



Human mobility in response to rainfall variability: opportunities for migration as a successful adaptation strategy in eight case studies

Tamer Afifi, Andrea Milan, Benjamin Etzold, Benjamin Schraven, Christina Rademacher-Schulz, Patrick Sakdapolrak, Alexander Reif, Kees van der Geest & Koko Warner

To cite this article: Tamer Afifi, Andrea Milan, Benjamin Etzold, Benjamin Schraven, Christina Rademacher-Schulz, Patrick Sakdapolrak, Alexander Reif, Kees van der Geest & Koko Warner (2016) Human mobility in response to rainfall variability: opportunities for migration as a successful adaptation strategy in eight case studies, *Migration and Development*, 5:2, 254-274, DOI: [10.1080/21632324.2015.1022974](https://doi.org/10.1080/21632324.2015.1022974)

To link to this article: <https://doi.org/10.1080/21632324.2015.1022974>



© 2015 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 05 May 2015.



[Submit your article to this journal](#)



Article views: 1160



[View related articles](#)



[View Crossmark data](#)



Citing articles: 26 [View citing articles](#)

Human mobility in response to rainfall variability: opportunities for migration as a successful adaptation strategy in eight case studies

Tamer Afifi^{a*}, Andrea Milan^b, Benjamin Etzold^c, Benjamin Schraven^d,
Christina Rademacher-Schulz^b, Patrick Sakdapolrak^e, Alexander Reif^f,
Kees van der Geest^g and Koko Warner^b

^aEnvironmental Migration, Social Vulnerability & Adaptation Section (EMSVa), United Nations University Institute for Environment and Human Security (UNU-EHS), Königswinterer Str. 269, 53227 Bonn, Germany; ^bEnvironmental Migration, Social Vulnerability & Adaptation Section (EMSVa), United Nations University Institute for Environment and Human Security (UNU-EHS), UN Campus, Platz der Vereinten Nationen 1, D-53113 Bonn, Germany; ^cGeography Department, University of Bonn, Meckenheimer Allee 166, 53115 Bonn, Germany; ^dDepartment Environmental Policy and Management of Natural Resources, German Development Institute (DIE), Tulpenfeld 6, D-53113 Bonn, Germany; ^eDepartment of Geography, University of Bonn, Meckenheimer Allee 176 53115 Bonn, Germany; ^fKurfürstenstr. 24, 53115 Bonn, Germany; ^gEnvironmental Migration, Social Vulnerability & Adaptation Section (EMSVa), United Nations University Institute for Environment and Human Security (UNU-EHS), Barranco del abogado 6, 3a, 18190 Cenes de la Vega, Spain

(Received 2 December 2014; final version received 20 February 2015)

This article analyses the dynamics between rainfall variability, food insecurity and human mobility in eight case studies, namely Ghana, Tanzania, Guatemala, Peru, Bangladesh, India, Thailand and Vietnam. It covers a large spectrum of rainfall-related climatic events, including floods, drought, seasonal shifts and dry spells, and their impact on food insecurity and in turn on human mobility in approximately 1300 households in the eight case studies. It also summarizes the outcomes of focus group discussions and participatory research approach sessions held with communities in the villages that are affected by rainfall variability. The article compares the outcomes of the case studies and identifies the similarities and areas of overlap. It concludes that for some households – regardless of the case study – there is high potential for migration to be a successful adaptation strategy. Some other households rather find it hard to adapt to the situation *in situ*; among them, some cannot afford moving to other areas to improve their livelihoods and remain ‘trapped’ while others do move, but barely survive or are even subject to worse conditions. The article provides policy recommendations for policy-makers and practitioners that might be applicable for these, and also other countries exposed to the same climatic issues. Finally, the article provides an outlook with lessons learned for the benefit of future research.

Keywords: human mobility; rainfall variability; food security; climatic stressors

Introduction

Rainfall is one of the most important factors that structure the livelihoods of farmers and pastoralists in rural areas worldwide. Changes in rainfall patterns can create

*Corresponding author. Email: afifi@uni-bonn.de

imbalances and lead to damages of rural livelihoods. This article addresses the complex relations between rainfall variability, food security and human mobility in eight case studies, namely Bangladesh, India, Thailand, Vietnam, Ghana, Tanzania, Guatemala and Peru (see Figure 1). It starts by distinguishing between the concepts of ‘migration as a successful adaptation strategy’ and ‘migration as a failure to adapt’. Next, the article makes the reader familiar with the *Where the rain falls* project.¹ Finally, the article provides a discussion and analysis of the project outcomes and concludes with some policy recommendations for the areas of origin and the areas of destination of migrants who leave home in the context of climatic changes, in particular, rainfall variability. It closes with providing an outlook for future research in the same field.

Climate-induced migration as a successful adaptation strategy vs. a failure to adapt

Adaptation to climate change can be understood as the process of adjustment to actual or expected climatic changes and their effects. In human systems, adaptation seeks to moderate, harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climatic changes (*IPCC glossary of terms*, 2012). Historically, people have engaged in long- and short-term migration as an adaptive response to climatic stress. Millions of individuals and households are employing a variant of this strategy today. When climatic stressors negatively affect local households, especially those whose livelihoods depend heavily on climatic factors (e.g. farmers and pastoralists), they need to react in order to maintain or restore their livelihoods. A common strategy is to move to other areas – temporarily or permanently. This type of human movement may be regarded as a ‘successful’ adaptation strategy, if the households’ livelihood conditions remain as they were before climatic factors hit them or even improve. Successful adaptation can be indicated by a household’s improved financial security by occupying jobs in the areas of destination that increase the income and improve the overall situation of the households. The latter might send one or more. If some household members migrate to urban areas, for instance, manage to occupy jobs there, and regularly send remittances to support the family members still living in rural areas, the income and the overall situation of the households might improve. Steady remittance income could be a way to balance variations in environmental cycles that

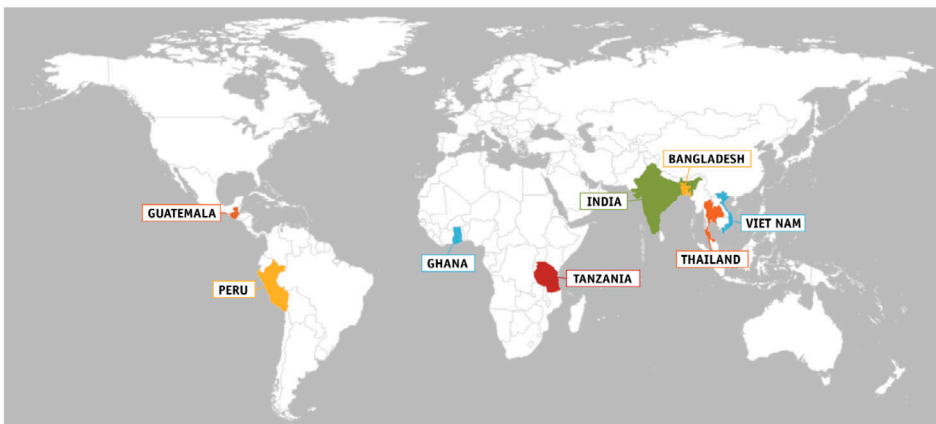


Figure 1. Geographic spectrum of the *Where the rain falls* project.
Source: CARE France.

affect harvests (Stark & Levhari, 1982). Migration can then be seen as a form of risk management.

However, human movement may also be considered a failure to adapt, particularly in the cases where households fall in the vicious circle of livelihood deterioration by moving to areas where they are prone to more risks. In this case, households with fewer assets and less coping capacity vis-à-vis environmental change may have to accept worsening standards of living.

