have caused the move?	3) • More considerations have been done with respect to the area of origin (French or English speaking countries) – p. 57 • Some reflections on the brain-drain related to the relative high number of people with a secondary education have been included in the analysis – p. 58 • Examples of extreme weather events that might have contributed to migration have been added – p. 62
For the moment the analyses are only descriptive of the whole sample. Further insights should be made by studying better the results with respect age, level of education, and language. There should be statistical tests at least on the average.	A number of chi-squared tests on these particular aspects (age, education, origin, etc.) have been run to verify the statistical significance of the sample. Age and level of education has been discussed in session 4.2 (From methods to results) against a survey dated 2007, while the language/country of origin has been addressed, with the other results of the qui-square tests in section 5 (Discussion).

Reviewer # 2 Comments	Responses by the author
On chapter 1	
Ethical arguments and beyond: • Are remittances possible 'substitute' for other forms of climate finance? The authors label this question as an ethical argument but in my opinion this is a more general argument on the validity of the research question.	The ethical arguments that have been raised during the chapter public presentation regards the fact the 100 billion USD needed to finance adaptation do not need to be on the shoulders of individuals that pays the survival of their family in the global South, but they rather need to come from public and private sources for the principle of 'common but differentiated responsibilities'.
• It is not clear to me what should be their 'new' role as an alternative source of international climate finance.	The chapter now explicitly clarifies in the introduction that the Copenhagen Accord uses a specific language to separate an alternative source from the others, meaning that this type of source it is neither disbursed by the public sector, nor can it be labelled as 'private finance'.
I would expect a discussion on the advantages and disadvantages of remittances over alternative financial sources.	The chapter clarifies that 'alternative' sources are not intended as private sources. With the caveat, it is now clearer that the whole analysis of the chapter is on whether remittances can be considered a source of adaptation finance or not.
I suggest the authors to discuss more in depth: • the current role of remittances in the adaptation of households and communities to climate shocks;	• More references to authors discussing the role of remittances in adaptation have been included, namely to Couharde and Generoso, 2015; World Bank, 2015; Quartey and Blankson, 2004, Maddison 2007 and King et al.'s 2014.
• The role of government (section 5) and the analysis of market failure that calls for corrective actions/policy implications would benefit from a more extensive analysis	• Market failure and government corrective actions have been addressed under the adaptation criteria 'mobilizing'
On chapter 3	
A discussion on the pro and cons of the employed survey methodology is necessary in order to effectively link the paper within the existing	More details on (i) the contribution of this survey to the existing literature (ii) the limitations of the survey conception/questionnaire

literature.	have been provided in the methodology session
The author should discuss the concerns related to the sample selection and better explain to the reader the specific context where the survey took place. To what extent the sample is representative of migrants originating from the set of origin countries?	More details on the survey team composition and the context have been provided as well as the concerns about sample selection (session 4.1). The chi-squared tests provided more information on the representativeness of the answers of some sub-samples, while the representativeness of the sample with regard to the countries of origin has been discussed against an old survey of 2007 (session 4.2)
Past migration experience. It is not clear if the author has asked sufficient information on past migration experience of the respondents. I cannot see any questions on the region of birth and region of residence before migration. Many individuals first migrate from rural areas to urban areas and then internationally. It would be crucial to include this element in the analysis. The questions in sections c and d are generically referred to the region of origin, is this the region of birth or the region where the individual was staying before migration? This crucially important element is not clear. I suggest presenting in a table the main differences between urban and rural migrants. A possible angle is that of highlighting differences across the main source countries	Unfortunately, the questionnaire was conceived in a way that did not allow separating the country of origin from the country of last permanence. The author discusses these limitations in session 4 (Methodology) recognizing that this might have left out important information on the migrants' profile, including the rural/urban origin.