UNDERSTANDING SOCIAL VULNERABILITY TO CLIMATE CHANGE USING A 'RISKSCAPES' LENS: CASE STUDIES FROM ETHIOPIA AND TANZANIA

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Summary: This paper uses the concept of riskscapes to understand the way climate risks manifest themselves and interact with other risks to create vulnerable local communities in Ethiopia and Tanzania. The main research question we addressed is: what are the different sources of risks facing farmers' livelihoods in the selected case study areas of both countries and where does climate risk fit? The study uses qualitative research methodology with thick description of our case studies to identify variables which are common in both countries. Accordingly, we identified six major risk settings which are important in determining the vulnerability of communities, namely 'climate hazard risk setting', 'subsistence risk setting', 'population increase risk setting', 'state policy failure risk setting', 'market volatility risk setting', and 'supernatural risk setting'. Our findings highlight two important points. First, the interaction between risk settings and climate risks differs from one place to another, depending on the ecological endowment and social fabric of the area of interest. Second, local communities and experts attach different importance to the six risk settings identified and the interaction between them, making up local community and expert riskscapes. Hence, we argue that effective climate risk management in the context of sub-Saharan Africa requires proper understanding of the way various risk settings interact with climate risk, and of the different weight that relevant actors attribute to these risks and their interaction.

Zusammenfassung: In dem Beitrag wird das theoretische Konzept der riskscapes aufgegriffen und am Beispiel von lokalen Gemeinschaften in Äthiopien und Tansania untersucht, wie sich Klimarisiken manifestieren und in welcher Wechselwirkung sie mit anderen Risiken stehen. Die zugrundeliegende Forschungsfrage zielt darauf ab, die unterschiedlichen Risiken bäuerlicher Lebensgemeinschaften in den Untersuchungsräumen aufzuzeigen und die Bedeutung von Klimarisiken zu identifizieren. Auf der Basis eines qualitativen Forschungsansatzes werden in beiden Ländern übereinstimmende Risikovariablen herausgearbeitet und hinsichtlich ihrer Wechselwirkungen beschrieben. Es konnten sechs Hauptrisikokonstellationen identifiziert werden, denen übergeordnete Bedeutung bei der Vulnerabilitätsbeurteilung der ländlichen Gemeinschaften zukommt: „Klimagefahren", „Lebensunterhalt", „Bevölkerungswachstum", „Politikversagen", „Marktschwankungen" und „Übernatürliches". Die Untersuchungen heben zwei wichtige Aspekte hervor. Erstens, die Wechselwirkung zwischen Risikokonstellation und Klimarisiken unterscheidet sich von Ort zu Ort, je nach Sozialgefüge und ökologischer Gegebenheit. Zweitens, lokale Gemeinschaften und ExptertInnen messen den sechs unterschiedlichen Risikokonstellationen unterschiedliche Bedeutung zu, so entstehen riskscapes der lokalen Gemeinschaften und riskscapes der ExpertInnen. Daraus resultierend argumentieren wir, dass effektives Management der Klimarisiken in Subsahara-Afrika ein angemessenes Verständnis über die unterschiedlichen Risikokonstellationen, die mit Klimarisiken in Wechselwirkung stehen, notwendig ist. Außerdem sollten die unterschiedlichen Bewertungen, die die relevanten Akteure diesen Risiken und Wechselwirkungen zuschreiben, einbezogen werden.

Keywords: Riskscapes, vulnerability, climate change, adaptation, sub-Saharan Africa, risk management

1 Introduction

Climate change is becoming a ubiquitous topic with recent associations of climate change with tropical cyclones (Knutson et al. 2010), the conflict in Syria (Gleick 2014), food security (Wheeler and Braun 2013) or mass migration (Black et al. 2011). Although it is not easy to attribute specific climate/weather events to climate change, there is an overall agreement that climate change affects all extreme events because they occur in an environment which is warmer than before (Trenberth 2012). That being said, the implications of climate change are being increasingly recognized as highly political (Marino and Ribot 2012). For example, questions of what constitutes adaptation, who should shoulder the cost of adaptation, what should be the role of the state in supporting adaptation, and how citizens should participate in adaptation decisions, are highly political questions (Giddens 2009, 163–164). Without questioning

the need for adaptation, the question of why people are vulnerable to the impacts of climate change in the first place, and who decides who is vulnerable and who is not, must be answered if climate actions are to be transformational (Ribot 2011). This paper uses empirical evidence from Ethiopia and Tanzania to argue that adaptation decisions need to be cognizant of the existence of multiple sources of vulnerabilities and the importance of understanding the different weight that different actors attach to these multiple sources.

The paper aims at showing the importance of taking into account the social dimensions of climate actions when situating climate risks within social vulnerabilities in the context of sub-Saharan Africa. It addresses two interrelated questions: How are climate risks produced out of multiple sources of vulnerability among smallholder farmers in sub-Saharan Africa? Are there differences in the way local communities and experts give weight to these sources of vulnerability? Addressing these questions responds to the call to look beyond the bio-physical dimensions of climate change and adaption and consider the social determinants of vulnerability and adaptation (Hackmann et al. 2014).

The paper builds on the current understanding of vulnerability by adding a consideration of the subjective nature of identification of sources of vulnerability. This is done by using the concept of 'riskscapes'. The physical science dominated field of climate change is often biased towards biophysical sources of climate hazards (Hackmann et al. 2014). In this case, vulnerability is seen as the residual risk after adaptation action has been taken (O'brien et al. 2007). However, the social turn in hazard studies (see, for example, Wisner et al. 2004; Cutter 1996; O'keefe et al. 1976), the entitlement literature on famine and food security (see, for example, Sen 1984 and watts and Bohle 1993), and political ecology work on land degradation (see, for example, Blaikie 1985) have made it clear that natural disasters, and by extension climate hazards, are misnomers; rather, most disasters are the result of social factors, mainly marginalization and surplus extraction. These studies do not deny the bio-physical aspects of disasters; rather, they are interested in how the bio-physical sources of vulnerability interact with political and market mechanisms to create risky situations for some sections of a population, making them vulnerable (Birkmann 2012). Such an approach enables one to better understand the structure of the possible impacts of climate change under certain socio-economic conditions in a place, and create a chain of explanations to trace the sources of vulnerability beyond a place.

