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## Working Paper 151

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# **Natural Disasters and Human Mobility**

Linguère Mously Mbaye and Klaus F. Zimmermann

## **Abstract**

This paper reviews the effect of natural disasters on human mobility or migration. Although there is an increase of natural disasters and migration recently and more patterns to observe, the relationship remains complex. While some authors find that disasters increase migration, others show that they have only a marginal or no effect or are even negative. Human mobility appears to be an insurance mechanism against environmental shocks and there are different transmission channels which can explain the relationship between natural disasters and migration. Moreover, migrants' remittances help to decrease households' vulnerability to shocks but also dampen their adverse effects. The paper provides a discussion of policy implications and potential future research avenues.

Keywords: natural disasters, forced migration, channels, remittances, migration as insurance, floods, earthquakes, droughts

JEL Codes: J61, O15, Q54, Q56

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# 1 Introduction

Natural disasters are often considered an important driver of migration. However, historical evidence shows that this relationship is not new and has existed since the beginning of human history. Nevertheless, the reactions are not well documented and the implications not yet fully understood, although the incidences of natural disasters and migration seem to have increased with more possibilities to study the evidence. The issue is very likely to become more relevant in the long run with global warming. Analyzing the short-term implications and the possible adjustment mechanisms is important, since this enables the introduction of reaction mechanisms to better deal with the consequences of a crisis. For instance, the migration response to a natural disaster is complex, it can be strong, moderate or even negative. People may be displaced and leave pushed by the challenges, or even move to the affected areas due to the new potentials arising.

The relationship between environmental disasters and migration is possibly one of the biggest challenges that future generations will face. Why is the relationship between natural disasters and migration so controversial? What are the transmission channels between natural disasters and migration? What are the consequences of migration decisions following natural disasters? This paper provides an overview of the literature on these specific points. The effect of natural disasters on migration is crucial because it has serious implications on economics, demography, and sociology. Subsequently, we draw on literature in these three areas.

The paper is structured as follows. Section 2 defines the topic and documents empirical trends. Section 3 explores the migration decision under the occurrence of natural disasters. Section 4 presents the transmission channels that can explain the relationship between natural disasters and migration. Section 5 discusses the consequences of the natural disasters on migration decision. More precisely, we assess if migration and associated remittances can help mitigate the environmental disasters' negative consequences, as well as the consequences in terms of other outputs. The last section presents the concluding remarks.

## 2 The research issue and empirical trends

A good reference introducing into the historical dimension of the topic is provided by Belasen and Polachek (2013), while we focus here more on historical empirical evidence since the mid- 19<sup>th</sup> century to more recent events. Gottschang (1987) documents migration driven by natural disasters such as floods and droughts in Northern China and Manchuria from 1890 to 1942. Boustan et al. (2012) use panel data from 1920 to 1940 in the United States (US) and consider disasters such as floods, tornadoes, earthquakes and hurricanes in a context where migration is a self-protection mechanism. They show that young men leave areas affected by tornados to settle in areas affected by floods. In the same country during the 1930's, Hornbeck (2012) documented how the Dust Bowl, caused by severe drought and intensive land use, had serious consequences on population decline in areas with high and medium erosion areas between 1930–1950.

Cross (2013) examines the period 1992–2008 to see how US communities deal with natural disasters such as storms, hurricanes, river flooding and tornadoes in terms of demographic changes. He found post-disaster relocation as well as more loss of population in small communities. This effect is related to the communities' level of wealth. Hurricane Katrina in 2005 was the major recent disaster that heavily impacted the US (Gutmann and Field, 2010; Vigdor, 2008) and induced the migration of 10,000 people in 26 states of the United States.

Based on a study from 1980 to 2009, Afonso (2011) shows that severe tropical storms induce migration in Central America and the Caribbean. Hanson and McIntosh (2012) are interested in migration between 25 Latin American and Caribbean countries and Canada, Spain, the US and the UK from 1980–2005. They found that labor supply, demand shocks and natural disasters are push factors for migration from Latin America to the US while this is not the case for migration to the other countries.

Furthermore, both developed and developing countries are already dealing with an increase in the severity of disasters and their effects. Figures related to natural disasters are both impressive and alarming. In developing countries such as Indonesia, a tsunami caused 500,000 victims in 2004 (Smith, 2007). Although the number of victims due to disasters decreased compared to the decade 1990–2000, it still remains high. According to the Annual Disasters and Statistical Review 2014 (Guha-Sapir et al., 2015), the annual average number of victims between 2004 and 2013 is estimated at 199.2 million people around the world. Economic damages from natural disasters are estimated at USD 99.2 billion in 2014.

The attached figures from the online appendix provided by Drabo and Mbaye (2013) document recent empirical evidence. The graphs show the trends of both natural disasters and migration from 1975 to 2000 with a focus on developing countries. For all regions of the world, natural disasters and migration exhibit an increasing trend over the period. The only exception was for Central Europe and Central Asia, where there was a decrease before 1990 but an increase then followed.

The Centre for Research in Epidemiological Disasters (CRED) considers all disasters sub-groups of extra-terrestrial disasters. Consequently, the term natural disasters include those that are geophysical (earthquake, mass movement, volcanic activity), meteorological (extreme temperature, fog, storm), hydrological (flood, landslide, wave action), climatological (glacial lake outburst, wildfire), and biological (epidemic, insect and animal infestation).

In the literature, different types of variables have been considered that pertain to the relationship between environmental factors and natural disasters. For instance, Reveuny and Moore (2009) found that environmental degradation, including both storms and land scarcity, increases out-migration. Other studies showed that weather anomalies measured through long-term deviations of rainfall and temperature are a migration determinant in Sub-Saharan Africa (Barrios et al., 2006; Marchiori et al.,



2012). Beine and Pearsons (2014) are interested both in long-term environmental factors with the use of rainfall and temperature data and short-term variables measured through natural disasters.

In this paper, we use the CRED's natural disasters definition, which relates to short-term shocks, and we also consider a broader concept of disasters that includes weather anomalies in a long-term perspective.

### **3 Natural disasters and migration: a controversial relationship**

To date, there is no consensus on the impact of natural disasters on migration. Studies by Black (2001) and Piguet and Pecoud (2011) highlight the need to relativize the scope of the natural disaster effect on so-called environmental refugees. The mixed evidence related to the role of disasters on migration is probably due to the fact that this relationship is complex and less straightforward than perceived by common knowledge.

Reuveny and Moore (2009) highlight the positive effect of environmental degradation on migration to developed countries. Drabo and Mbaye (2013), based on a study that focuses on developing countries, show that natural disasters mainly related to climate change increase overall migration. They specify in their study that this effect is driven by the most educated people, who can afford migration costs. Robalino et al. (2015) study the impact of hydro-meteorological disasters on internal migration in Costa Rica from 1995 to 2000. They find that there is a difference in the migratory response depending on the severity of shocks. On average, emergencies increase migration. However, those with the most severe consequences, measured in terms of death people, decrease migration. Gray and Bilsborrow (2013) confirm that climate variability may increase migration but the relationship is complex and presents some non-linearities. Using retrospective migration survey and data on topography, climate and weather shocks, they find that negative environmental shocks do not necessarily increase rural outmigration and can even decrease it. While internal migration does not necessarily respond to rainfall shocks, international migration is significantly influenced by environmental shocks.

Some studies find that environmental factors lead to both internal and international migration. This holds true for Marchiori et al. (2012), who find that weather anomalies may cause both internal and international migration in Sub-Saharan Africa. However, other studies show that seasonal and circular migration are more common than international mobility in the case of environmental shocks. Gray (2009) uses empirical evidence from Ecuador and shows that adverse environmental conditions do not necessarily increase out migration but do have an effect on internal migration. This has been confirmed by Beine and Parsons (2014) in a macroeconomic study; however, this internal effect depends on regions. For instance, Barrios et al. (2006) find an increasing effect of climate variables on internal migration only in Sub-Saharan Africa.

On the other hand, Deng (2011) explores the relationship between natural disasters and urban insecurity in China with rural-urban migration as a channel. Using Chinese data from 2002, her findings show that while natural disasters only slightly increase migration, they impact the composition of migrants in a structural way. Natural disasters force rural inhabitants to move while they would have stayed without the occurrence of these shocks. Moreover, in terms of wages, they earn less in urban areas than their counterparts, which may lead to an increase of urban insecurity.