Overview of the *Where the rain falls* project

The *Where the rain falls* project covered eight case studies in four regions; Latin America (Guatemala and Peru), Sub-Saharan Africa (Ghana and Tanzania), South Asia (Bangladesh and India) and Southeast Asia (Thailand and Vietnam). The main research objective was to identify the interrelations between rainfall variability, food insecurity and human mobility. The corresponding research question was: *Under what circumstances do households use migration as a risk management strategy in response to increasing rainfall variability and food insecurity?*

What is meant by rainfall variability in the context of the *Where the rain falls* project? Rainfall variability encompasses all the phenomena that the interviewed households and communities sensed in the past 20–30 years regarding drought, floods, shifts of rainy seasons, changes in the rainy days per annum, rainfall intensity and dry spells. The authors are aware that the farmers in the research areas can always be prone to such phenomena. However, what this research attempted to detect is situations where these phenomena have deviated from their ‘normal’ patterns, based on the experience of the interviewed persons; whether this anomaly has an impact on their livelihoods and to what extent human mobility is affected consequently.

The research units were mainly the households. However, community members were interviewed regardless of their belonging to specific households. In addition, opinions of experts in related areas were also incorporated in the research.

Three methods were applied in the field to collect primary data:

- (1) Quantitative questionnaires (household level) that focused on the three key variables, namely rainfall variability, food insecurity and human mobility without overlooking other important demographic, socioeconomic, cultural and political factors. The questionnaires mainly consisted of closed questions, but also included some open questions in order to better understand the various situations of the households. It was mainly the household head who was interviewed, but in the cases where the latter was absent, the best informed available representative of the household was interviewed instead. Questions covering human mobility attempted to identify the link between this variable, food and livelihood security and rainfall variability.
- (2) Qualitative participatory research approach (PRA) tools (community members), including focus group discussions (FGD); transect walks to identify the locations of the most important institutions (schools, religious bodies, cooperatives ... etc.) as well as the location of the rich, medium and poor households; livelihood risk ranking to identify the livelihood risks that the communities face at most, their ranking and the way they prepare for/respond to these risks; mobility maps to find out the destinations of the people who move elsewhere, the frequency of their movement and the magnitude of their travel; seasonality calendars that show the

rain, cropping and harvesting seasons and also relate them to other social and cultural events in the communities; and Venn diagrams that demonstrate the influence of various institutions (e.g. schools, courts, religious institutions) and individuals (mayors, teachers, priests) on the livelihoods of the communities.

- (3) Expert interviews with practitioners and scholars in climate change, meteorology, migration as well as local and national government representatives and policy-makers.²

Where possible, the researchers used stratified rather than simple random sampling techniques.

Case studies

Bangladesh

The research in Bangladesh focused on four villages in the Kurigram district in Rangpur division in the country's north, which is known for a high incidence of poverty and seasonal food insecurity. The study in the Kurigram region in northern Bangladesh (Ahmed et al., 2012; Etzold, Ahmed, Hassan, & Neelormi, 2014) found that rainfall variability, household food security and migration patterns are closely intertwined. In the region, agricultural production mostly depends on rainfall, as costly irrigation systems are not widespread. Disruptions of livelihoods, such as natural hazards and significant changes in the annual monsoon cycle, are perceived by the local people as severe livelihood risks, since both have direct effects on food production and incomes. An 'untypical' longer dry period during the monsoon season can, for instance, lead to crop damage and reduced food production. It will also contribute to a local increase in food prices and reduce the demand for agricultural labourers throughout the harvest season. As a consequence, small-scale farmers and wage labourers will have to reduce their food consumption to cope with the effects of rainfall variability or they will have to seek alternative income sources, for instance through migration (cf. Findlay & Geddes, 2011; Gray & Mueller, 2012; Poncet, Gemenne, Martiniello, & Bousetta, 2010).

Almost half of the interviewed households in the survey had internal migrants in their family. Ninety-seven per cent of the migrants were men. Most movements take place within the country and over short distances. Forty-nine per cent of the movements were to urban centres, while rural-to-rural migration accounted for 47% of all movements. Although the number of out-migrants has increased significantly over the past decades, the vast majority of the people in Kurigram district are not mobile.

Migration is seen by the respondents as a way to cope during a period of crisis, in particular to avoid or reduce food insecurity (as noted by 79% of respondents in the survey), but also as a normal income diversifying activity (as mentioned by 27%). The major reasons to migrate can be ranked as follows: poverty and lack of employment opportunities in the home region, then food insecurity, followed by rainfall variability and natural hazards.

The results also show that persisting local patterns of social inequality and food insecurity matter crucially for different groups' propensity to migrate in the context of rainfall variability. The most affluent and food-secure people do not *need* to migrate in order to adapt to the negative effects of rainfall variability because their livelihoods are already fairly resilient. In stark contrast, the poorest and most food-insecure people *cannot* migrate at all. These most vulnerable 'trapped' households are forced to cope locally with rainfall variability as they neither have adult male family members who

could work as labour migrants, nor resources to facilitate migration, nor access to the necessary migration networks (cf. Black, Arnell, Adger, Thomas, & Geddes, 2013; Poncelet et al., 2010).

Some households are ‘getting ahead’ as migration led to a diversification of their livelihoods and a reduction of their sensitivity to rainfall variability. Members from other rainfall-sensitive households migrate, because they have been negatively affected by too much or too little rain at the wrong time, and seek to cope with such a temporary crisis. Yet, they are just ‘getting by’ and can neither get out of poverty, nor reduce their sensitivity to rainfall variability. Some households use migration as an option of ‘last resort’ (Penning-Rowsell, Sultana, & Thompson, 2013) to overcome the worst periods of hunger, but their overall situation and the conditions for those ‘left behind’ actually deteriorate (see also Peth & Birtel, 2015; Warner & Afifi, 2014; Warner et al., 2012).

The Bangladesh case study demonstrated that instead of rainfall variability – as one indicator of climate change – it is social inequality and food insecurity in the region as well as the structural economic differences between more remote rural areas, prospering agricultural regions and the major urban centres that *drive* migration from the Kurigram region. Nonetheless, labour migration is one of the most important coping strategies of rural households in the context of multiple climatic risks.

For more detailed information on this case study, please refer to Ahsan, Hassan, Etzold, and Neelormi (2012) and Etzold et al. (2014).

India

The research undertaken in India covered the four villages JullanPakaria, Akalteri, Banahil and Silli – in the Janjgir–Champa district of Chhattisgarh State – where the farmers mainly rely on a single annual crop of paddy rice grown during the monsoon season. Food insecurity is considerably high, although the majority of farmers (84%) in the four villages have access to canal irrigation. The irrigation system allows for only one crop per year (in this case paddy rice). The consequence is unemployment during the dry season, which often leads to migration as a coping strategy, particularly for smallholder and landless households.

Rainfall-related problems, such as drought, delayed monsoon rains, seasonal shifts and more erratic monsoon rains facing households negatively affect food security. Although there is no evident decline in average annual rainfall, meteorological data confirm a significant drop in the number of rainy days per year (from 65 to 56). More than one-third of the interviewed households reported that droughts and dry spells have increased over the past 10–20 years. Around 60% of the interviewed households reported suffering from shorter rainy seasons.

Given the high dependence of local residents on rice monoculture during the monsoon season, rainfall-related risks, such as delayed or erratic rainfall, shifting seasons, flash floods and the shortage of freshwater for drinking, were categorized as major risks for the interviewed communities. This may explain the significant increase observed in survey results of households engaging in day labour now compared to 10 years before the research took place.