Critical social science studies of vulnerability bring our attention to the existence of multiple risks which interact to create a particular hazard (Birkmann et al. 2013; Müller-Mahn and Everts 2013; Turner et al. 2003). O'Brien et al. (2004) provide a methodological approach for capturing multiple stressors in vulnerability assessment. Tschakert (2007) expands the methodology of vulnerability assessment under multiple stressors by focusing her attention on the people who are vulnerable and engaging them in an assessment of their own vulnerability. Aggarwal et al. (2010) indicate the importance of considering a multiplicity of risks, including climate, land-based and socio-economic risks, facing sub-Saharan Africa and southeast Asia in order to ensure their security. The implication of such a multiplicity and overlapping of risks is that it becomes challenging, if not impossible, to comprehend, calculate and control risks in full (Müller-Mahn and Everts 2013; Eakin and Luers 2006).

However, the current literature on vulnerability is still vague on taking seriously the subjectivity involved in vulnerability assessment. Sources of vulnerability are often assumed as something out there, as something which could be measured with objective indicators (Ribot 2011). In practice, there could be a difference in the weight that different actors assign to different risks and their interaction. This difference could also affect the risk management practices that are pursued by actors. In this regard, the concept of riskscapes (Müller-Mahn and Everts 2013) can be useful for unpacking the subjective dimensions of vulnerability assessments.

Borrowing from Appadurai (1990) the concept of "scapes" as pre-eminent instances of imagined worlds, müller-Mahn and Everts (2013, 26) argue that 'risk'[1] is always multiple. There is not one risk, but multiple risks, entwined with other risks. As a result, they argue, there is a possibility of different notions of risk that could apply to the same place but with different conclusions. They refer to this notion of risks as riskscapes, a term which denotes the landscape of risk settings[2] shared by actors engaged in managing risks. In their empirical example of drought, conflict and famine in Africa, müller-Mahn and Everts (2013) identify two sets of

[1] Risk is defined by November (2008, 8) as "a potential phenomenon, which has not yet occurred, but which we predict may develop into a harmful event (a crisis) affecting individuals or communities in one or more areas".

[2] Risk setting in this paper refers to a category of risk that involves a variety of different factors.

practices which inform climate risk management, expert practice and local people's practice. Expert practice consists of risk management actions taken by international, national and sub-national government and non-government experts. Local people's practice consists of risk management practices by rural residents who live with climate risks and other hazards in their everyday life. By looking at the dominant riskscapes and their overlap, one can trace and better understand the practices that they induce (ibid.). Hence, this paper uses the concept of riskscapes to aid understanding of the way climate risks manifest themselves and interact with other risks to create vulnerable local communities in Ethiopia and Tanzania,[3] paying special attention to how important actors such as local community members and experts frame local vulnerabilities differently. The paper is not intended to provide a fully-fledged vulnerability assessment in the two countries. Rather, the main focus of the paper is on the importance of considering subjectivities in any assessment of the different dimensions of vulnerability.

2 Methodology

The selected sites studied in the two countries are known for the existence of climate-related and non-climate-related risks to farmers' livelihoods. The Ethiopia case study was conducted in Gubalafto and Kobo districts, in North Wollo Administrative Zone, Amhara Region. These two districts were the epicentres of the historical droughts in the mid-1970s and 80s. The Tanzanian case study was undertaken in Muleba and Missenyi districts, in the Ngono River Basin, Kagera Region. These districts have been seriously affected by crop pests and diseases which are believed to be a result of climate change. This paper draws data from our broader PhD projects, and the site selection was based on the particular interests of our main research questions. Accordingly, in Ethiopia four study villages were chosen, Woyniye and Laster Gerado from Gubalafto District, and Aradome and Addiskign from Kobo District, because of the existence of two proxy adaptation interventions in these villages. For the case of Tanzania, six villages situated in the Ngono River Basin were chosen because they were hit hardest by prolonged drought in 1997 and 2006. These villages are Magata, Katanga and Karutanga in Muleba District, and Bugorora, Kabingo and Mbale in Missenyi District (cf. Fig. 1).

The study is based on a modified grounded-theory-based qualitative research approach. The selection of the sample of respondents was based on our theoretical requirement, namely individuals who could provide information relevant to our research questions (Yeung 1997; Pratt 1995). Data was collected using a combination of extensive and intensive methods: intensive methods were in-depth interviews, focus group discussions and field observations, while extensive approaches involved analysis of secondary data such as official documents and scientific literature. The Ethiopian case consisted of 12 focus group discussions and 50 key informant interviews with both experts and local communities, as well as participant observation in two rounds of field work. The local communities consisted of residents in the two study villages. The experts were village, district, zonal and regional experts, mainly in the area of agriculture. We also used official records and published literature to capture 'riskscapes of experts.' The first round of field work was conducted within the timeframe July to September 2013, and the second round was from January to June 2014. In the Tanzanian case, a total of 18 focus group discussions were undertaken with local communities and 70 key informant interviews were conducted with local communities and stakeholders. We have combined our work to create a comparative case study for Ethiopia and Tanzania. The main technique we used for comparison is what Sørensen (2010, 5) calls 'thick comparison', where a detailed qualitative description of different cases is used to identify comparable elements. The comparable elements enabled us to conduct what Miles and Huberman (1994) call a 'variable based multiple case qualitative study', in which the comparable elements identified are used as building blocks for the arguments of the paper.