Nonetheless, other evidence highlights the fact that long-term migration responds less to natural disasters than short-term migration. Henry et al. (2004) and Findley (1994) show in the case of West Africa (Burkina Faso and Mali, respectively) drought causes temporary and permanent migration to rural areas that have higher levels of rainfall. However, this effect depends on the destination and duration of migration.

Different types of disasters can cause different types of migration. Using multivariate events-history models with panel data from Bangladesh over the period 1994-2010, Gray and Mueller (2012b) show that floods only have marginal effects on migration. However, they mainly affect women and the poorest are not necessarily the most affected. On the other hand, crop failures highly influence migration. Finally, they suggest that natural disasters related to climate do not necessarily have an increasing effect on overall migration but can have a long-term effect on migration of rural

populations. According to Koubi et al. (2016), individual perceptions of drought, which can be assimilated to long term environmental event, decrease migration while perceptions of floods, assimilated to sudden environmental event, increase migration.

More generally it is even possible that disasters reduce migration. Halliday (2006) shows that in El Salvador, earthquakes decrease migration prospects by limiting access to savings and credits. The negative effect of disasters on migration is also due to the fact that public investment in affected areas can dampen the effect of self-protection mechanisms such as migration or because labor demand increases in affected areas (Boustan et al., 2012; Henri et al., 2004; Gray and Mueller, 2012a).

## **4 Indirect effects of disasters on migration: exploring transmission channels**

Migration is a coping mechanism against shocks (Stark and Levhari, 1982; Rosenzweig and Stark, 1989). The New Economics of Labor Migration literature developed the idea of migration as a strategy of risk diversification. More recently, Naudé (2010) and Beine and Parsons (2014) do not find a direct effect of natural disasters on migration but rather an indirect effect. For instance, Naudé (2010) argues that disasters may affect migration from Sub-Saharan Africa by inducing conflicts and negatively affecting Gross Domestic Product (GDP). When disasters increase vulnerability through channels such as agricultural productivity, economic growth, poverty or conflicts, people have to find coping mechanisms and migration is one of them. In this part, we will draw on literature on the impact on disasters on these transmission channels.

### **4.1 Natural disasters, economic growth and migration**

Felbermayr and Gröschl (2014), with data on physical strength of natural disasters from 1979 to 2010 recorded by geophysicists or meteorologists, find a negative relationship between disasters and real GDP per capita. More precisely, their results show that a disaster in the top one percentile of the disaster index distribution decrease GDP per capita by 6.83% while a disaster in the top 5 percentile disasters decrease GDP per capita by 0.46%. Fomby et al. (2013) use a cross-country panel data of 84 countries including 60 developing countries and 24 developed ones from 1960 to 2007. Their findings show that severe disasters have detrimental effects on growth. However, there are some differences depending on the type of disasters. While droughts have negative impacts on GDP growth, floods have positive effects. Negative impacts of growth appear in the short-term after the occurrence of the shock while the positive effects, if any, appear with some delays. Similar results have also been found previously by Loyza et al (2012).

The latter also show that there is some heterogeneity in the effects of weather shocks between developing and developed countries with more pronounced effects in the first type of countries. This has also been found by other studies in the literature. For instance, Gallup et al. (1999) find that extreme hot weather is correlated with poverty in 1950, and tropical countries are 50% poorer and have a slower growth rate (0.9 percentage points) per year between 1965 and 1990. Nordhaus (2006) shows that geographic factors including weather variables can explain 20% of the difference in income between Africa and industrialize countries. Looking at the link between historical variations in temperatures within countries and economic growth, Dell et al. (2012) find that high temperatures decrease economic growth but only in poor countries. Indeed, a 1°C increase in temperature decreases economic growth in poor countries by 1.39 percentage points. This negative effects of climate shocks is even more important for African and vulnerable countries.

For a cross-country analysis, Barrios et al. (2010) use panel climatic data, in particular rainfall anomalies and data from 1960 to 1990 of 60 countries including 22 African countries. They find that since the sixties a decrease in rainfall is responsible of the reduction between 15 and 40% of the gap in the African GDP per capita compare to other developing countries. Rasmussen (2004) shows that the cost of natural disasters is higher for small islands which are very vulnerable. Moreover, natural disasters decrease economic output, worsen the external and fiscal balance and increase poverty. In the same line, Noy (2009) found that developing countries and small economies suffer the most in the short-term in terms of adverse macroeconomic consequences of disasters.

## 4.2 Weather shocks, agricultural productivity and migration

Natural disasters can affect economic growth through different channels such as labor productivity (Seppanen et al., 2003), industrial outputs (Dell et al., 2012; Hsiang, 2010); health and mortality (Deschênes and Greenstone, 2011; Burgess et al., 2011), but also education and individual economic performance (Maccini and Yang, 2009).<sup>1</sup> Among all these factors, the most related to natural disasters is the agricultural productivity. Weather variables can negatively influence agricultural productivity (Schlenker and Lobell, 2010; Yang and Choi, 2007). For instance, Dell et al. (2012) show that an increase of 1°C in temperatures decreases growth in agricultural output by 2.66 percentage points in poor countries.

The negative consequence of weather shocks on crop yields can in turn translate into higher migration (e.g Hornbeck, 2012; Gray and Mueller, 2012b). For instance, rural families who have to deal with agricultural production risks may send a member to migrate to urban areas in order to diversify the household's income sources (Stark and Levhari, 1982). Munshi (2003) showed that a decrease in rainfall in Mexico leads to more emigration to the US. Using country level panel data from 1970 to 2009, Feng et al. (2012) show a negative relationship between countries level outmigration and crop yields in the Corn-Belt in the US. More precisely, they find that a 1 % decline in crop yields due to weather shocks increase the migration of the adult population by 0.17%. Weather induced yield shocks also impact negatively internal migration from the US (Feng et al., 2010).

## 4.3 Natural disasters, vulnerability and migration

Vulnerability is another channel closely linked to economic growth which can explain the relationship between natural disasters and migration. Carter et al. (2007) study severe environmental shocks' long-run economic impact in Ethiopia and Honduras. They find that these shocks severely affect the most vulnerable people, who can be caught into poverty traps. Poor households are thus put in a vicious circle. Since they are more vulnerable, they fall into poverty more easily than wealthier households and subsequently, this situation increases their vulnerability. The latter affects different groups in different ways. For instance, studies showed that women are more vulnerable to disasters (Enarson, 2000). Neumayer and Plümper (2008) focus on how natural disasters affect the gender gap in life expectancy. From an analysis based on 141 countries over the period 1981 to 2002, they show that natural disasters decrease life expectancy of women compared to men. This effect is persistent with the intensity of the disasters. Put differently, the natural disaster effect on the gender gap life expectancy increases with shock intensity. Countries where women have good socioeconomic status tend to have a lower effect of disasters on the gender gap life expectancy.

Schultz and Elliott (2012) use census and environmental hazards data from the US in the 1990s to show that disasters are positively associated with changes in local population growth and housing. Furthermore, post-disaster recovery can be at the origin of polarization in the socioeconomic structure of affected areas. Put differently, families at the top of the income distribution would positively benefit from these shocks while there would be no decrease in the number of poor in the communities.

There are other factors beyond vulnerability and inequality which can be considered as transmission channels between shocks and disasters. Arouri et al. (2015) use fixed effects at the commune level to

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<sup>1</sup> Dell et al. (2014) provide a review of the literature on the impact of the variation of temperature, rainfall and other extreme weather events on economic outcomes such as agricultural and industrial outputs, labor productivity, energy demand, health, conflict and economic growth. They discuss various studies, mainly based on panel estimates, which show that weather conditions have a significant impact on economic outcomes.

assess the effects of natural disasters on poverty and welfare in rural Vietnam. Considering floods, storms, and droughts, they find that these shocks negatively affect household expenditures and income. However, while these studies suggest that disasters can affect migration through different channels, other studies show that this is not necessary always the case. Gignoux and Menendez (2016) use panel individual level data and study the long term effects of earthquakes in rural Indonesia since 1985. They find some economic losses due to the shocks in the short-term. In the first 2 years after the shock, total expenditure per capita decrease by 10 percentage points compare to the situation before the earthquake. However, in the medium run, meaning between 2 and 5 years after the shock, individuals start recovering and in the long term or 6 to 12 years after the shock, total expenditure per capita are 10% higher than before the shock. These positive effects of the earthquake are mainly due to external aid which allows reconstituting physical assets and investing in public infrastructures. Gignoux and Menendez (2016) do not find any large population movement or reallocation of labor across sectors.