Migration is one of the most important strategies to cope with rainfall variability and food insecurity. Even the people who stay and borrow from others might still be forced to resort to migration in order to be able to repay their loans. Therefore, migration is often the last resort for resource-poor, landless households, especially when they

are unable to access or benefit from livelihood options *in situ*; most of the migration from the research area is seasonal (around 66%), and the most common pattern is migrating from January to May after the main harvest (November–December).

Although family migration serves for integration and unification, it does have a negative impact on the quality of education. Some respondents complained about school dropouts. While migration helps the respondents to adapt to rainfall-related challenges, it does not provide them with better opportunities. In some cases, migration has negative intergenerational consequences when the need to migrate compromises skill building and education necessary for improvements in life quality, health and the ability to attain stable livelihoods.

For more detailed information on this case study, please refer to Murali and Afifi (2012, 2014).

Thailand

The case study in Northern Thailand explored the interrelations of environmental factors, migration and adaptation in four villages in the Ban-Puang subdistrict, located in the province of Lamphun (see Promburom & Sakdapolrak, 2012; Sakdapolrak et al., 2014). The quantitative and qualitative data of the research area do not show a clear link between rainfall variability and migration decisions.

Households in the study area consider their livelihood security affected by (a) economic risks e.g. through increasing commodity prices, decreasing income, increasing pressure to intensify agricultural production and therefore a high level of indebtedness, (b) environmental stress due to rainfall-related events and trends, such as droughts and dry spells or heavy rainfall and land and forest degradation, and (c) a progressive social transformation in the village due to the introduction of consumption-oriented lifestyle patterns as well as a dissolution of former systems of social security and a decline in social interaction among the villagers. While multidimensional social and economic pressures on the households were steadily increasing, food insecurity could not be observed in the research area. The research in Ban-Puang subdistrict revealed that migration is not considered as a primary coping and risk mitigation strategy in the context of environmental stress. However, internal and international migration is widespread and an integral part of the livelihoods' system. Migration from the study area is closely related to the market integration of this formally marginal area and linked to a process of structural change in the economy and the labour market.

Migration and feedback effects of migration play an important role for the livelihoods in the study area. An in-depth follow-up study revealed that 28.1% of all households in one of the study villages currently receives financial remittances from migrated household members (Reif, 2012). Nearly 50% of households received financial remittances in the past. Financial remittances are mainly used by the local households to buy food and to invest in their farms for agricultural diversification and to intensify production. Qualitative interviews with the villagers show that financial remittances of migrants are enabling them to enhance their scope of action in the context of economic and environmental risks and to strengthen their coping and adaptive capacities. With the additional money, income redundancies are created and proactive investments in the income portfolio, including agricultural production diversification and intensification, are made and hence their vulnerability against environmental and economic risks can be reduced.

Next to financial flows, social remittances, understood as flows of knowledge, values, practices, ideas and social capital creating, are interchanged between migrants and their homes. New innovative agricultural practices and also the initiation of participatory decision-making processes at the village level were considered by some villagers to be introduced or at least crucially influenced by former migrant's experience, knowledge and ideas. When it comes to non-agricultural income options, ideas about new local businesses and knowledge about their organization mostly were introduced by returning migrants, who established or worked in those businesses in different cities in Thailand before, e.g. the opening of an internet café, a building centre and different small shops. These examples highlight that through intensifying translocal embeddedness, the ability of households to respond to environmental risks and hence their social resilience is influenced and can potentially be increased (Sakdapolrak, 2014).

For more detailed information on this case study, please refer to Promburom and Sakdapolrak (2012) and Sakdapolrak, Promburom, and Reif (2014).

Vietnam

The research in Vietnam took place in three villages of Hung Thanh Commune (Dong Thap Province) in the upper delta of the Mekong River (Khoa, Thao, & van der Geest, 2012). The research area is located about 135 km from the coast and is part of the commercial rice production region of the Mekong delta. Rice cultivation is the main economic activity of households in the study area and fishing is an important secondary source of food and income. The area is flooded annually, with peak flood levels usually occurring between September and November. The annual floods enrich the soil, but also pose a threat to people's lives, properties and livelihoods, especially when floods are higher than usual.

The research revealed several changes in rainfall patterns over the past 20–30 years: the total amount of annual rainfall has increased; the rainy season lasts longer than before; rainfall has become less predictable; and the occurrence of extreme weather events, such as thunderstorms and heavy rainfall has increased. Despite increasing rainfall in the past 20–30 years, flood levels have decreased over the same period due to changing rainfall patterns and water retention upstream of the Mekong River.

More than half of the household survey respondents (62%) have their own rice farm. The vast majority indicated that their rice yields are negatively affected by changing rainfall patterns and changing flood regimes. Despite this, rice productivity is increasing as a result of better seed varieties, improved techniques, increased usage of fertilizers and a higher frequency of cultivation. Hence, the negative effects of climatic changes are to some extent offset by positive man-made agricultural changes.

About 31% of the surveyed households were landless, while land-scarce households – owning less than one hectare – made up 26% of the household sample. The remaining households (43%) owned an average of 2.4 ha of land. The benefits of increased rice productivity hardly trickle down to landless households who mainly engage in farm labour: 41% reported experiencing food shortage in the past year and 52% in the past 5–10 years. Food insecurity reaches its peak in the flood season, from September to November, when demand for farm labour is low.

Out-migration has increased sharply, particularly in the past 10 years. In 90 out of 150 households (60%), at least one current member had migration experience. Men (63%) migrated more than women (37%). Seasonal migration mainly occurs during the flood season, when there is less work in the community. Most seasonal migrants move

within Dong Thap Province, and work as farm labourers, fishermen or in local factories. Migrants who leave the Hung Thanh Commune for longer periods mostly move to destinations outside the Mekong Delta region, but still within the southern part of Vietnam. They mostly go to the industrial zones of Ho Chi Minh City, Binh Duong and Dong Nai.

The upper Mekong Delta in Vietnam is going through a process of rapid economic development, and increasing migration is mostly driven by demand for labour in industrial centres (pull factors). However, an analysis differentiated by socioeconomic groups (Van der Geest, Khoa, & Thao, 2014) reveals that poorer and land-scarce households are much more affected by climatic stressors than non-poor households. Their ability to cope and adapt locally – for example by diversifying their livelihoods with non-farm activities – is limited. Migration is a common alternative, and migration propensities are much higher among poor and landless households than among non-poor households. They use migrant savings and remittances primarily to buy food and to pay back their loans. In some cases, the money feeds into *in situ* adaptation measures, such as raising the foundation of houses, diversification into non-farm activities, community-based saving schemes and investment in children's education to facilitate future employment in economic sectors that are less sensitive to the vagaries of the weather.

For more detailed information on this case study, please refer to Khoa et al. (2012) and Van der Geest et al. (2014).

Ghana

The analysis of the qualitative and quantitative data gathered in four villages of the Nadowli District of Ghana's Upper West Region – which largely belongs to the West-African savannah belt – reveals that it is not seasonal migration per se, but rather the timing of seasonal migration which is closely interrelated with the vulnerability of smallholder households in Northern Ghana. This semi-arid area is characterized by unimodal rainfall regime, which allows one rain-fed production cycle of roughly six months only. Since colonial times, migration during the dry season has been a very important strategy to respond to temporary food shortages in Northern Ghana that until today has remained the poorhouse of the West African country. Many young men went to Central and Southern Ghana to work in the gold mines, cocoa farms or other economic sectors. Financial and food remittances as well as the skills the migrants have gained during their stays in the south helped the migrants' families overcome food crises and generate additional buffers towards future crises. Furthermore, as seasonal migrants usually returned at the end of the dry season, they could also help their families with the next rainfed agricultural production cycle.