3 Contextualizing climate risks

This section explores the framing of vulnerability to climate-related risks by different actors located inside and outside the study areas. Climate change vulnerability studies often focus on characterizing different social categories in terms of actual or expected impacts of a certain change in climate parameters (see for example Ribot 2010, 53-54). Such studies put climate risks at the centre of their analysis (Taylor 2014). The problem with this kind

[3] The choice of these two countries is due to the fact that the two authors carried out empirical studies there for their PhD theses.

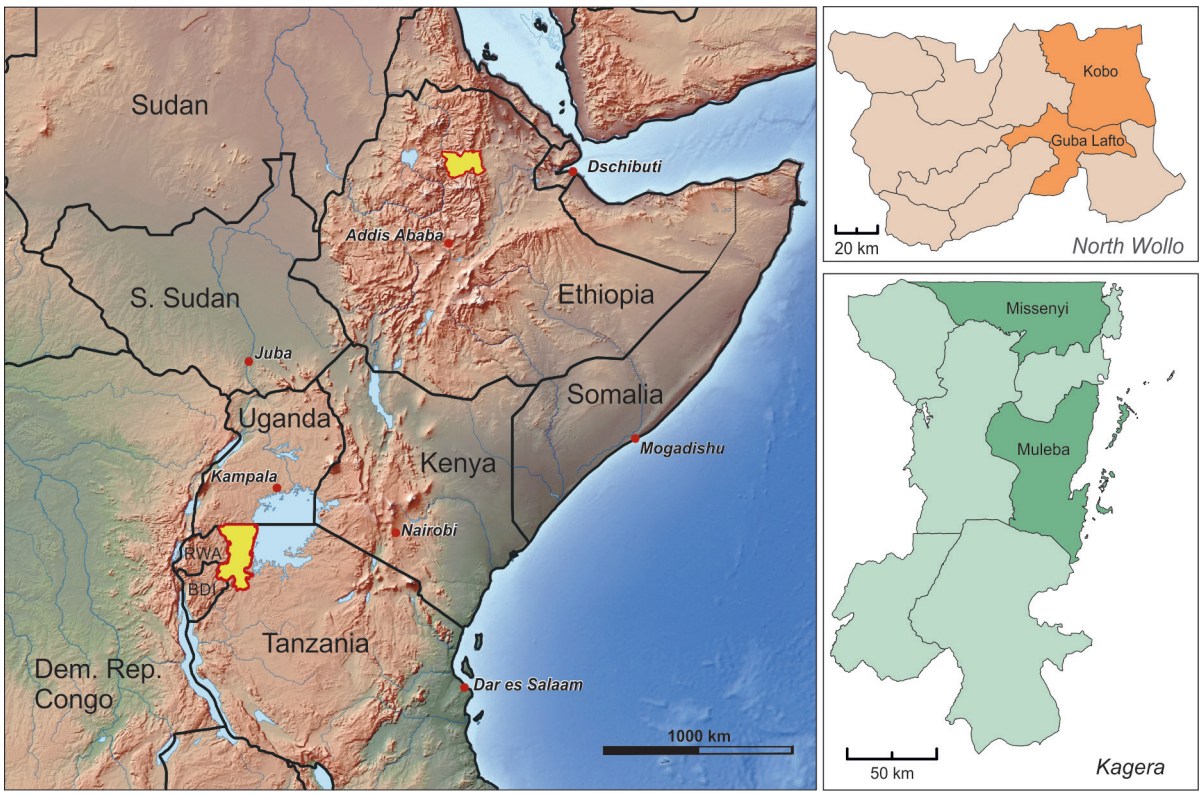

Fig. 1: Study areas in Etiopia and Tanznia

of research is that it not only places the bio-physical dimension of climate change artificially centre stage, but also obscures the way different hazards interact to produce livelihood risks. To avoid such a trap and situate climate risks within the broader context of the social vulnerability of a particular area, this paper focuses on identifying a multiplicity of risk settings, both climate-related and non-climate-related, and risk perceptions in order to understand how livelihood risks are produced in the study areas.

3.1 Multiplicity of sources of livelihood risks

One core aspect of the concept of riskscapes is recognition of the multiplicity and overlapping of riskscapes (Müller-Mahn and Everts 2013). This is in line with established vulnerability assessment frameworks, which also recognize the existence of multiple stressors and stresses that interact with each other to create hazardous conditions (Birkmann et al. 2013; Turner et al. 2003). Despite agreement on the identification by experts and local communities of food security as the main risk to farmers' livelihoods in the study areas, there is a difference among them in respect of their view of the sources of risks. After analysing our data from the two case studies, we were able to identify six settings that local communities and experts consider as major sources of livelihood risks. These are: climate hazard risk setting, subsistence risk setting, population increase risk setting, market volatility risk setting, state policy failure risk setting and supernatural risk setting. It is important to note these are risk settings perceived by local communities and experts. Accordingly, there are both overlaps as well as divergences in the importance attached to the risk settings and their interaction among local communities and experts.

3.1.1 Climate hazard risk setting

The first risk setting is what we call the 'climate hazard risk setting'. This is widely recognized among the experts and local communities alike. In Ethiopia's case, at national level, studies show that spatial variability is the main defining characteristic of rainfall patterns in the country (Getnet 2013). For example, Seleshi and Zanke (2004) report that the annual and the main rainy season total rainfall in

eastern and southern Ethiopia, and the main season rainy days in eastern Ethiopia, show a significant decline since 1982. At sub-national levels, in Amhara Region where the Ethiopian case study was conducted, an assessment made by Bewket and Conway (2007) shows the eastern part of the region exhibiting lower total annual rainfall and higher variability compared to the western part. Conway (2000) studied climatic conditions in Wollo and Tigray areas, the former being the exact place where our study was conducted, and concluded that the climatic condition of these areas is characterized by inter annual variability in general, and short rainy season fluctuation in particular.