#### **4.4 Natural disasters, conflict and migration**

Natural disasters can induce some income shocks which will trigger conflict and then migration. For instance, Ghimire et al. (2015) compiled historical data on civil conflicts, large floods and displacement from 126 countries over the period 1985 to 2009. They show that while migration due to large floods is not at the origin of new conflicts, it can exacerbate existing conflicts, above all in developing countries, although this effect does not last overtime. According to Reuveny (2007), climate induced migration can lead to conflict in receiving areas. Subsequently, we are drawing literature on the link between natural disasters and conflicts.

Miguel et al. (2004) use rainfall variation as instrumental variable for economic growth in 41 African countries between 1981 and 1999. Controlling for country fixed effects, they found that a negative growth shock of 5 percentage points increase the likelihood of civil conflict by one-half in the following year. Moreover in the reduced-form, they show that the higher is the level of rainfall, the lower will be the likelihood of civil conflict in Africa. In the same vein, Miguel (2005) uses rainfall data from 67 villages in Tanzania for 11 years (1992-2002) and shows that extreme rainfall variation measuring income shocks is at the origin of violence and crime such as the murder of elderly women accused of witchcraft by their relatives.

Dell et al. (2012) found that high temperatures are associated with political instability and conflicts in poor countries. More precisely, a 1°C rise in temperature increase the likelihood of having a leader transition by 3.1 percentage points, in particular, through coups. Hsiang et al. (2013) use quantitative findings from 10,000 years BC to now, across the world and across disciplines to show that rainfall and temperatures variations have substantial effect on different conflict outcomes. More precisely, they found that one standard deviation change in extreme weather increase the frequency of interpersonal violence by 4% and intergroup conflict by 14%.

## **5 Consequences of migration decisions following disasters: the role of remittances**

In this part, we draw on the literature that assesses how migration can reduce the adverse effects of environmental disasters, particularly through remittances. Remittances are critical in dealing with natural disasters, both during the disaster and in the aftermath (Fagen, 2006). Indeed, compared to non-recipients, remittance receivers show decreased vulnerability to disasters and have better opportunities to deal with them (Savage and Suleri, 2006). Amuedo-Dorantes et al. (2011) are interested in the impact of natural disasters, foreign development aid and real exchange rates on remittances in the context of Small Islands Developing States. Using Panel VAR methods to deal with endogeneity issues, they found that both remittances inflows and foreign aid are positively responsive to natural disasters. Migrants clearly show altruistic behavior when their left-behind relatives have to deal with adverse negative shocks. At the same time, they show that remittances tend to be substitutable to other inflows such as foreign aid.

In another study, Mohapatra et al. (2012) look at remittances in the aftermath of natural disasters such as floods, earthquakes and droughts. They are also interested in examining if remittances help to prepare for future disasters. Using both macro and microeconomic analysis, they show that remittances are positively correlated with natural disasters in origin countries that have a high share of migrants relative to the total population. This positive effect of remittances is demonstrated in the ex-ante preparation of natural disasters, particularly from high-income countries since they are much larger amounts compared to internal migration transfer flows. Remittances also positively benefit households in responding to adverse environmental shocks. More specifically, evidence from Burkina Faso and Ghana show that those receiving remittance from OECD countries have better coping strategies for natural disasters because migrants' transfers provide them with opportunities to live in concrete houses and have easier access to means of communication. In Ethiopia, international remittance receivers can rely more on inflows than on household assets to insure food security in the case of shocks. Finally, the example of Bangladesh shows that in the aftermath of a flood in 1998, per capita household consumption was higher for remittance receivers.

Although natural disasters are cited among the determinants of remittances volatility (Jackman, 2013), in addition to the study of Mohapatra et al. (2012), other analyses show that remittances help dampen environmental disasters' negative effects. For instance, Arouri et al. (2015) found that internal remittances help to make households more resilient to natural disasters. Yang and Choi (2007) use rainfall shocks as instrumental variables to assess the relationship between remittances and income variations in the Philippines. They find that international remittances fulfill an insurance role during income shocks, with the replacement rate almost equal to 100%. Similarly, Yang (2008) shows that hurricanes increase the remittances in poor countries. Finally, from a sample of 113 developing countries over the period 1980 to 2007, Combes and Ebeke (2013) find that while natural disasters increase output growth volatility, remittances attenuated disasters' marginal destabilizing impact. However, this effect is not linear. For remittances rationed between 8 and 17% of GDP, the dampening effect of migrants' transfers is maximized. However in this same interval, remittances increase the instability due to disasters.

## 6 Concluding remarks

Both developing and developed countries have to deal with natural disasters. Migration plays an insurance role when households face adverse shocks. Moreover, due to remittances, migration helps those left-behind to cope with disasters.

The overview of the literature allows to understand why the relationship between natural disasters and migration is so controversial and why a consensus is so difficult to find in the literature. Indeed, while some studies find that natural disasters increase migration, others find that they decrease it or do not even have any impact on migration. One explanation is that it has been found that the effect of natural disasters on migration depends on the type of disaster and the effects need to be explored through a short- or long-term perspective. This illustrates the complexity of this relationship. More events have to be studied to obtain stable insights.

The variation of findings consequently raises various questions. The first one relates to the engagement of governments and public services in their work to assist people facing adverse environmental shocks. Indeed, if people only rely on migrants to help them to deal with shocks, what about those who do not have migrants in their households? This raises some important equity issues. The more vulnerable probably have fewer migrants in their households and thus are more exposed during shocks. This raises the issue to what extent public support and the use of private funds generated by migrants need to be coordinated.

The second issue is related to the research perspective. There is a need to better identify who exactly migrates when environmental disasters occur. It is also important to know whether remittances are sufficient enough to deal with shocks in the long term. Furthermore, as shown in the paper, natural disasters can affect migration through different channels such as economic growth, agricultural productivity or conflict. It would be important to have more research on how post disaster interventions to mitigate negative effects of shocks on these outcomes can affect migration flows. This opens various future avenues for research related to natural disasters and migration.