In recent years, patterns of environmental and climatic change – in particular, soil infertility and increasing rainfall variability – are putting additional pressure on local households making some more prone to food insecurity. Study results show that the traditional migration during the dry season has increasingly shifted towards the rainy season as one-third of the migrants captured in the survey left during the dry season as compared to two-third who left during the rainy season. Despite the fact that almost all households live below the poverty line, the socioeconomic situation of households in the study area is unequal. Rainy season migration has become a prominent feature, especially among poorer and vulnerable households. Rainy season migration reduces the farm household's labour availability during the critical stages of the rainfed production process, which in turn may lead to further reduced yields and lower food security.

Qualitative interviews with rainy season migrants reveal that most of them perceive rainy season migration to the informal mining sites (*galamsey*) of Ghana as more promising than rainfed subsistence agriculture at home despite the immense dangers and quite uncertain outcomes associated with informal gold mining. Only if migrants can remit money, food or other material goods, they can compensate for their absence during the main farm activities on their home farm plots. If they are not able to do so, their households are facing the severe risk of an even further worsened food security status and a higher level of vulnerability.

With regard to their future perspectives, a majority of migrants prefer non-agricultural professions and some already invested in relevant training and apprenticeships. Accordingly, the temporal shift in seasonal migration comes along with a fundamental shift in livelihood preferences away from agriculture and a relative loss of importance of subsistence agriculture, respectively. This is in particular valid for the poorer and more vulnerable households.

For more detailed information on this case study, please refer to Rademacher Schulz and Mahama (2012) and Rademacher-Schulz, Schraven, and Mahama (2014).

Tanzania

The research in Tanzania was conducted in three villages – Bangalala, Ruvu Mferijini and Vudee – in the same district of the Kilimanjaro Region, a semi-arid zone in the Pangani Basin of the northern part of the country. Due to the high level of reliance on agriculture and the limited off-farm employment opportunities in the district, insufficient and inadequate rainfall often leads to crop failure, food insecurity and out-migration for poor households.

The rainfall is characterized by a bimodal pattern with the ‘long’ (*masika*) rains occurring in March to May and the ‘short’ (*vuli*) rains occurring in September to December. There was an overall consensus between the experts, household representatives and PRA participants that rainfall patterns in the same district have changed significantly over the past 20 years. The main perceived changes were: (1) increased frequency of prolonged dry spells during the rainy season; (2) later onset and earlier cessation of rains; and (3) increased frequency of heavy storms. In addition to changes in the timing and distribution of the two annual rainy seasons, increasing temperatures and stronger winds are the key factors that exacerbate local water shortages. An analysis of local rainfall data over the last 30 years provides evidence to support these perceptions of negative changes in rainfall, including: a decline in long season (*masika*) and total annual rainfall; reduced number of rainy days per year (from 90 to 71); and a pattern of early cessation, and thus shorter growing seasons.

Based on data from the household survey and the PRA sessions, the top three economic activities – agriculture, livestock and casual labour – are all very dependent on the natural resource base of the region, and little diversification into off-farm livelihood activities has taken place.

Under the conditions that prevail in same district, changes in rainfall patterns lead directly to food insecurity, and drought was identified as the major hazard to household livelihoods. More than 80% of household survey respondents reported that rainfall variability negatively affected their food production ‘a lot’. Food and livelihood insecurity is normally highest from September to January. In the base village Bangalala, only 5% of households are able to ensure three meals per day for all household members, while

65% of the households could only afford two meals per day. As to the poorest 30%, it often struggles to provide one nutritiously acceptable meal per day.

Focus group participants in the three research villages reported utilizing the following short-term coping strategies to deal with food shortages: (1) changes in household food consumption (fewer meals per day or even going an entire day without eating, elimination of more expensive foods such as fish, eating lighter meals); (2) changes in economic activity (casual labour in the local community, cutting timber, collecting firewood, burning charcoal and reducing cultivated area); (3) sale of assets (most often livestock, but almost never land); and (4) seeking help from others (government relief, assistance from NGOs, borrowing money from friends and family).

Moreover, migration is a very important adaptation strategy for households in the villages of research. The top three factors affecting household migration decisions, all directly related to rainfall, were: (1) increased drought frequency; (2) longer drought periods; and (3) water shortage. Migration is overwhelmingly internal, with very few (mostly Masaai herders) moving across international borders (to Kenya). The majority of migrants appear to move to other rural areas with more favourable weather conditions, where they can engage in the farming and livestock-keeping activities with which they are most familiar or find work as casual labourers. FGDs with youth, who are on the whole freer to move, suggest that they see little future in agriculture and may be more inclined to seek their fortunes in urban areas, despite the hardships encountered there by migrants with limited education and financial resources.

For more detailed information on this case study, please refer to Liwenga, Kwezi, and Afifi (2012) and Afifi, Liwenga, and Kwezi (2014).

Guatemala

The *Rainfalls Guatemala* case study took place in four rural communities (Buena Vista, El Cerro, El Durazno and Quiquibaj) belonging to the municipality of Cabricán, in the Western Highlands of the country (Department of Quetzaltenango).

Local households manage risks related to their subsistence agriculture-based livelihoods in two main ways: local agricultural and non-agricultural diversification and migration of one or more household members, mostly to the United States.

The four communities are characterized by small land holdings (approximately 94% of the parcels measure less than 0.7 ha) and their soil requires intensive conservation practices. The vast majority of survey respondents highlighted that changing rainfall patterns are affecting local livelihoods which depend on one yearly harvest of a rainfed crop sub-system called 'milpa'. As a consequence, farmers are not only trying to produce the highest quantity of food in a limited piece of land, but also combining different crops and varieties of each crop. These varieties yield the highest level of production under different climatic conditions. All survey respondents mentioned owning livestock which they sell to obtain cash in case of short-term liquidity crises.

The main non-agricultural diversification activity is weaving. Locals receive the equipment, tools and materials from entrepreneurs from a nearby town called Salcajá and they only produce as much as they are required to from the entrepreneur. Moreover, the increasing number of people in Cabricán who are entering this market is pushing down incomes from this activity. According to PRA participants, each weaver is now required to only do one or two 'cortes' (a 1-m wide and 7-m long tissue) a week, less than half of what they were required few years ago. Given the relative isolation of

Cabricán from national and international markets, households struggle to sell their production on the market.

Migration is usually the strategy of last resort: people are attached to their community of origin and they only leave when no other option is available. Nevertheless, given the high prevalence of poverty and food insecurity, migration is still common: survey data show that 25% of the households have one or more migrants (22% international, mostly to the US, and 3% internal).

Remittances are the most important factor determining housing conditions and social inequalities within the communities: there is a clear distinction between old and new houses, all of which have been built thanks to remittances from one or more household members living in the United States.

Households in Buena Vista, El Cerro, El Durazno and Quiquibaj have limited local diversification options and decreasing opportunities for migration as part of successful adaptation strategies.

Firstly, migration can only be part of adaptation efforts of households that can afford it. The prevalence of poverty in Cabricán remains very high while the cost of migration is increasing. As a consequence, the most vulnerable households will only be able to use migration as part of their adaptation strategies, if their economic conditions improve, or if they are offered a loan.

Secondly, the most common and profitable migration destination in recent years – the United States – is becoming too risky and expensive to reach. The other traditional migration option, seasonal migration to the southern coastline, is no longer available due to a change in agricultural practices in the coastline. So far, no other destination seems to be available for locals to use migration as part of successful adaptation strategies.

For more detailed information on this case study, please refer to Milan and Ruano (2014) and Ruano and Milan (2014).