At village level, the amount of rain in the short rainy season, and the timing of the main rainy season, were of great concern to the local communities, as they affect the local cropping calendar. For example, in one of the villages studied in Ethiopia, Woynine Village, the short rainy season is very important in this village for short season production. But the respondents said that recently the amount of rainfall during the short season has not been enough, especially with the hot temperatures during these months. One elderly respondent said, "The rains during the short season do not fit well with the crop calendar"[4] (individual interview, Woyniye Village, Ethiopia, January 2014). The onset of the rainfall in the long rainy season is said to be alright, although at times it is late. Early cessation of the rainfall, however, is said to be becoming common and detrimental. One of the interviewees related his experience and his fears as follows: "Last year the rain stopped at the end of August, during seed setting stage, the crop suffered" (individual interview, Woyniye Village, Ethiopia, January 2014). Similarly, in the second study village in Ethiopia, Laste Gerado Village, the short rainy season was said to be getting erratic. One of the respondents said, "now we don't have short rainy season, it has been very long since I planted crops during that season" (individual interview, Laste Gerado Village, Ethiopia, February 2014). In the other two villages studied in Ethiopia, Addis Kign and Aradome, rainfall in the short rainy season is not common, as these areas are semi-arid. Unlike the above two villages, however, the problem in respect of the long rainy season is not just early cessation, but also variability, even during the rainy season.

In Tanzania, at the national level, temperatures are expected to increase by 2-4% by 2100. Precipitation, on the other hand, is expected to drop by 20% in the interior regions, and to increase by 50% in the Lake Victoria area (Rowhani et al. 2011). Agricultural systems in Tanzania depend on the seasonality of rainfall; however, prolonged droughts, reduced precipitation and increased incidence of floods have resulted in a decrease in crop yield (URT 2012b; Rowhani et al. 2011). Various studies assert that climate change, manifested through temperature and rainfall variabilities, is responsible for seasonal changes which have in turn affected agricultural activities in some regions of Tanzania (Levira 2009). In some regions an unusual temperature increase has led to crop failure. In other areas, rainfall has been decreasing, causing water scarcity for crops and livestock (Ndaki 2014).

At the local level, people had varied perceptions of the changing climate. Recurrent shortage of rain was widely reported in all the six villages where the study was undertaken. It was reported that rainfall had decreased over the past 30 years. The testimony of members of local communities indicates that in the past it rained every month, and each rain had a particular function. For example, the rain in June was important for pasture regeneration after long dry spells. Such rains were of particular significance for livestock that had to withstand drought conditions. The specific name given to such rains in the Haya language is *myoyo ya nte* – literally meaning the 'souls of cattle'. The rain in August, called *izimbya mazi*, was specifically needed for coffee inflorescence (*orwakyo*). The changes in the rainy season have completely distorted the agricultural almanac of local communities. During the time when this study was carried out it was supposed to be the period of the short rainy season, but it was not raining and crops were drying up due to moisture stress. The account of one elderly respondent show what people have experienced: "For the past 30 years rain is decreasing at a faster rate than in previous years. We have planted maize and beans but as you can see it is not raining. In the past we used to have two rainy seasons, namely short rains (*omusenene*) and long rains (*etoigo*). The rain was sufficient for crop growth. But for over 10 years rains have decreased" (individual interview with elderly respondent, Karutanga Village, Tanzania, September 2014).

It was also revealed that temperatures in the two studied districts (Missenyi and Muleba) were increasing at an unusual rate compared to the past 30 years. Focus group discussants explained this

[4] All the interviews and focus group discussions in both countries were made using local languages. The translations presented here are the authors' own translations.

as follows: "Currently, we have observed an unusual temperature increase compared to the past 30 years…. we used to have more cool than warm months. Currently, we have more warm months. It was rare to have extremely high temperatures in September as it used to be the coolest month. Nowadays blankets are hardly used at night because it is extremely hot" (focus group discussion with farmers, Magata Village, September 2013). In some instances, local communities felt that the weather had grown more unpredictable. Some of the respondents in Magata Ward stated that 30 years ago, it was easy to predict the weather of the following day as there were specific periods for certain rainfall and temperature levels, but that weather forecasting has now become complicated in the study area. Similar observations have been made in different areas of Tanzania, as documented by other studies. For instance, the study by Msalilwa et al. (2013) in Kilolo district, Iringa region, reveals that there have been changes in the local climate patterns in the area. The major climatic changes identified by the local people are unpredictable rainfall and increase in temperatures. Similarly, in Mwanga district it has been reported that temperatures have increased in recent years due to prolonged droughts which occur every year. In the past, droughts were reported every 10 to 15 years. According to the findings of this study, droughts have become more frequent and intense, especially since the 1980s (Mngumi 2016). The study by Mongi et al. (2010) in semi-arid areas of Tanzania shows that farmers in Uyui and Tabora Urban districts have noticed an increase in temperatures for a long period of time. According to the findings of this study, there is a general agreement across age groups that temperatures are becoming much hotter with time.