## 7 References

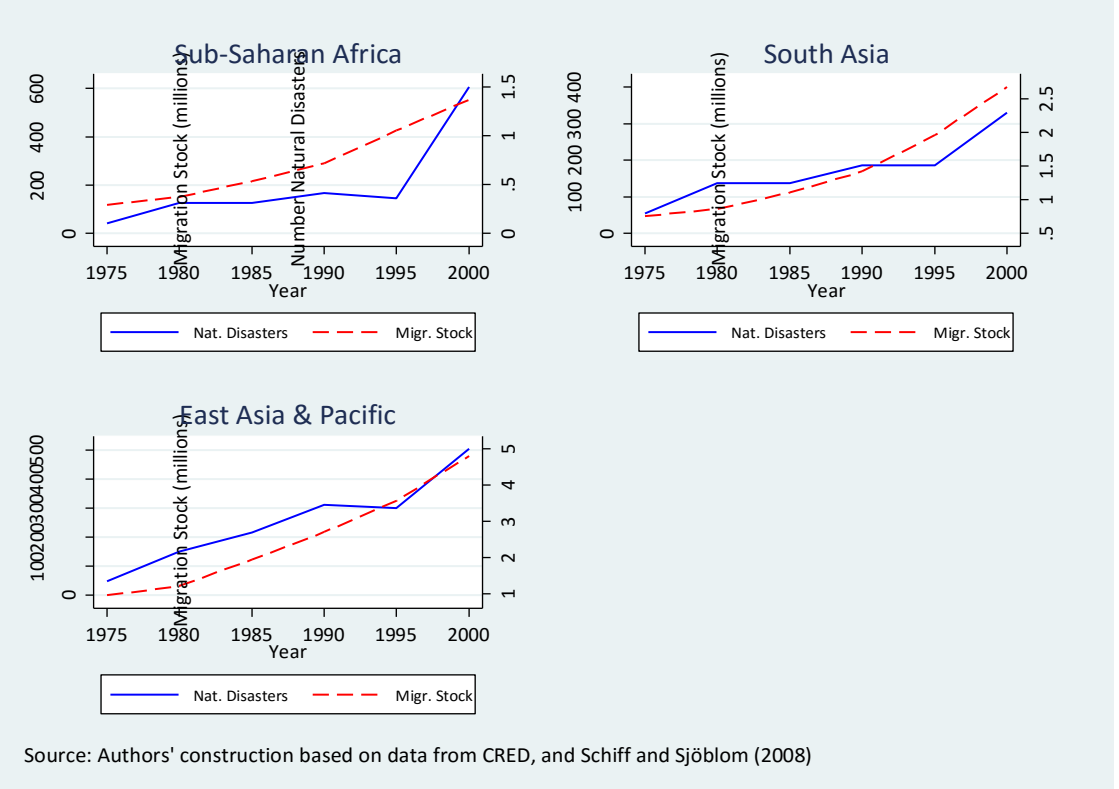
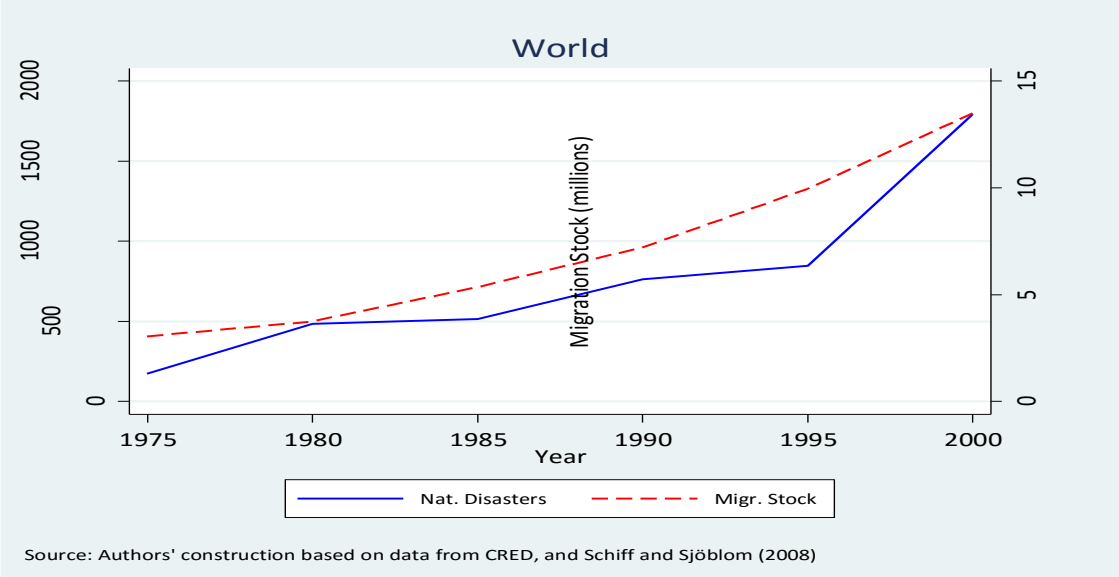
- Amuedo-Dorantes, C.; Pozo, S. & Vargas-Silva, C. (2010), 'Remittances in Small Island Developing States', *The Journal of Development Studies* 46(5), 941-960.
- Arouri, M.; Nguyen, C. & Youssef, A. B. (2015), 'Natural Disasters, Household Welfare, and Resilience: Evidence from Rural Vietnam', *World Development* 70, 59-77.
- Barrios, S.; Bertinelli, L. & Strobl, E. (2010), 'Trends in rainfall and economic growth in Africa: A neglected cause of the African growth tragedy', *The Review of Economics and Statistics* 92(2), 350-366.
- Beine, M. & Parsons, C. (2015), 'Climatic factors as determinants of International Migration', *The Scandinavian Journal of Economics* 117(2), 723--767.
- Belasen, A. R. & Polachek, S. W. (2013), Natural disasters and migration, in: A. F. Constant and K. F. Zimmermann (Eds.), *International Handbook on the Economics of Migration*. Edward Elgar Publishing, Inc., Cheltenham, UK. 309 - 330.
- Black, R. (2001), *Environmental refugees: myth or reality?*, Working Paper No. . 34, UNHCR.
- Boustan, L. P.; Kahn, M. E. & Rhode, P. W. (2012), 'Moving to higher ground: migration response to natural disasters in the early twentieth century', *The American Economic Review*, 102(3): 238-244.
- Burgess, R.; Deschenes, O.; Donaldson, D. & Greenstone, M. (2011), 'Weather and death in India', Cambridge, United States: Massachusetts Institute of Technology, Department of Economics. Manuscript.
- Combes, J.-L. & Ebeke, C. (2011), 'Remittances and Household Consumption Instability in Developing Countries', *World Development* 39(7), 1076-1089.
- Dell, M.; Jones, B. F. & Olken, B. A. (2012), 'Temperature shocks and economic growth: Evidence from the last half century', *American Economic Journal: Macroeconomics*, 4 (3): 66-95.
- Dell, M.; Jones, B. F. & Olken, B. A. (2014), 'What do we learn from the weather? The new climate-economy literature', *Journal of Economic Literature* 52(3), 740-798.
- Deng, Q. (2011), 'Natural disasters, migration and urban insecurity in China', mimeo, Chinese Academy of Social Sciences.
- Deschênes, O. & Greenstone, M. (2011), 'Climate Change, Mortality, and Adaptation: Evidence from Annual Fluctuations in Weather in the US', *American Economic Journal: Applied Economics* 3(4), 152-85.
- Drabo, A. & Mbaye, L. M. (2013), 'Natural disasters, migration and education: an empirical analysis in developing countries', *Environment and Development Economics*, 1--30.
- Enarson, E. P. (2000), *Gender and natural disasters*, ILO Geneva.
- Fagen, P. W. (2006), 'Remittances in conflict and crises: How remittances sustain livelihoods in war, crises and transitions to peace', Policy Paper International Peace Academy.
- Felbermayr, G. & Gröschl, J. (2014), 'Naturally negative: The growth effects of natural disasters', *Journal of Development Economics* 111, 92 - 106.
- Feng, S.; Krueger, A. B. & Oppenheimer, M. (2010), 'Linkages among climate change, crop yields and Mexico-US cross-border migration', *Proceedings of the National Academy of Sciences* 107(32), 14257--14262.
- Feng, S.; Oppenheimer, M. & Schlenker, W. (2012), 'Climate Change, Crop Yields, and Internal Migration in the United States'(17734), Technical report, National Bureau of Economic Research.
- Findley, S. E. (1994), 'Does Drought Increase Migration? A Study of Migration from Rural Mali during the 1983-1985 Drought', *International Migration Review* 28(3), pp. 539-553.
- Fomby, T.; Ikeda, Y. & Loayza, N. V. (2013), 'The growth aftermath of natural disasters', *Journal of Applied Econometrics* 28(3), 412-434.