Peru

The Peru case study was conducted in Acopalca, Chamisería and Paccha, three mountain communities located in the Shullcas river sub-basin and its surroundings. Rainfall patterns influence food production in the communities, since most of the agricultural activities in the area is rainfed. Food insecurity is only a temporary and short-term problem for most households, and it is usually caused by severe weather events, such as the 2003 frost or the 2007 floods.

Most households in the research area combine rural and urban activities. In the highlands, cattle herding on communal land prevail over urban employment as the most common economic activity. In the lowlands, urban employment is the main source of income, but agricultural production in small land holdings (usually less than 1 ha) remains important because of the scarcity and insecurity of urban opportunities.

Most of the population on the highlands cannot reach Huancayo through daily commuting: besides being farther from Huancayo than lowland communities, they are scattered and their houses are often not directly accessible by paved roads. On the contrary, most of the population on the lowlands is concentrated in a relatively small area which is very well connected to the city of Huancayo, with several daily buses that reach the city in 20–30 min.

In spite of these differences, the entire research area is characterized by ‘confederations of households’ whose livelihoods are based on a complex network of intra- and

inter-household relationships and connections both within communities and with migration destinations (Smith, 1984).

Migration has always been a common livelihood diversification and risk management strategy in the area (Mallon, 1983). While migration in the 1980s and 1990s was mainly driven by the government's conflict with the terrorist group Shining Path, patterns of human mobility in rural areas of the province of Huancayo are now determined primarily by economic considerations.

On the lowlands, the prevailing form of mobility is daily commuting to Huancayo. Agricultural activities in the communities are combined with urban employment of at least one household member. A second important form of mobility is seasonal migration to intermediate cities in the central jungle region where migrants work either on the coffee harvest (between March and August) or on the pineapple and ginger harvests. Other common forms of migration include short-term migration of young people to Lima during the school vacation period (January to February) and permanent migration to Lima and abroad.

More than one hour is needed to reach Huancayo from the highlands in the research site (in some cases several hours, depending on the location of the household); as a consequence, daily mobility is not common there. Households are often split; the mother and kids remain in the rural community while the father works and lives in the city of Huancayo. The most common migration destination is the United States where migrants work as shepherds under contracts that generally last for three years. At the end of this period, most migrants return to their community and bring back their earnings which are normally used for the house and to buy cattle. Other common destinations include Lima as well as several cities in Argentina and other foreign destinations. Only few migrants go to the central jungle for seasonal work.

The Peru case study shows an area in which households successfully integrate different forms of mobility into their livelihood diversification strategies. Most households using different forms of human mobility seem to be able to maximize their income and minimize livelihood risks through a mix of *in situ* and migration-related diversification strategies.

For more detailed information on this case study, please refer to Ho and Milan (2012) and Milan and Ho (2014).

Discussion and analysis

The outcomes of the field research show that human mobility in the eight case studies is attributed to various extents of rainfall variability combined with other factors. As indicated above, rural communities in the eight research locations are concerned about rainfall, particularly its timing, quantity and predictability, in addition to drought and dry spells. Most of the agriculture-based households report that rainfall variability negatively affects production and contributes to food and livelihood insecurity.

Whether human mobility is a successful adaptation strategy or a failure to adapt also varies across the case studies and across the households within each case study. Therefore, it is difficult to cluster or rank the case studies according to the success or failure in the migration process. However, one can rely on some indicators, such as comparing the overall situation of the households before and after the migration process in terms of physical assets (e.g. houses), income/financial remittances in addition to the education and skills acquired in the migration process; in the eight case studies in general, human mobility is largely driven by livelihood-related needs. However, in countries like

Thailand, Vietnam and Peru, where the households are relatively better off, there are a growing number of migrants seeking improved skill sets (e.g. through education and training). Particularly in Thailand and Vietnam, many move to industrial estates. In this case, one could carefully conclude that human mobility is a successful adaptation strategy. Here, it is important to highlight the role of remittances – especially in the cases of Thailand and Vietnam – in improving the financial situation of the households and in pushing migration towards being a successful adaptation strategy. The remittances represent a new flow of income for the communities who cannot afford migrating anymore. It provides them with new options for improving the quality of their livelihoods and start new micro-scale projects. Moreover, households that cannot afford high quality education could make use of the remittances for that purpose. All that adds a component of sustainability to the livelihoods, and contributes to the overall development of the communities

On the other hand, in cases where the overall situation leans towards more poverty, vulnerability and food insecurity, such as in Bangladesh, India, Guatemala, Ghana and Tanzania, human mobility is rather rural–rural (pastoralists moving within the borders of Tanzania but also crossing the borders to Kenya; and farmers seeking more productive agricultural areas). Particularly in Ghana, many move to mining areas, where they might increase their income; but, they expose themselves to more dangerous risks and become dependent on rather *informal* mining sites. At the same time, it is hard for the people left behind within the rainy season to handle the situation in absence of the needed labour. As to the case of India, when people migrate due to unemployment during the dry season to other areas, they mostly do so in families and expose their children to lower quality of education or even school dropouts.

Therefore, the last group of case studies (Bangladesh, India, Guatemala, Ghana and Tanzania) could in general terms – but not necessarily in all households – belong to the group of a failure to adapt, since as mentioned, in every case study there is a spectrum of conditions that vary across the households. For example, in the case of Bangladesh, we have the outliers of households that do not even need to migrate, as they are already well off, whereas there are other households in extreme poverty and vulnerability, for which migration is not even an option, as they lack the means to move and are forced to stay ‘trapped’ *in situ*. And in the case of Guatemala, although its households are regarded as relatively vulnerable as compared to the first group case studies, still remittances play an important role in the improvement of the livelihoods, especially in terms of new housing options. Table 1 summarizes the migration outcomes in relation to rain–fall variability and sheds light on the extent of migration being a successful adaptation strategy in the eight case studies covered in this article.

Conclusions and recommendations

From the analysis above, we conclude that for some households – regardless of the case study – there is high potential for migration to be a successful adaptation strategy. Some other households rather find it hard to adapt to the situation *in situ*; among them, some cannot afford moving to other areas to improve their livelihoods and remain ‘trapped’ while others do move, but barely survive or are even subject to worse conditions. The following overall recommendations are directed to national policy-makers in the eight case study countries, especially that there are overlaps and similar patterns across these case studies.

Table 1. Summary of migration outcomes in association with rainfall variability and food insecurity in the eight research sites.

Case study	Type of rainfall variability	Migration outcomes	Extent of success as adaptation
Bangladesh Northern Bangladesh (Kurigram region)	Significant changes in the annual monsoon cycle and drier periods during monsoon season	Seasonal labour migration and permanent out-migration has increased significantly over the past decades, caused to a large extent by food insecurity associated with rainfall variability	Migration does not save households from poverty, food insecurity or sensitivity to rainfall variability; the situation of the 'left behind' might deteriorate
India Janjgir–Champa district of Chhattisgarh State	Drought, delayed monsoon rains, seasonal shifts and more erratic monsoon rains	Migration is an important strategy to cope with rainfall variations and subsequent food insecurity	Family integration and slightly improved livelihoods but negative implications for education quality and overall schooling
Thailand Northern Thailand Ban-Puang subdistrict	Drought, dry spells and heavy rainfall	Migration is not exclusively associated with rainfall variability and food insecurity, but is a general strategy to cope with environmental and economic risks	Migration is a successful adaptation strategy: remittances, knowledge, better skills and technology transmitted by the migrants
Vietnam (Dong Thap Province) in the upper delta of the Mekong River	Increasing total amount of annual rainfall; heavier floods, longer rainy seasons; less predictable rainfall; storms, heavy rainfall and thunder and lightning	Out-migration has increased sharply, particularly in the past 10 years and is highly associated with diversifying livelihoods and reducing risks related to rainfall variability and food shortage, especially in the flood season	Migration is a successful adaptation strategy: migrant savings and remittances; livelihood diversification; better education and improved skills
Ghana Nadowli District of Ghana's Upper West region	Drought and dry spells	Traditional migration in response to temporary food shortages during the dry season has increasingly shifted towards the rainy season	Migration is a less successful adaptation strategy due to lack of labour in the rainy season and the movements to risky informal mining areas
Tanzania Same district of the Kilimanjaro region	Prolonged dry spells; later onset and earlier cessation of rains; increased frequency of heavy storms; increasing temperatures and stronger winds; decline in long season (<i>masika</i>) and total annual rainfall; reduced	Migration predominantly takes place due to increased drought frequency, longer drought periods and overall water shortage that negatively impacts the food supply	Migration is relatively successful but does not improve the situation <i>in situ</i> . The danger of people moving towards urban areas and changing their activities and hereby neglecting the land and agriculture is increasing

(Continued)

Table 1. (Continued).