3.1.2 Subsistence risk setting

The second risk setting is what we call 'subsistence risk setting', where due to the absence of alternative livelihood options, farmers have found themselves exploiting the available natural resources excessively for their subsistence. This in turn has led to exhaustion of the resource base and degradation of farms and rangelands. It was reported during the interviews with farmers in both case studies that due to excessive utilization of natural resources, which also involves poor land use practices, the soil is no longer productive. This has affected the production of both food crops and cash crops. This problem is referred to in government documents at different levels. While acknowledging the subsistence requirements of farmers, they are blamed for using traditional farm practices and for irresponsible resource use which has led to degradation of their natural resource base. In the case of Ethiopia, hillside farming, free grazing and soil mineral mining are frequently cited as detrimental to the food security of local communities, especially by experts working in the study areas. As Dessalegn (2003) argues, subsistence farming practices by smallholder farmers are often regarded as backward and detrimental to the resource base. Such a view regards farmers as ignorant of the level of degradation of their environment. A good example is a statement made by a group of prominent NRM specialists in Ethiopia, Hans Hurni and his team: "Ethiopian farmers do not perceive soil degradation to be a problem for agriculture, let alone a life threatening issue affecting the productivity of the soil" (Hurni et al. 2010: 196).

In Tanzania, subsistence farmers are often blamed for environmental changes that lead to degradation. In an interview, one district expert stated, 'The reason for change in our climate condition is degradation of our natural resource base" (key informants interview, Magata Ward, Tanzania, September, 2014). This corresponds to a statement in Ndaki (2014) which argues that local factors such as deforestation and land degradation contribute to the decreasing rainfall and increasing temperature trends in his study areas. A study by Shemsanga et al. (2010) also claims that local people contribute to climate change in different ways, including deforestation, or keeping large herds of cattle with corresponding overgrazing.

In both case studies, this risk setting is often mentioned by experts. However, local community members also refer to it (see Table 1). The difference is that while the experts focus on blaming local communities as being ignorant and irresponsible, local communities often link their actions with the absence of alternative livelihood options.

3.1.3 Population increase risk setting

This risk setting links livelihood risks with high population pressure, which results in the fragmentation of farmlands and over-exploitation of natural resources (see Table 1). The average land holding in Ethiopia is 0.96 ha of land, with younger farmers age 38 and less having 0.2 ha less land than those farmers who are aged 50, and 0.3 ha less than those

who are 60 years old (Headey et al. 2014). In the first study village, the last time land was redistributed was in the early 1990s. Because of the small size of the parcels of land, an average of 0.25 ha, parents have not been able to share their land with their children. Those individuals who were a little less than 18 years of age at that time have been left without access to land. In the other three study villages, a population increase has led to the fragmentation of land as parents divide their farm land and share it with their children. This risk setting is claimed to cause competition over existing resources; the increase in the number of users stretches the existing resource base to such an extent that it threatens local livelihoods. This was seen in the villages of Aradom and Adis Kign, where competition over flood water has increased over time as more and more people become interested in irrigating their land, in both the upper and lower catchment areas of a local river.

In the Tanzanian case, the population growth rate has been increasing to an alarming degree. As a result, the issue of land degradation is becoming a serious challenge in both districts. In the 2012 Tanzanian National Census, the population of the study area was estimated to be over 1.3 million, making up approximately 2.7% of the entire population of Tanzania (URT 2012a). This population increase means increasing pressure on the available land resources. The issue of land shortage due to population growth seems to be critical. Some people wonder whether in the next twenty years land will be sufficient to fulfil the needs of the existing population. One elderly respondent had the following to say about the land shortage issue: "The land crisis is becoming a serious issue in this village. I suggest serious measures should be taken by the families or the community to control population increase. If no substantial measures are taken, children will kill their parents to get land." It was reported by one of the Ward Executive Officers (WEOs) in Magata Ward that a number of cases concerning land issues have been reported at the ward office. Most involve children blaming their parents for not giving them land.

3.1.4 Market volatility risk setting

The fourth risk setting is what we call 'market volatility risk setting'. This is a source of risk which is related to engagement in the input as well as the output markets (see Tab. 1). In all the four villages studied in the Ethiopian case, output market volatility, especially for cash crops, was considered a major bottleneck in improving farmers' livelihood. For example, a socio-economic study in Kobo District states: "With increasing production in good rains, farmers suffer from low prices and demand. With bad rains the farmers lost all their purchasing power and productivity due to lack of cash income and continuously increasing prices of inputs and other basic commodities" (MoWR 2007).

In the case of Tanzania, the decrease in agricultural production has contributed to an increase in food prices, which in turn has negative impacts on the local people. During an interview with some of the businessmen at Magata and Bugorora weekly markets, they blamed the problem primarily on an unusually long drought season, adding that price increases of food crops were due to scarcity of rains which in turn reduced agriculture production. There had been uncharacteristically low production of both food and cash crops following long dry spells, and an outbreak of banana wilt disease had caused an increase in banana prices. It was revealed that the price of bananas during the time of this study stood at over Tshs 20,000 (8 Euro) per bunch, which was a huge amount for the average banana customer. Such an unusually high price for bananas caused them to be perceived as a luxury food. However, lack of access to the market was the main issue that was widely reported by many of the local farmers from both districts. The economy of the study area relies heavily on agriculture, livestock keeping and fishing. Coffee used to be the major cash crop grown in the region before 1997, but after 1997 the price started to fluctuate due to an unreliable market, and this discouraged farmers from engaging in coffee farming.

3.1.5 State policy failure risk setting

The fifth risk setting is what we call 'state policy failure risk setting', where local communities accuse government officials of forcing them to engage in risky farming practices or limit their access to critical resources (see Tab. 1). In the Ethiopian study, a strong case was made by local communities against fertilizer use, especially in the lowland study villages. Farmers argued that without access to irrigation, the use of fertilizer, especially urea (carbamide), is too risky as it could burn the crop in case of rainfall failure during the flowering and seed setting stages. One respondent stated: "We are

being forced to use fertilizer. We have seen that it burns the crop if it does not get enough moisture" (informal discussion with a farmer, Laste Gerado Village, March 2014).