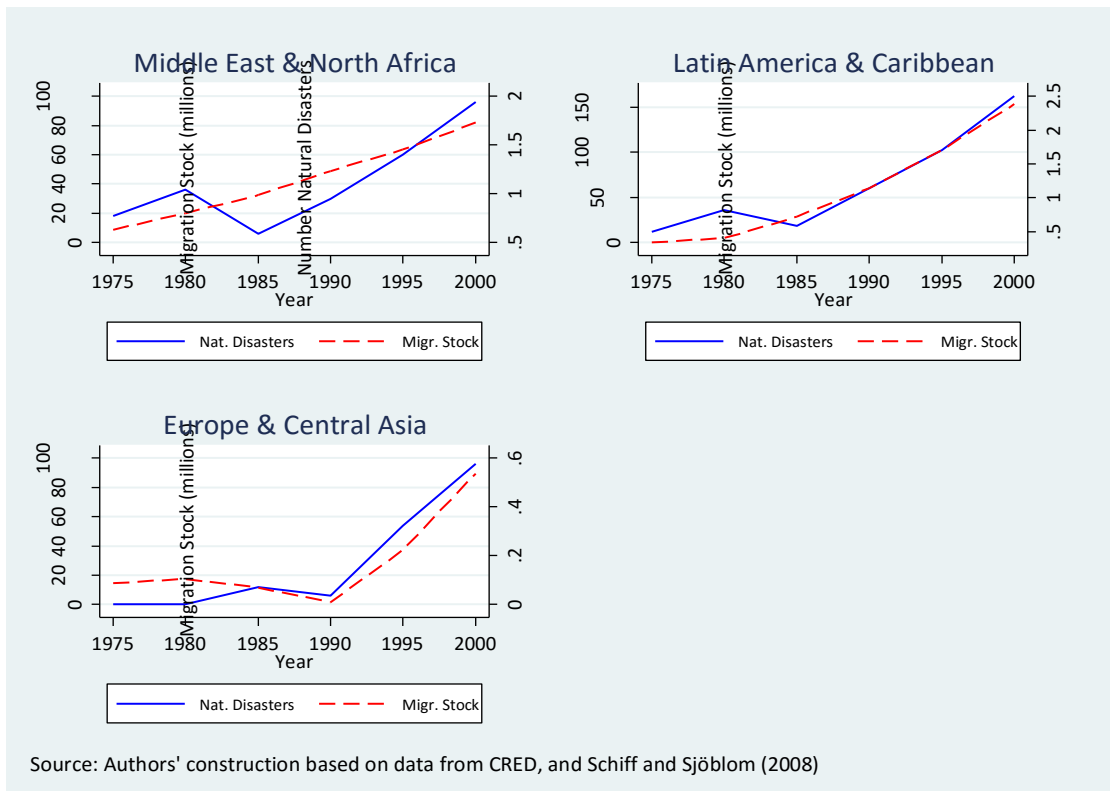
- Gallup, J. L.; Sachs, J. D. & Mellinger, A. D. (1999), 'Geography and economic development', *International Regional Science Review* 22(2), 179-232.
- Ghimire, R.; Ferreira, S. & Dorfman, J. H. (2015), 'Flood-induced displacement and civil conflict', *World Development* 66, 614--628.
- Guha-Sapir D, Hoyois Ph. , Below. R. (2015) *Annual Disaster Statistical Review 2014: The Numbers and Trends*. Brussels: CRED."
- Gignoux, J. & Menéndez, M. (2016), 'Benefit in the wake of disaster: Long-run effects of earthquakes on welfare in rural Indonesia', *Journal of Development Economics* 118, 26-44.
- Gray, C. & Bilsborrow, R. (2013), 'Environmental Influences on Human Migration in Rural Ecuador', *Demography* 50(4), 1217-1241.
- Gray, C. & Mueller, V. (2012a), 'Drought and Population Mobility in Rural Ethiopia', *World Development* 40(1), 134 - 145.
- Gray, C. L. & Mueller, V. (2012), 'Natural disasters and population mobility in Bangladesh', *Proceedings of the National Academy of Sciences* 109(16), 6000-6005.
- Gray, C. L. (2009), 'Environment, land, and rural out-migration in the southern Ecuadorian Andes', *World Development* 37(2), 457--468.
- Guha-Sapir, D.; Hoyois, P. & Below, R. (2013), *Annual Disaster Statistical Review 2012: The Numbers and Trends*. CRED, Université Catholique de Louvain, Brussels.
- Gutmann, M. P. & Field, V. (2010), 'Katrina in historical context: Environment and migration in the US', *Population and Environment* 31(1-3), 3--19.
- Halliday, T. (2006), 'Migration, Risk, and Liquidity Constraints in El Salvador', *Economic Development and Cultural Change* 54(4), pp. 893-925.
- Henry, S.; Schoumaker, B. & Beauchemin, C. (2004), 'The impact of rainfall on the first out-migration: A multi-level event-history analysis in Burkina Faso', *Population and Environment* 25(5), 423--460.
- Hornbeck, R. (2012), 'The Enduring Impact of the American Dust Bowl: Short- and Long-Run Adjustments to Environmental Catastrophe', *American Economic Review* 102(4), 1477-1507.
- Hsiang, S. M. (2010), 'Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America', *Proceedings of the National Academy of Sciences* 107(35), 15367-15372.
- Hsiang, S. M.; Burke, M. & Miguel, E. (2013), 'Quantifying the influence of climate on human conflict', *Science* 341(6151), 1235367.
- Jackman, M. (2013), 'Macroeconomic Determinants of Remittance Volatility: An Empirical Test', *International Migration* 51(s1), e36--e52.
- Koubi, V.; Spilker, G.; Schaffer, L. & Bernauer, T. (2016), 'Environmental Stressors and Migration: Evidence from Vietnam', *World Development* 79, 197-210.
- Loayza, N. V.; Olaberria, E.; Rigolini, J. & Christiaensen, L. (2012), 'Natural disasters and growth: Going beyond the averages', *World Development* 40(7), 1317-1336.
- Maccini, S. & Yang, D. (2009), 'Under the Weather: Health, Schooling, and Economic Consequences of Early-Life Rainfall', *American Economic Review* 99(3), 1006-26.
- Marchiori, L.; Maystadt, J.-F. & Schumacher, I. (2012), 'The impact of weather anomalies on migration in sub-Saharan Africa', *Journal of Environmental Economics and Management* 63(3), 355-374.
- Miguel, E. (2005), 'Poverty and witch killing', *The Review of Economic Studies* 72(4), 1153-1172.
- Miguel, E.; Satyanath, S. & Sergenti, E. (2004), 'Economic shocks and civil conflict: An instrumental variables approach', *Journal of Political Economy* 112(4), 725-753.

- 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.
- Munshi, K. (2003), 'Networks In The Modern Economy: Mexican Migrants In The U.S. Labor Market', *The Quarterly Journal of Economics* 118(2), 549-599.
- Naudé, W. (2010), 'The Determinants of Migration from Sub-Saharan African Countries-super- +', *Journal of African Economies* 19(3), 330-356.
- Neumayer, E. & Plümper, T. (2007), 'The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002', *Annals of the Association of American Geographers* 97(3), 551--566.
- Nordhaus, W. D. (2006), 'Geography and macroeconomics: New data and new findings', *Proceedings of the National Academy of Sciences of the United States of America* 103(10), 3510--3517.
- Noy, I. (2009), 'The macroeconomic consequences of disasters', *Journal of Development Economics*, 88(2), 221-231.
- Piguat, E. & Pecoud, A. (2011), *Migration and climate change*, Cambridge University Press.
- Rasmussen, T. N. (2004), 'Macroeconomic implications of natural disasters in the Caribbean. IMF working paper WP/04/224'.
- Reuveny, R. (2007), 'Climate change-induced migration and violent conflict', *Political Geography* 26(6), 656 - 673.
- Reuveny, R. & Moore, W. H. (2009), 'Does Environmental Degradation Influence Migration? Emigration to Developed Countries in the Late 1980s and 1990s\*', *Social Science Quarterly* 90(3), 461-479.
- Robalino, J.; Jimenez, J. & Chacón, A. (2015), 'The Effect of Hydro-Meteorological Emergencies on Internal Migration', *World Development* 67(C), 438-448.
- Rosenzweig, M. R. & Stark, O. (1989), 'Consumption smoothing, migration, and marriage: Evidence from rural India', *The Journal of Political Economy*, 905--926.
- Savage, K. & Suleri, A. (2006), 'Remittances in Crises: A Case Study from Pakistan', *Overseas Development Institute (ODI)*.
- Schlenker, W. & Lobell, D. B. (2010), 'Robust negative impacts of climate change on African agriculture', *Environmental Research Letters* 5(1), 014010.
- Schultz, J. & Elliott, J. R. (2013), 'Natural disasters and local demographic change in the United States', *Population and Environment* 34(3), 293--312.
- Seppanen, O.; Fisk, W. J. & Faulkner, D. (2003), 'Cost benefit analysis of the night-time ventilative cooling in office building', *Lawrence Berkeley National Laboratory*.
- Stark, O. & Levhari, D. (1982), 'On migration and risk in LDCs', *Economic Development and Cultural Change*, 191--196.
- Vigdor, J. (2008), 'The economic aftermath of Hurricane Katrina', *The Journal of Economic Perspectives* 22(4), 135--154.
- Yang, D. & Choi, H. (2007), 'Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines', *World Bank Economic Review* 21(2), 219-248.
- Yang, D. (2008), 'Coping with Disaster: The Impact of Hurricanes on International Financial Flows, 1970-2002', *The B.E. Journal of Economic Analysis & Policy* 8(1), 13.