Case study	Type of rainfall variability	Migration outcomes	Extent of success as adaptation
Guatemala Municipality of Cabricán in the Western Highlands of the country	number of rainy days per year Heavier rain and consequent humidity of the soil; unpredictability of rain and hail fall	Migration as a strategy of last resort – in cases of poverty and food insecurity – due to the strong attachment to land	Migration is only a successful adaptation strategy for better off households (using the remittances in building new houses ... etc.). However, for too poor households, migration might not be an option, since they lack the means for migration
Peru Region of Junín, in the Central Highlands of Peru	Increasingly unpredictable rainfall patterns; higher intensity and lower frequency of rainfall events; more heavy rains at unexpected times; and longer dry spells during the rainy season	Migration determined primarily by economic considerations, especially that food insecurity is rather a temporary and short-term issue	Migration is a relatively successful adaptation strategy, since migrants maximize their income and minimize livelihood risks through a mix of <i>in situ</i> and migration- related diversification strategies

Policy recommendations

The remaining question is how to make migration work for the migrants as well as their families/relatives *in situ*. It is difficult to provide universal recommendations that can be applied in the eight case studies, since the circumstances differ across them. Nevertheless, one can provide a list of general recommendations that might improve the situation *in situ* and others that might help the migration process being successful and beneficial.

In situ

From all the case studies above, it is clear that it is key to provide the communities with sufficient financial resources:

- To improve their livelihoods.
- To be able to diversify livelihoods and spread the risks.
- To compensate for the adverse impacts of climate change, specifically rainfall variability.
- To be able to move to other areas to improve their livelihoods.

An appropriate way in doing that might be providing them with microcredit or even direct loans repayable in the short and medium run. However, the financial means could also be made available by safety nets, such as cooperatives or religious institutions. What is needed is a better coordination between the various institutions and individuals to maximize the benefits of the communities.

In situ

- Providing the communities with more resources that partially compensate for the adverse effects of climate change/rainfall variability (e.g. facilitating irrigated agriculture where possible). The case of India is an example for that; the communities were complaining about the water scarcity of the canal and them overwhelmingly relying on rainfed agriculture. This is the reason why they could afford planting only paddy rice instead of diversifying their agricultural production and being therefore exposed to high risks. They claimed that the local government was not fair in distributing the canal water among the farmers.

Other options could be providing the farmers with better fertilizers to make the best use of the available scarce resources without overexploiting these.

- More job opportunities: for the communities to diversify their livelihoods, financial means are not sufficient; jobs need to be created *in situ*. Where the skills of the farmers are incompatible with the needs of local factories and enterprises, training programmes are required for the skills of the farmers to meet these needs, instead of importing skilled labour from elsewhere, which might also be expensive for the factories and enterprises.
- Awareness raising and education: it is essential to help the communities in economizing the usage of the scarce water resources and applying environment-friendly practices. For some communities, it would be important to diversify the crops and not only rely on one crop a year. Although cultural aspects often justify the use of a monoculture, intensive awareness raising about the benefits of spreading the risks could help the communities becoming more flexible in that aspect.

On the move

- Systematic and organized human mobility: the researchers observed in many of the case studies that local governments do not acknowledge out-migration and attempt to conceal it, as this might be regarded as a sign for their failure to secure the communities *in situ*. It is important that this perception is relaxed, since human mobility has always taken place historically and is not necessarily a negative matter. Once the local governments realize that fact, they could support the individuals willing to migrate in that decision. This would give human mobility an organized characteristic, where the migrants can be traced and are under the protection of the local governments/authorities. Accordingly, the migrants would be less exposed to harassment, exploitation, trafficking or to other similar risks during the migration process or in the areas of destination.
- Encouragement of sending remittances: as seen from the outcomes of the study, remittances play a crucial role in improving the situation of the households in the areas of origin. This applies to both the vulnerable and resilient households across the eight case studies. Mobilizing the sending of remittances by giving the migrants good incentives, such as incorporating them in *in situ* investments (e.g. micro-scale local projects) that are profitable for the migrants would create a multiplier for benefits of such remittances rather than the latter creating a one-on-one benefit by only sending them directly to the households. The local governments are encouraged to facilitate such investments and exempt them from any burdens that would deter the migrants from opting for that.

- Integration in the areas of destination: since the risk for migrants not being well perceived by host communities, it is necessary to maximize the benefits these communities acquire from migrants without the latter being exploited or subject to loss of dignity or identity. Therefore, it is important to help migrants occupy jobs that are compatible with their skills without them crowding out the host communities. It is also important to provide integration programmes that help both the migrants and the host communities integrate.

It is important to note that almost a common answer by the youth in the FGDs to the question: 'What would they like to do in the future?' was: 'We would like to explore other jobs than in the sector of agriculture'. The danger here lies in the fact that a vicious circle of land neglecting and nature deterioration could occur. And therefore, concrete interventions are needed.

Outlook for future research

Where the rain falls provides second generation research in the topic Climate Change and Human Mobility after several research projects that explored the issue on a broader level.³ The variables used in the project are more specific as compared to other studies; for example, the project does not address issues related to climate change in general but focuses on rainfall variability, which turned out to be an important variable in previous studies. Then, the project does not necessarily seek a direct causal relationship between rainfall variability and human mobility, but rather studies the interaction between this variable, food security and human mobility.

The research also provides a combination of qualitative methods that are supplemented by a quantitative survey, mostly with closed questions, in order for the researchers to be able to have quantified outcomes. Furthermore, instead of increasing the number of case studies, the research focuses on only eight case studies with a broad geographical scope, in order to run comparisons between the cases.

However, there are always challenges as well as take home lessons after accomplishing any study. An important limitation is the lack of follow-up of the respondents to record observations over a given period of time or in different seasons. In this situation, the responses on some key aspects of the study (e.g. rainfall variability) were largely dependent on the respondent's ability to recall past events.

Adapting the questionnaires to the different cultures and general circumstances that exist in each case study was an important issue. It was inevitable to do so in cases of tribal/cast contexts or when it comes to polygamy in some cultures (implications on which households to interview). Doing so without losing the possibility of comparing across the case studies was a challenge. A challenge linked to that is the translation of the questionnaires and whether they really capture all information required for conducting sound research, especially that the researchers do not always have control over such translations due to the lack of local language knowledge.

An important limitation is related to the generalization of the study findings. Since the research took place in only three villages within a particular district of a region, it is not possible to produce standard outcomes and apply them to an entire country.

The above are some examples of drawbacks/limitations that faced the research. However, the *Where the rain falls* research in general provides insightful outcomes that

future research could build on in the same or in other countries facing climatic problems and where human mobility is likely to be linked to such problems in the future.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This article is based on data collected during the 'Where the Rain Falls Project' which was supported by the AXA Group and the John D. and Catherine T. MacArthur Foundation.