In Tanzania, local communities also condemned state policies which seemed detrimental to them. They were against the government decision to convert Ngono wetland and Mnene forest into conservation areas. They argued that this decision is a threat to their livelihood activities, as they do not have anywhere to undertake farming and grazing activities during times of drought. Expanding this further, the respondents reported that the laxity of government officials in enforcing environmental regulations contribute to climate change risks. State policy requires farmers to apply fertilizer when farming. This is objected to by local communities because fertilizer affects the long-term productivity of the soil. One of the participants made the following remark on this issue: "Extension Officers have been advising us to apply fertilizers when planting different crops. Unfortunately, once you apply fertilizer you will be able to have good harvests only in that season. But in the subsequent seasons you won't harvest much. Thus, we don't like application of fertilizers as it reduces the productivity of the soil." The respondents also claimed that the government has leased out the land to private investors for cultivation under the canopy of green economy. This so-called *Kilimo Kwanza* (Agriculture First) initiative is primarily focused on large-scale farming investments that are intended to transform small-scale farming into commercial farming. This state initiative has created risks to the community, as the majority of members of the local community are reported as not having enough land for farming and grazing activities. They have only small plots of land for all their livelihood activities. In the case of prolonged drought, it is difficult for farmers to extend their activites to land that has been seized by investors.

3.1.6 Supernatural risk setting

The sixth risk setting is the 'supernatural risk setting'. Local people were of the view that neglecting and disrespecting ancestral spirits created different types of risks within the community. This risk setting was mentioned only in the case of Tanzania, where older people said that the current generation is increasingly being influenced by Western belief systems and abandoning the indigenous belief system (see Tab. 1). They said that nowadays people are not offering sacrifices to the traditional god (*wamara*), and as a result Wamara is not happy and will not intervene in case of scarcity of rain or excessively long dry spells. They explained that the failure of the local community to appease the ancestral spirits and the gods of rain by performing traditional rituals makes them angry. The respondents were of the opinion that certain evil deeds can cause the wrath of ancestral spirits to continue for generations. It was claimed that the persisting anger of the ancestral spirits had affected the patterns of weather and climate. However, for over 30 years the traditional belief systems have been slowly losing their importance. Some of the fundamental local institutions have collapsed, leading to increased environmental uncertainties, as most of the traditional rituals are not currently being performed by the community. For instance, during the focus group discussion in Kabingo Village, the participants associated the decline of the *Abagurusi* institution with existing environmental uncertainties, which in turn have contributed to food insecurity and poverty. Similar sentiments were echoed during an interview with one respondent in Katanga Village:

> "In the case of environmental uncertainties such as long drought seasons, *Abagurusi* could convene under the big trees (*emirundu*) and pray for rain……they performed traditional rituals by giving sacrifices to the spirits. Nowadays, the community does not undertake all these cultural practices after the collapse of the *Abagurusi* institution….this is the reason for all these problems." (Focus group discussion on 3rd September 2014 at Katanga village)

The decline of *Abagurusi* has led the community to cut down the *emirundu* for different uses. In the past each village had at least ten *emirundu* which were used by the local community for different cultural practices. But today, the number of such trees is decreasing fast, making it difficult to observe cultural practices that would solve the problem of scarcity of rain and drought. It is clear that undermining the supernatural apparatuses which assist the community in reducing vulnerability increases the environmental uncertainties due to climate change. Thus, food insecurity and poverty resulting from environmental degradation is associated with the decline of customary institutions in both districts.

It is important to note that these six risk settings were not the only ones mentioned as sources of risks. In both countries, there were many other risks mentioned by farmers in the study villages. For

Tab. 1: Sample quotes to exemplify the six risk settings in Ethiopia and Tanzania

Risk settings	Example Quotations	
	Ethiopia	**Tanzania**
Climate hazards	"Last year the rain stopped at the end of August during the seed setting stage and the crop suffered a lot" (individual interview).	"In recent years, temperatures have increased compared to the past 30 years….in the past we had more cool months than warm months. In recent years, warm months have increased compared to the cool ones" (key informant interview).
Subsistence	"The reason for change in our climate condition is because of degradation of our natural resource base in the district. Farmers also recognize this. They accept that they are the ones to blame because they are the ones who have been destroying their natural resources base" (expert interview).	"The decrease of rains is sometimes caused by ourselves because we are cutting trees excessively. In our village, we had big trees which were helpful in regulating the climate" (focus group discussion).
Population	"Around 79% of the households in the Kobo-Girana Valley Project area have less than one ha of land, with many landless youth finding it hard to sustain themselves" (Kobo-Girana Valley-Development Project document).	"Demographic dynamics have triggered degradation of water catchment areas in Bugorora Village, the situation becomes worse during a long dry season as water is too scarce" (key informant interview).
State policy	"Fertilizers, especially urea, require moisture during the seed setting stage of the crop, the uncertainty of the rainfall means that there is a good chance of the fertilizer drying out the crop. However, the extension agents force us to use fertilizer despite this negative impact" (individual interview).	"Government officers should be responsible for what is happening because we have been told that there are environmental and natural resource officers, but all of them are doing nothing. If those officials were doing their job properly, the effects of climate change that we currently face would not have been the way they are today" (focus group discussion).
Market	"Seasonal fluctuation of crop prices, increasing prices of basic farm inputs, lack of transport and road network, under developed infrastructure, lack of access to market information, etc. are the major problems limiting crop production" (Kobo-Girana Valley-Development Project document).	"Business men mostly from Uganda have their agents in this village who buy food on their behalf. These agents, who play the role of middlemen usually buy immature bananas, sweet potatoes and cassava…..this is serious as farmers are lured to sell their crops without knowing what they will eat tomorrow. This could result in food insecurity as in the future people will not have enough food stocks" (expert interview).
Supernatural		"I think the lack of practising traditional customs within the community has provoked the ancestral spirits and the traditional god. We don't respect our traditional gods anymore, and due to this, they cannot intervene in the case of drought or rain scarcity" (key informant interview).

example, in the Ethiopian case, in one of the study villages the undulating topography coupled with local farming practices was said to play a significant role in aggravating soil erosion and threatening food security of households. In Tanzania, people said that livestock diseases together with shortage of pasture threatened households whose food security depends on livestock and livestock products. The six risk settings described above were selected because they show common risk settings perceived by local communities in both Ethiopia and Tanzania. The last risk setting is unique to Tanzania, and we have included it because the majority of local communities in all the six villages mentioned it repeatedly, and we decided to include it as a unique risk setting in the Tanzanian case.