# 8 Appendix

Figures: Trends of Natural Disasters and Migrant Stocks from Low and Lower Middle Income Countries<sup>i</sup>





Source: Drabo and Mbaye (2013)

<sup>i</sup> These figures are from Drabo and Mbaye (2013). In Drabo and Mbaye (2013), number of natural disasters represents the number of natural disasters over the period 1975-2000 and which are related to climate change such as meteorological disasters (storms), hydrological disasters (floods, and other wet mass-movements) and climatological disasters (drought, wildfire and extremely high temperatures). For the migration variable, emigration rates are calculated as the stocks of migrants from origin countries to the six main destination countries (Australia, Canada, France, Germany, the UK and the United States) for low, medium and high education levels, divided by the stock of people over 25 years old corresponding to the same education level in the origin country, plus the stock of migrants of the sending countries.

1. Evers, Hans-Dieter and Solvay Gerke (2005). Closing the Digital Divide: Southeast Asia's Path Towards a Knowledge Society.
2. Bhuiyan, Shajahan and Hans-Dieter Evers (2005). Social Capital and Sustainable Development: Theories and Concepts.
3. Schetter, Conrad (2005). Ethnicity and the Political Reconstruction of Afghanistan.
4. Kassahun, Samson (2005). Social Capital and Community Efficacy. In Poor Localities of Addis Ababa Ethiopia.
5. Fuest, Veronika (2005). Policies, Practices and Outcomes of Demand-oriented Community Water Supply in Ghana: The National Community Water and Sanitation Programme 1994 – 2004.
6. Menkhoff, Thomas and Hans-Dieter Evers (2005). Strategic Groups in a Knowledge Society: Knowledge Elites as Drivers of Biotechnology Development in Singapore.
7. Mollinga, Peter P. (2005). The Water Resources Policy Process in India: Centralisation, Polarisation and New Demands on Governance.
8. Evers, Hans-Dieter (2005). Wissen ist Macht: Experten als Strategische Gruppe.
- 8.a Evers, Hans-Dieter and Solvay Gerke (2005). Knowledge is Power: Experts as Strategic Group.
9. Fuest, Veronika (2005). Partnerschaft, Patronage oder Paternalismus? Eine empirische Analyse der Praxis universitärer Forschungs Kooperation mit Entwicklungsländern.
10. Laube, Wolfram (2005). Promise and Perils of Water Reform: Perspectives from Northern Ghana.
11. Mollinga, Peter P. (2004). Sleeping with the Enemy: Dichotomies and Polarisation in Indian Policy Debates on the Environmental and Social Effects of Irrigation.
12. Wall, Caleb (2006). Knowledge for Development: Local and External Knowledge in Development Research.
13. Laube, Wolfram and Eva Youkhana (2006). Cultural, Socio-Economic and Political Constraints for Virtual Water Trade: Perspectives from the Volta Basin, West Africa.
14. Hornidge, Anna-Katharina (2006). Singapore: The Knowledge-Hub in the Straits of Malacca.
15. Evers, Hans-Dieter and Caleb Wall (2006). Knowledge Loss: Managing Local Knowledge in Rural Uzbekistan.
16. Youkhana, Eva; Lautze, J. and B. Barry (2006). Changing Interfaces in Volta Basin Water Management: Customary, National and Transboundary.
17. Evers, Hans-Dieter and Solvay Gerke (2006). The Strategic Importance of the Straits of Malacca for World Trade and Regional Development.
18. Hornidge, Anna-Katharina (2006). Defining Knowledge in Germany and Singapore: Do the Country-Specific Definitions of Knowledge Converge?
19. Mollinga, Peter M. (2007). Water Policy – Water Politics: Social Engineering and Strategic Action in Water Sector Reform.
20. Evers, Hans-Dieter and Anna-Katharina Hornidge (2007). Knowledge Hubs Along the Straits of Malacca.
21. Sultana, Nayeem (2007). Trans-National Identities, Modes of Networking and Integration in a Multi-Cultural Society. A Study of Migrant Bangladeshis in Peninsular Malaysia.
22. Yalcin, Resul and Peter M. Mollinga (2007). Institutional Transformation in Uzbekistan's Agricultural and Water Resources Administration: The Creation of a New Bureaucracy.
23. Menkhoff, T.; Loh, P. H. M.; Chua, S. B.; Evers, H.-D. and Chay Yue Wah (2007). Riau Vegetables for Singapore Consumers: A Collaborative Knowledge-Transfer Project Across the Straits of Malacca.
24. Evers, Hans-Dieter and Solvay Gerke (2007). Social and Cultural Dimensions of Market Expansion.
25. Obeng, G. Y.; Evers, H.-D.; Akuffo, F. O., Braimah, I. and A. Brew-Hammond (2007). Solar PV Rural Electrification and Energy-Poverty Assessment in Ghana: A Principal Component Analysis.

26. Eguavoen, Irit; E. Youkhana (2008). Small Towns Face Big Challenge. The Management of Piped Systems after the Water Sector Reform in Ghana.
27. Evers, Hans-Dieter (2008). Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development
28. Ampomah, Ben Y.; Adjei, B. and E. Youkhana (2008). The Transboundary Water Resources Management Regime of the Volta Basin.
29. Saravanan.V.S.; McDonald, Geoffrey T. and Peter P. Mollinga (2008). Critical Review of Integrated Water Resources Management: Moving Beyond Polarised Discourse.
30. Laube, Wolfram; Awo, Martha and Benjamin Schraven (2008). Erratic Rains and Erratic Markets: Environmental change, economic globalisation and the expansion of shallow groundwater irrigation in West Africa.
31. Mollinga, Peter P. (2008). For a Political Sociology of Water Resources Management.
32. Hauck, Jennifer; Youkhana, Eva (2008). Histories of water and fisheries management in Northern Ghana.
33. Mollinga, Peter P. (2008). The Rational Organisation of Dissent. Boundary concepts, boundary objects and boundary settings in the interdisciplinary study of natural resources management.
34. Evers, Hans-Dieter; Gerke, Solvay (2009). Strategic Group Analysis.
35. Evers, Hans-Dieter; Benedikter, Simon (2009). Strategic Group Formation in the Mekong Delta - The Development of a Modern Hydraulic Society.
36. Obeng, George Yaw; Evers, Hans-Dieter (2009). Solar PV Rural Electrification and Energy-Poverty: A Review and Conceptual Framework With Reference to Ghana.
37. Scholtes, Fabian (2009). Analysing and explaining power in a capability perspective.
38. Eguavoen, Irit (2009). The Acquisition of Water Storage Facilities in the Abay River Basin, Ethiopia.
39. Hornidge, Anna-Katharina; Mehmood Ul Hassan; Mollinga, Peter P. (2009). 'Follow the Innovation' – A joint experimentation and learning approach to transdisciplinary innovation research.
40. Scholtes, Fabian (2009). How does moral knowledge matter in development practice, and how can it be researched?
41. Laube, Wolfram (2009). Creative Bureaucracy: Balancing power in irrigation administration in northern Ghana.
42. Laube, Wolfram (2009). Changing the Course of History? Implementing water reforms in Ghana and South Africa.
43. Scholtes, Fabian (2009). Status quo and prospects of smallholders in the Brazilian sugarcane and ethanol sector: Lessons for development and poverty reduction.
44. Evers, Hans-Dieter; Genschick, Sven; Schraven, Benjamin (2009). Constructing Epistemic Landscapes: Methods of GIS-Based Mapping.
45. Saravanan V.S. (2009). Integration of Policies in Framing Water Management Problem: Analysing Policy Processes using a Bayesian Network.
46. Saravanan V.S. (2009). Dancing to the Tune of Democracy: Agents Negotiating Power to Decentralise Water Management.
47. Huu, Pham Cong; Rhlers, Eckart; Saravanan, V. Subramanian (2009). Dyke System Planing: Theory and Practice in Can Tho City, Vietnam.
48. Evers, Hans-Dieter; Bauer, Tatjana (2009). Emerging Epistemic Landscapes: Knowledge Clusters in Ho Chi Minh City and the Mekong Delta.
49. Reis, Nadine; Mollinga, Peter P. (2009). Microcredit for Rural Water Supply and Sanitation in the Mekong Delta. Policy implementation between the needs for clean water and 'beautiful latrines'.
50. Gerke, Solvay; Ehlert, Judith (2009). Local Knowledge as Strategic Resource: Fishery in the Seasonal Floodplains of the Mekong Delta, Vietnam