Notes

1. More details about the *Where the rain falls* project (2012) can be found here <http://wheretherainfalls.org/>.
2. For detailed information about the methods, see Rademacher-Schulz et al. (2012).
3. An example for a first generation research project is the Environmental Change and Forced Migration Scenarios (EACH-FOR, 2009) project (sponsored by the European Commission in the sixth Framework Programme) that used semi-structured expert interviews and open question migrant and non-migrant questionnaires for exploring the issue. The Foresight report (2011) by the UK Government provides a meta-analysis of various research efforts and comes up with interesting overall conclusions in the same topic of interest.

Notes on contributors

Tamer Afifi is an independent researcher. Prior to this, Tamer was an associate academic officer in the Environmental Migration, Social Vulnerability and Adaptation (EMSVA) section of UNU-EHS. He primarily worked in the areas of environmental change, human displacement, economics of development and international economics. He has also worked for five years as a lecturer of economics at the Faculty of Commerce, Sohag University, Egypt, where he taught microeconomics, macroeconomics, international trade and econometrics. He is a co-author of the Global Policy Report of the Where the Rain Falls project (Warner, K., Afifi, T., Henry, K., Rawe, T., Smith, C., de Sherbinin, A., 2012) and co-authored 'Enhancing Adaptation Options and Managing Human Mobility in the Context of Climate Change, in Humanitarian Crises and Migration (eds.)' with Koko Warner (2014).

Andrea Milan is a research associate at the United Nations University Institute for Environment and Human Security (UNU-EHS) in Bonn. He is also a GPAC PhD Fellow in Governance and Policy Analysis at the United Nations University Maastricht Economic and Social Research Institute for Innovation and Training (UNU-MERIT) and Maastricht Graduate School of Governance (MGSOG). Milan's work focuses on social impacts of climate change as well as migration in the context of global environmental change. He has extensive knowledge in the fields of climate change adaptation, human migration in mountain areas and small island states. Andrea Milan has conducted empirical research in Bangladesh, Guatemala Haiti, Kiribati, Mexico, Nauru, Peru and Tuvalu. In the last three years, he has also lectured students and policy-makers in various countries.

Benjamin Etzold is a research associate and lecturer at the Department of Geography of the University of Bonn. For years, he has been dealing with relevant sociopolitical issues in the field of development geography, migration studies and labour geography. His regional focus is Bangladesh, West Africa and the European border space. He led the Bangladesh case study within the 'Where the rain falls' project and co-authored 'The Clouds gather in the sky, but no rain falls, Vulnerability to rainfall variability and food insecurity in Northern Bangladesh and its effects on migration' (Etzold, B., A.U. Ahmed, S.R. Hassan and S. Neelormi, 2014).

Benjamin Schraven is a senior researcher at the German Development Institute (DIE-GDI). He has worked extensively on the areas of environmental change and migration, livelihood resilience and smallholder agriculture. He has conducted field research in particular in West Africa. Furthermore, Benjamin frequently cooperates with international organizations such as the World Bank, the Global Migration Group or UNICEF. He has published numerous relevant articles including ‘Environmental degradation, climate change, migration and youth’ (eds., 2014) and ‘Smallholder adaptation to climate change: dynamics and limits in Northern Ghana’ (Laube, W., Schraven, B., and Awo, M., 2014).

Christina Rademacher-Schulz is an associate academic officer in the Environmental Migration, Social Vulnerability and Adaptation (EMSVA) section of UNU-EHS. She mainly works in the area of environmentally induced migration, livelihood resilience and natural resources management. She was responsible for the Ghana case study of the ‘Where the Rain falls’ project and engages in the development of new research projects. Furthermore, she manages the activities of her section within the COST Action IS 1101 ‘Climate change and migration’ programme, such as workshop or Training School organization and teaching. She is co-author of the article ‘Time matters: shifting seasonal migration in Northern Ghana in response to rainfall variability and food insecurity’ (Rademacher-Schulz, C., Schraven, B., Mahama, E. S., 2014) as well as the report of the ‘Where the Rain Falls’ case study: Results from Nadawli District, Upper West Region, Ghana (Rademacher-Schulz, C., and Mahama, E. S., 2012).

Patrick Sakdapolrak is a research group leader at the Geography Department of the University of Bonn. He is an expert in the field of social vulnerability, livelihoods and social resilience approaches, as well as migration and translocality. He has worked empirically in Thailand, India as well as Kenya. He was awarded a special prize for excellent practice-relevant research in the field of development studies (the KfW-Förderpreis) for his PhD thesis on health vulnerability among poor urban groups in India. In 2013, he had a temporary professorship for social geography and sustainability research at the LMU in Munich. He co-authored ‘Why successful in-situ adaptation with environmental stress does not prevent people from migrating? Empirical evidence from Northern Thailand’ (Sakdapolrak, P., Promburom, P., Reif, A. (2013) and published ‘Livelihoods as social practices. Re-energising livelihoods research with Bourdieu’s theory of practice’ (2014).

Alexander Reif is an independent scholar currently working as a policy officer for Education for Sustainable Development at Germanwatch. He has been working extensively on the research topics of climate change, migration studies, development geography, social resilience and translocality. He co-authored ‘Why successful in-situ adaptation with environmental stress does not prevent people from migrating? Empirical evidence from Northern Thailand’ (Sakdapolrak, P., Promburom, P., Reif, A., 2013).

Kees van der Geest is an associate academic officer at the United Nations University Institute for Environment and Human Security (UNU-EHS). He is a human geographer, specialized in studies of migration, environment, development, livelihood resilience and climate change (vulnerability, impact, adaptation, and loss and damage). He has extensive fieldwork experience, mostly in Ghana (5 years), but also in Burkina Faso, Vietnam, Bangladesh, Nepal and Bolivia. At UNU-EHS, he coordinates the work on ‘Loss and damage associated with climate change impacts’ and manages a 5-year research-to-action project about livelihood resilience in Bangladesh. Kees van der Geest co-authored the working paper ‘What the IPCC Fifth Assessment Report has to say about loss and damage’ together with Koko Warner (2015). He also published ‘Loss and damage from climate change: Local-level evidence from nine vulnerable countries’ (Warner, K. and van der Geest K., 2013).

Koko Warner is the head of the Environmental Migration, Social Vulnerability and Adaptation Section at the United Nations University Institute for Environment and Human Security (UNU-EHS). She has extensive knowledge in the areas of environmentally induced migration, social vulnerability, climate risk insurance and financial coping mechanisms. She is a lead author for the Intergovernmental Panel on Climate Change’s Fifth Assessment Report, Working Group 2 on Adaptation. Koko speaks and writes widely about these findings, and she also leads an

innovation lab – the Munich Climate Insurance Initiative – that tests new ideas about climate risk management strategies in practice. Koko brings these findings and possible solutions to decision-makers in national and international policy fora such as the UNFCCC climate negotiations. She has published in numerous journals and serves on the editorial board of the International Journal of Global Warming. She was one of the lead authors in the ‘Where the Rain Falls’ project and is a co-author of UNU-EHS Working paper ‘What the IPCC Fifth Assessment Report has to say about loss and damage’ (Van der Geest, K. and Warner K., 2015).