3.2 Livelihood risks at the intersection of risk settings

People in rural Ethiopia and Tanzania face numerous livelihood risks in their day-to-day lives. A comprehensive study of risks in general would need to study all the risks involved in a certain area (November 2008). However, the complexity of studying all risks, and our specific research interest in climate risks, made us narrow down our focus to livelihood risks that are likely to be affected by climate change.

The two core risks which stood out in both expert and community practices in both countries were food insecurity and poverty traps. For example, in Ethiopia, the Amhara Region Bureau of Agriculture strategic plan for 2010-2015 states that the people, especially those living in the north-eastern part of the region, are exposed to chronic food insecurity (BoA 2010). The region's 2013/14 annual plan also states that, "the people in Amhara region have been suffering from food insecurity" (BoA 2013). At Zonal level, the North Wollo Zonal Bureau of Agriculture 2013/14 annual plan states that, as the zone is characterized by hilly terrain and valleys, it is highly exposed to serious soil erosion which makes the zone highly vulnerable to chronic food insecurity (OoA 2013). At district level, interviews with the Gubalafto District administration and experts also show that food security is at the centre of their concern. One of the experts said, "We are more worried about food security. We have farmers who are not able to properly feed their families three times a day or cover their food demand for more than 6 months" (Individual expert interview, Ethiopia, March 2014).

Interviews with local people identified the same risks, food security and poverty, as important risks in their areas. One respondent said, "This area is turning into desert. The last two or three years were difficult. It is not too serious, to the extent of famine, but we are struggling" (individual interview, Laste Gerado Village, Ethiopia, February 2014). Another respondent added, "People in our village work hard to get good crops. However, the drought has destroyed all our hard work many times. While we want to develop ourselves, nature is holding us back" (individual interview in Woyniye Village, Ethiopia, January 2014).

In Tanzania also, most of the risks are associated with food insecurity and poverty. These risks interact with climate risks and result in community vulnerability. Our findings reveal that climate risks cause community vulnerability as most livelihood activities depend on an element of weather. It was reported during the interviews and focus group discussions that increased food insecurity was a result of climate-related risks. One participant in a focus group discussion expressed the following sentiment regarding food insecurity: "We are struggling to work hard but all our efforts are useless; rains are inconsistent and unpredictable. This contributes to food insecurity" (focus group discussion, Katanga Village, Tanzania, September 2014).

Incidences of pests and diseases have contributed to the decrease in crop and livestock production, which in turn contributes to poverty and food insecurity among the farmers in the study area. In both districts, the effects of pests and disease were severely felt during long dry seasons. Numerous crop diseases were reported, such as severe cassava mosaic (*batobato kali)* and cassava brown streak disease (*michilizi kahawia)*. Sweet potatoes were affected by sweet potato mosaic disease, and in the case of maize the primary diseases were leaf rust and maize streak. The results from both districts show that livestock keeping is also seriously affected by diseases, foot-and-mouth disease, East Coast fever and Rift Valley fever being the most commonly mentioned. With regard to the pests affecting the production of crops and livestock, nematodes and beetles were reported to be a major problem in bean production, especially in Missenyi District. According to local people from both districts, most of these pests and diseases, which lead to food insecurity and poverty, are caused by climate change. The Missenyi District Agriculture Officer (DAO) explains what people have experienced:

> "For a period of 10 to 15 years, the incidences of new diseases and pests have been a problem in crop and livestock production hence leading to food insecurity and extreme poverty. Once we try to find the cure for a certain disease, another new disease emerges. Most of the pests and diseases are favoured by climate conditions, especially long dry spells" (interview with District Agriculture Officer, Missenyi, Tanzania October 2014).

In both country case studies, farmers face a variety of risks, threating the food security of households in the study areas. As discussed in the previous section, the sources of risks are various, and actors such as local community members and experts attribute different weight to the different sources of risks. The risk settings identified in the previous section interact with each other differently in differ-

ent places. Since these effects are felt at particular places, we turn our analysis towards understanding how livelihood risks are produced at the interface of the different risk settings identified above (See Tab. 2 for examples in two villages in Ethiopia and Tanzania). In the Ethiopian case, in the first village, climate hazards such as the erratic nature of the short rainy season and early cessation of the long rainy season were identified as the major risks. In addition, the undulating topography of the village causes serious erosion and flooding, and conflict among farmers in the catchment area is commonly due to floodwater management. The average farmland per household is also very small, which means that a small shock in production is detrimental to food security. Hence, the livelihoods of the villagers are 'at risk' due to multiple risk settings. The third and the fourth study villages had much in common because of the homogeneity of their climate and livelihood activities. Moisture stress is the major bottle neck affecting agriculture in these villages. This climate hazard is aggravated by diminishing access to floodwater, due to increase in upstream use, which was the backbone of farming in these areas. Poor farmers also face additional risks from the state policy which promotes 'modern' farming, especially on farms with access to irrigation. This exerts pressure on resource-poor farmers who have no financial capacity to invest in improved seeds and fertilizer, or who cannot take the risk of output market failure. As a result, many resource-poor farmers are forced to rent out their land or give it for sharecropping.