51. Schraven, Benjamin; Eguavoen, Irit; Manske, Günther (2009). Doctoral degrees for capacity development: Results from a survey among African BiGS-DR alumni.
52. Nguyen, Loan (2010). Legal Framework of the Water Sector in Vietnam.
53. Nguyen, Loan (2010). Problems of Law Enforcement in Vietnam. The Case of Wastewater Management in Can Tho City.
54. Oberkircher, Lisa et al. (2010). Rethinking Water Management in Khorezm, Uzbekistan. Concepts and Recommendations.
55. Waibel, Gabi (2010). State Management in Transition: Understanding Water Resources Management in Vietnam.
56. Saravanan V.S.; Mollinga, Peter P. (2010). Water Pollution and Human Health. Transdisciplinary Research on Risk Governance in a Complex Society.
57. Vormoor, Klaus (2010). Water Engineering, Agricultural Development and Socio-Economic Trends in the Mekong Delta, Vietnam.
58. Hornidge, Anna-Katharina; Kurfürst, Sandra (2010). Envisioning the Future, Conceptualising Public Space. Hanoi and Singapore Negotiating Spaces for Negotiation.
59. Mollinga, Peter P. (2010). Transdisciplinary Method for Water Pollution and Human Health Research.
60. Youkhana, Eva (2010). Gender and the development of handicraft production in rural Yucatán/Mexico.
61. Naz, Farhat; Saravanan V. Subramanian (2010). Water Management across Space and Time in India.
62. Evers, Hans-Dieter; Nordin, Ramli, Nienkemoer, Pamela (2010). Knowledge Cluster Formation in Peninsular Malaysia: The Emergence of an Epistemic Landscape.
63. Mehmood Ul Hassan; Hornidge, Anna-Katharina (2010). 'Follow the Innovation' – The second year of a joint experimentation and learning approach to transdisciplinary research in Uzbekistan.
64. Mollinga, Peter P. (2010). Boundary concepts for interdisciplinary analysis of irrigation water management in South Asia.
65. Noelle-Karimi, Christine (2006). Village Institutions in the Perception of National and International Actors in Afghanistan. **(Amu Darya Project Working Paper No. 1)**
66. Kuzmits, Bernd (2006). Cross-bordering Water Management in Central Asia. **(Amu Darya Project Working Paper No. 2)**
67. Schetter, Conrad; Glassner, Rainer; Karokhail, Masood (2006). Understanding Local Violence. Security Arrangements in Kandahar, Kunduz and Paktia. **(Amu Darya Project Working Paper No. 3)**
68. Shah, Usman (2007). Livelihoods in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. **(Amu Darya Project Working Paper No. 4)**
69. ter Steege, Bernie (2007). Infrastructure and Water Distribution in the Asqalan and Sufi-Qarayateem Canal Irrigation Systems in the Kunduz River Basin. **(Amu Darya Project Working Paper No. 5)**
70. Mielke, Katja (2007). On The Concept of 'Village' in Northeastern Afghanistan. Explorations from Kunduz Province. **(Amu Darya Project Working Paper No. 6)**
71. Mielke, Katja; Glassner, Rainer; Schetter, Conrad; Yarash, Nasratullah (2007). Local Governance in Warsaj and Farkhar Districts. **(Amu Darya Project Working Paper No. 7)**
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73. Yarash, Nasratullah; Smith, Paul; Mielke, Katja (2010). The fuel economy of mountain villages in Ishkamish and Burka (Northeast Afghanistan). Rural subsistence and urban marketing patterns. **(Amu Darya Project Working Paper No. 9)**
74. Oberkircher, Lisa (2011). 'Stay – We Will Serve You Plov!'. Puzzles and pitfalls of water research in rural Uzbekistan.
75. Shtaltovna, Anastasiya; Hornidge, Anna-Katharina; Mollinga, Peter P. (2011). The Reinvention of Agricultural Service Organisations in Uzbekistan – a Machine-Tractor Park in the Khorezm Region.



76. Stellmacher, Till; Grote, Ulrike (2011). Forest Coffee Certification in Ethiopia: Economic Boon or Ecological Bane?
77. Gatzweiler, Franz W.; Baumüller, Heike; Ladenburger, Christine; von Braun, Joachim (2011). Marginality. Addressing the roots causes of extreme poverty.
78. Mielke, Katja; Schetter, Conrad; Wilde, Andreas (2011). Dimensions of Social Order: Empirical Fact, Analytical Framework and Boundary Concept.
79. Yarash, Nasratullah; Mielke, Katja (2011). The Social Order of the Bazaar: Socio-economic embedding of Retail and Trade in Kunduz and Imam Sahib
80. Baumüller, Heike; Ladenburger, Christine; von Braun, Joachim (2011). Innovative business approaches for the reduction of extreme poverty and marginality?
81. Ziai, Aram (2011). Some reflections on the concept of 'development'.
82. Saravanan V.S., Mollinga, Peter P. (2011). The Environment and Human Health - An Agenda for Research.
83. Eguavoen, Irit; Tesfai, Weyni (2011). Rebuilding livelihoods after dam-induced relocation in Koga, Blue Nile basin, Ethiopia.
84. Eguavoen, I., Sisay Demeku Derib et al. (2011). Digging, damming or diverting? Small-scale irrigation in the Blue Nile basin, Ethiopia.
85. Genschick, Sven (2011). Pangasius at risk - Governance in farming and processing, and the role of different capital.
86. Quy-Hanh Nguyen, Hans-Dieter Evers (2011). Farmers as knowledge brokers: Analysing three cases from Vietnam's Mekong Delta.
87. Poos, Wolf Henrik (2011). The local governance of social security in rural Surkhondarya, Uzbekistan. Post-Soviet community, state and social order.
88. Graw, Valerie; Ladenburger, Christine (2012). Mapping Marginality Hotspots. Geographical Targeting for Poverty Reduction.
89. Gerke, Solvay; Evers, Hans-Dieter (2012). Looking East, looking West: Penang as a Knowledge Hub.
90. Turaeva, Rano (2012). Innovation policies in Uzbekistan: Path taken by ZEFa project on innovations in the sphere of agriculture.
91. Gleisberg-Gerber, Katrin (2012). Livelihoods and land management in the Ioba Province in south-western Burkina Faso.
92. Hiemenz, Ulrich (2012). The Politics of the Fight Against Food Price Volatility – Where do we stand and where are we heading?
93. Baumüller, Heike (2012). Facilitating agricultural technology adoption among the poor: The role of service delivery through mobile phones.
94. Akpabio, Emmanuel M.; Saravanan V.S. (2012). Water Supply and Sanitation Practices in Nigeria: Applying Local Ecological Knowledge to Understand Complexity.
95. Evers, Hans-Dieter; Nordin, Ramli (2012). The Symbolic Universe of Cyberjaya, Malaysia.
96. Akpabio, Emmanuel M. (2012). Water Supply and Sanitation Services Sector in Nigeria: The Policy Trend and Practice Constraints.
97. Boboyorov, Hafiz (2012). Masters and Networks of Knowledge Production and Transfer in the Cotton Sector of Southern Tajikistan.
98. Van Assche, Kristof; Hornidge, Anna-Katharina (2012). Knowledge in rural transitions - formal and informal underpinnings of land governance in Khorezm.
99. Eguavoen, Irit (2012). Blessing and destruction. Climate change and trajectories of blame in Northern Ghana.
100. Callo-Concha, Daniel; Gaiser, Thomas and Ewert, Frank (2012). Farming and cropping systems in the West African Sudanian Savanna. WASCAL research area: Northern Ghana, Southwest Burkina Faso and Northern Benin.