References

- Affii, T., Liwenga, E., & Kwezi, L. (2014). Rainfall-induced crop failure, food insecurity and out-migration in Same-Kilimanjaro, Tanzania. *Climate and Development*, 6, 53–60. doi:10.1080/17565529.2013.826128
- Ahsan, A. U., Hassan, S. R., Etzold, B., & Neelormi, S. (2012). “Where the Rain Falls” project. *Case study: Bangladesh. Results from Kurigram District, Bangladesh* (Report No. 2). Bonn: United Nations University Institute for Environment and Human Security.
- Ahmed, T., Mahfuz, M., Ireen, S., Ahmed, A. M. S., Rahman, S., Islam, M. M., ... Cravioto, A. (2012). Nutrition of children and women in Bangladesh: Trends and directions for the future. *Journal of Health Population and Nutrition*, 30(1), 1–11.
- Black, R., Arnell, N. W., Adger, N., Thomas, D., & Geddes, A. (2013). Migration, immobility and displacement outcomes following extreme events. *Environmental Science and Policy*, 27, 32–43.
- EACH-FOR. (2009). *Environmental change and forced migration scenarios (EACH-FOR) project*. An European Commission (EC) funded project in the 6th Framework Programme (FP6), Brussels. Retrieved from www.each-for.eu
- Etzold, B., Ahmed, A. U., Hassan, S. R., & Neelormi, S. (2014). Clouds gather in the sky, but no rain falls. Vulnerability to rainfall variability and food insecurity in Northern Bangladesh and its effects on migration. *Climate and Development*, 6, 18–27. doi:10.1080/17565529.2013.833078
- Findlay, A., & Geddes, A. (2011). Critical views on the relationship between climate change and migration: Some insights from the experience in Bangladesh. In E. Pigué, A. Pécoud, & P. de Guchteneire (Eds.), *Migration and climate change* (pp. 138–159). Paris: Cambridge University Press.
- Foresight: Migration and global environmental change*. (2011). Final project report. London: The Office for Science.
- Gray, C. L., & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. *Proceedings of the National Academy of Sciences of the United States of America*, 109, 6000–6005. doi:10.1073/pnas.1115944109
- Ho, R., & Milan, A. (2012). “Where the Rain Falls” project. *Case study: Peru. Results from Huancayo Province, Peru* (Report No. 5). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- IPCC glossary of terms*. (2012). Intergovernmental Panel on Climate Change. Retrieved from http://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf
- Khoa, N. V., Thao, N. C., & van der Geest, K. (2012). “Where the Rain Falls” project. *Case study: Vietnam. Results from Hung Thanh Commune in the Mekong Delta, Vietnam* (Report No. 8). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- Liwenga, E., Kwezi, L., & Affii, T. (2012). *Rainfall, food security and human mobility: Tanzania case study* (Report No. 6). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- Mallon, F. A. (1983). *The defense of community in Peru's Central Highlands: Peasant struggle and capitalist transition, 1860–1940*. Princeton, NJ: Princeton University Press.
- Milan, A., & Ho, R. (2014). Livelihood and its effects on migration patterns at different altitudes in the Central Highlands of Peru. *Climate and Development*, 6, 69–76, 18–27. doi:10.1080/17565529.2013.833078
- Milan, A., & Ruano, S. (2014). Rainfall variability, food insecurity and migration in Cabricán, Guatemala. *Climate and Development*, 6, 61–68. doi:10.1080/17565529.2013.857589
- Murali, J., & Affii, T. (2012). *Rainfall, food security and human mobility: India case study* (Report No. 4). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).

- Murali, J., & Afifi, T. (2014). Rainfall variability, food security and human mobility in the Janjgir-Champa district of Chhattisgarh state, India. *Climate and Development*, 6, 28–37. doi:10.1080/17565529.2013.867248
- Penning-Rowsell, E., Sultana, P., & Thompson, P. (2013). The ‘last resort’? Population movement in response to climate-related hazards in Bangladesh. *Environmental Science & Policy*, 27, 44–59. doi:10.1016/j.envsci.2012.03.009
- Peth, S., & Birtel, S. (2015). Translocal livelihoods and labor migration in Bangladesh: Migration decisions in the context of multiple insecurities and a changing environment. In B. Mallick & B. Etzold (Eds.), *Environment, migration and adaptation – Evidence and politics of climate change in Bangladesh* (pp. 99–118). Dhaka: AHDPH.
- Poncelet, A., Gemenne, F., Martiniello, M., & Boussetta, H. (2010). A country made for disasters: Environmental vulnerability and forced migration in Bangladesh. In T. Afifi & J. Jäger (Eds.), *Environment, forced migration and social vulnerability* (pp. 211–222). Berlin: Springer Verlag.
- Promburom, P., & Sakdapolrak, P. (2012). “Where the Rain Falls” project. Case study: Thailand. Results from Thung Hua Chang District, Northern Thailand (Report No. 7). Bonn: UNU-EHS.
- Rademacher-Schulz, C., Afifi, T., Warner, K., Rosenfeld, T., Milan, A., Etzold, B., & Sakdapolrak, P. (2012). *Rainfall variability, food insecurity and migration in Cabricán, Guatemala* (Intersections No. 10). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- Rademacher Schulz, C., & Mahama, E. S. (2012). “Where the Rain Falls” project. Case study: Ghana. Results from Nadowli District, Upper West Region, Ghana (Report No. 3). Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- Rademacher-Schulz, C., Schraven, B., & Mahama, E. S. (2014). Time matters: shifting seasonal migration in Northern Ghana in response to rainfall variability and food insecurity. *Climate and Development*, 6, 46–52. doi:10.1080/17565529.2013.830955
- Reif, A. (2012). *Translokaliätät als Aspekt sozialer Resilienz. Ein Fallbeispiel zur Rolle von Migration und Rücksendungen für die soziale Resilienz im ländlichen Nordthailand* [Translocality as a dimension of social resilience. A case study on the role of migration and remittances for social resilience in rural Thailand]. Bonn: University of Bonn.
- Ruano, S., & Milan, A. (2014). *Climate change, rainfall patterns, livelihoods and migration in Cabricán, Guatemala* (Report No. 14). Bonn: UNU-EHS.
- Sakdapolrak, P. (2014). *Building resilience through translocality. Climate change, migration and social resilience of rural communities in Thailand* (Trans Re Working Paper No. 1). Bonn: University of Bonn.
- Sakdapolrak, P., Promburom, P., & Reif, A. (2014). Why successful *in situ* adaptation with environmental stress does not prevent people from migrating? Empirical evidence from Northern Thailand. *Climate and Development*, 6, 38–45. doi:10.1080/17565529.2013.826129
- Smith, G. A. (1984). Confederations of households: Extended domestic enterprises in city and country. In N. Long & B. Roberts (Eds.), *Miners, peasants and entrepreneurs: Regional development in the central highlands of Peru* (pp. 217–234). Cambridge: Cambridge University Press.
- Stark, O., & Levhari, D. (1982). On migration and risk in LDCs. *Economic Development and Cultural Change*, 31, 191–196.
- Van der Geest, K., Khoa, N. V., & Thao, N. K. (2014). Internal migration in the Upper Mekong Delta, Viet Nam: What is the role of climate-related stressors? *Asia-Pacific Population Journal*, 29, 25–41.
- 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), 1–17. doi:10.1080/17565529.2013.835707
- Warner, K., Afifi, T., Henry, K., Rawe, T., Smith, C., & de Sherbinin, A. (2012). “Where the Rain Falls”: *Climate change, food and livelihood security, and migration. Global policy report of the Where the Rain Falls Project*. Bonn: UNU-EHS (United Nations University Institute for Environment and Human Security) and CARE.
- Where the rain falls. (2012). A research project in cooperation between the United Nations University Institute for Environment and Human Security (UNU-EHS) and CARE with the sponsorship of AXA Group and MacArthur Foundation. Retrieved from <http://wheretherainfalls.org/>