101. Sow, Papa (2012). Uncertainties and conflicting environmental adaptation strategies in the region of the Pink Lake, Senegal.
102. Tan, Siwei (2012). Reconsidering the Vietnamese development vision of “industrialisation and modernisation by 2020”.
103. Ziai, Aram (2012). Postcolonial perspectives on ‘development’.
104. Kelboro, Girma; Stellmacher, Till (2012). Contesting the National Park theorem? Governance and land use in Nech Sar National Park, Ethiopia.
105. Kotsila, Panagiota (2012). “Health is gold”: Institutional structures and the realities of health access in the Mekong Delta, Vietnam.
106. Mandler, Andreas (2013). Knowledge and Governance Arrangements in Agricultural Production: Negotiating Access to Arable Land in Zarafshan Valley, Tajikistan.
107. Tsegai, Daniel; McBain, Florence; Tischbein, Bernhard (2013). Water, sanitation and hygiene: the missing link with agriculture.
108. Pangaribowo, Evita Hanie; Gerber, Nicolas; Torero, Maximo (2013). Food and Nutrition Security Indicators: A Review.
109. von Braun, Joachim; Gerber, Nicolas; Mirzabaev, Alisher; Nkonya Ephraim (2013). The Economics of Land Degradation.
110. Stellmacher, Till (2013). Local forest governance in Ethiopia: Between legal pluralism and livelihood realities.
111. Evers, Hans-Dieter; Purwaningrum, Farah (2013). Japanese Automobile Conglomerates in Indonesia: Knowledge Transfer within an Industrial Cluster in the Jakarta Metropolitan Area.
112. Waibel, Gabi; Benedikter, Simon (2013). The formation water user groups in a nexus of central directives and local administration in the Mekong Delta, Vietnam.
113. Ayaribilla Akudugu, Jonas; Laube, Wolfram (2013). Implementing Local Economic Development in Ghana: Multiple Actors and Rationalities.
114. Malek, Mohammad Abdul; Hossain, Md. Amzad; Saha, Ratnajit; Gatzweiler, Franz W. (2013). Mapping marginality hotspots and agricultural potentials in Bangladesh.
115. Siriwardane, Rapti; Winands, Sarah (2013). Between hope and hype: Traditional knowledge(s) held by marginal communities.
116. Nguyen, Thi Phuong Loan (2013). The Legal Framework of Vietnam’s Water Sector: Update 2013.
117. Shtaltovna, Anastasiya (2013). Knowledge gaps and rural development in Tajikistan. Agricultural advisory services as a panacea?
118. Van Assche, Kristof; Hornidge, Anna-Katharina; Shtaltovna, Anastasiya; Boboyorov, Hafiz (2013). Epistemic cultures, knowledge cultures and the transition of agricultural expertise. Rural development in Tajikistan, Uzbekistan and Georgia.
119. Schädler, Manuel; Gatzweiler, Franz W. (2013). Institutional Environments for Enabling Agricultural Technology Innovations: The role of Land Rights in Ethiopia, Ghana, India and Bangladesh.
120. Eguavo, Irit; Schulz, Karsten; de Wit, Sara; Weisser, Florian; Müller-Mahn, Detlef (2013). Political dimensions of climate change adaptation. Conceptual reflections and African examples.
121. Feuer, Hart Nadav; Hornidge, Anna-Katharina; Schetter, Conrad (2013). Rebuilding Knowledge. Opportunities and risks for higher education in post-conflict regions.
122. Dörendahl, Esther I. (2013). Boundary work and water resources. Towards improved management and research practice?
123. Baumüller, Heike (2013). Mobile Technology Trends and their Potential for Agricultural Development
124. Saravanan, V.S. (2013). “Blame it on the community, immunize the state and the international agencies.” An assessment of water supply and sanitation programs in India.

125. Ariff, Syamimi; Evers, Hans-Dieter; Ndah, Anthony Banyouko; Purwaningrum, Farah (2014). Governing Knowledge for Development: Knowledge Clusters in Brunei Darussalam and Malaysia.
126. Bao, Chao; Jia, Lili (2014). Residential fresh water demand in China. A panel data analysis.
127. Siriwardane, Rapti (2014). War, Migration and Modernity: The Micro-politics of the Hijab in Northeastern Sri Lanka.
128. Kirui, Oliver Kiptoo; Mirzabaev, Alisher (2014). Economics of Land Degradation in Eastern Africa.
129. Evers, Hans-Dieter (2014). Governing Maritime Space: The South China Sea as a Mediterranean Cultural Area.
130. Saravanan, V. S.; Mavalankar, D.; Kulkarni, S.; Nussbaum, S.; Weigelt, M. (2014). Metabolized-water breeding diseases in urban India: Socio-spatiality of water problems and health burden in Ahmedabad.
131. Zulfiqar, Ali; Mujeri, Mustafa K.; Badrun Nessa, Ahmed (2014). Extreme Poverty and Marginality in Bangladesh: Review of Extreme Poverty Focused Innovative Programmes.
132. Schwachula, Anna; Vila Seoane, Maximiliano; Hornidge, Anna-Katharina (2014). Science, technology and innovation in the context of development. An overview of concepts and corresponding policies recommended by international organizations.
133. Callo-Concha, Daniel (2014). Approaches to managing disturbance and change: Resilience, vulnerability and adaptability.
134. Mc Bain, Florence (2014). Health insurance and health environment: India's subsidized health insurance in a context of limited water and sanitation services.
135. Mirzabaev, Alisher; Guta, Dawit; Goedecke, Jann; Gaur, Varun; Börner, Jan; Virchow, Detlef; Denich, Manfred; von Braun, Joachim (2014). Bioenergy, Food Security and Poverty Reduction: Mitigating tradeoffs and promoting synergies along the Water-Energy-Food Security Nexus.
136. Iskandar, Deden Dinar; Gatzweiler, Franz (2014). An optimization model for technology adoption of marginalized smallholders: Theoretical support for matching technological and institutional innovations.
137. Bühler, Dorothee; Grote, Ulrike; Hartje, Rebecca; Ker, Bopha; Lam, Do Truong; Nguyen, Loc Duc; Nguyen, Trung Thanh; Tong, Kimsun (2015). Rural Livelihood Strategies in Cambodia: Evidence from a household survey in Stung Treng.
138. Amankwah, Kwadwo; Shtaltovna, Anastasiya; Kelboro, Girma; Hornidge, Anna-Katharina (2015). A Critical Review of the Follow-the-Innovation Approach: Stakeholder collaboration and agricultural innovation development.
139. Wiesmann, Doris; Biesalski, Hans Konrad; von Grebmer, Klaus; Bernstein, Jill (2015). Methodological review and revision of the Global Hunger Index.
140. Eguavo, Irit; Wahren, Julia (2015). Climate change adaptation in Burkina Faso: aid dependency and obstacles to political participation. Adaptation au changement climatique au Burkina Faso: la dépendance à l'aide et les obstacles à la participation politique.
141. Youkhana, Eva. Postponed to 2016 (147).
142. Von Braun, Joachim; Kalkuhl, Matthias (2015). International Science and Policy Interaction for Improved Food and Nutrition Security: toward an International Panel on Food and Nutrition (IPFN).
143. Mohr, Anna; Beuchelt, Tina; Schneider, Rafaël; Virchow, Detlef (2015). A rights-based food security principle for biomass sustainability standards and certification systems.
144. Husmann, Christine; von Braun, Joachim; Badiane, Ousmane; Akinbamijo, Yemi; Fatunbi, Oluwole Abiodun; Virchow, Detlef (2015). Tapping Potentials of Innovation for Food Security and Sustainable Agricultural Growth: An Africa-Wide Perspective.
145. Laube, Wolfram (2015). Changing Aspirations, Cultural Models of Success, and Social Mobility in Northern Ghana.
146. Narayanan, Sudha; Gerber, Nicolas (2016). Social Safety Nets for Food and Nutritional Security in India.

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