In the Tanzanian case, in one of the study villages, erratic rains and early cessation of the rainy season have been recurrent incidents experienced by the local communities. This affects the livelihood systems of the communities, with thousands of acres of banana homegardens (*ebibanja*) facing severe moisture stress. In addition, livestock keepers have been facing shortages of pastures and good water sources for their animals. In another study village, the population has been increasing at a rapid rate, leading to land shortages. Hence, some communities have resorted to cultivating crops and grazing animals around water catchment areas, causing severe degradation. Due to this, the local communities have experienced recurrent water scarcity, resulting in poor irrigation for the crops and shortage of water for animals. These two risks (weather variation and population increase) interact, resulting in a high degree of food insecurity and poverty in these two villages.

4 Discussion

With regard to the risk settings discussed above, it is important to note two things. First, the risk settings have both material and discursive dimensions. The material dimension is the concrete and measurable dimension of the risk settings, such as shifts in rainfall patterns in the short rainy season, and shrinking of land size because of population pressure. The discursive dimension is the way local communities and experts translate these risk settings into livelihood risks, such as how subsistence farming practices degrade the environment, and how that in turn affects local livelihoods. Understanding both the material and the discursive dimensions of risk settings is essential, as it reveals the logics behind the risk management practices of the actors involved.

Second, local communities and experts do not give equal weight to the risk settings identified here: their views converge in some cases and diverge in others (see Fig. 2). For example, in both case studies, there was a convergence between local communities and experts on the climate hazard risk setting. While they both recognize the fact that the impacts of climate change are a result of interaction between climate-related and non-climate-related risk settings, the climate hazard risk setting was said by both to have a detrimental effect on local livelihoods. There was also moderate convergence on population pressure and market-related risk settings between local communities and experts. We call it 'moderate convergence' because there are also some divergences of opinion between local communities and experts. Even though experts concur with local communities on the importance of market-related and population-increase-related risk settings, they also blame farmers for not following the technological advice of experts in tackling the risks. The divergences are mainly related to the subsistence risk setting and the state policy failure risk setting. In both case studies, experts often argue that subsistence farming practices are to blame for the aggravated impacts of all the other risk settings. Local communities, on the other hand, argue that state experts and officials often do not understand local realities when they offer technologies and advice for dealing with the various risk settings that are affecting their livelihoods. These differences of risk framing, what we call 'riskscapes of local communities and experts', have consequences for the choice of risk management practices.

Tab. 2: Risk settings, riskscapes and risk management: examples from an Ethiopian and a Tanzanian village

Risk settings interaction, a case from Ethiopia	Risk settings interaction, a case from Tanzania
One of the study villages in Ethiopia, Laste Gerado, is located close to the lowlands; hence, it suffers from moisture stress for most of the year. An erratic short rainy season and early cessation of the long rainy season are the main climate risks in this village. The village also has a high number of livestock with a free grazing system. Villagers claim that their livestock are their insurance and hence they keep them even at a high expense. The large number of livestock and the free grazing system make it practically impossible to plant crops in the short rainy season, even when the rains are good. The local irrigation scheme developed by the regional government also suffers from the free grazing system, as it is difficult and costly to protect irrigated fields from damage caused by livestock. However, the villagers argue that the free grazing system is the only option for the poor and the elderly in the village, who cannot afford the labour and material costs of a cut-and-carry feeding system. The village also has a large number of young migrants who travel to Saudi Arabia. However, a recent crackdown on illegal migrants in Saudi Arabia made many of these young people from the village return home. One respondent stated that many young men with no land to plough went to Arab countries. Now many of them are back again. This creates a serious social crisis. The land owned by a farmer is often fragmented, so that one farmer may have three plots in three different places, which makes it difficult to manage. The area is also adjacent to the lowland area, which makes it extremely dry. Despite the dry nature of the area, government experts often force farmers to use technologies such as improved seeds and fertilizer, which fail when the rains cease during the seed setting stage. Thus, livelihoods in this village are at risk not only because of climate change but also due to other risk settings in the village. What is important to notice here is the different weight that farmers and experts give to the different risk settings. For the government experts, for example, the degradation of the natural resource base and the challenge to irrigation because of the free grazing system is the main problem, coupled with farmers' resistance to accept improved agricultural practices. With this riskscape in mind, they strongly recommend NRM interventions and investment in irrigation. For the villagers, the climate variability together with fragmented land make agriculture an unattractive business. With these riskscapes in mind, most believe that their livelihood will be guaranteed only if they manage to send their children to work in Arab countries.	Bugorora Village is situated adjacent to Ngono wetland. Local communities in the village depend on this wetland for farming and grazing activities, especially during the dry season. In recent years, this wetland has been designated as a conservation area by the government through the Ministry of Natural Resources and Tourism (MNRT). Hence, no human activity is allowed to take place within this wetland. This has affected the livelihood of the surrounding communities as they can undertake no farming or grazing activities. Local communities in this village were unhappy with the government's decision to convert the Ngono wetland into a conservation area. As reported during an interview with one of the elderly villagers, in the past local communities relied on the wetland for their livelihood, using it for agriculture and grazing their livestock. Currently, however, such activities are strictly prohibited, which adds more pressure on the scarce land resources. Apparently, land shortages are increasingly being felt within the villages surrounding this wetland, because people have to do all their livelihood activities within the *kibanja*, which in turn, contributes to soil infertility and reduced productivity. It was reported by the local communities that, in 1997, if it had not been for the Ngono wetland, the community would have been affected by severe food insecurity. There was a long dry season that caused drought in the Missenyi District and villagers had to undertake farming activities in the Ngoro wetland. This helped them a lot as they were able to harvest enough sweet potatoes. Now that this wetland has been transformed into a conservation area, the majority of households face severe food shortages in long dry seasons. In addition to the prohibition on wetland farming and grazing, local communities condemn the village authorities and the government for leasing chunks of land to individual investors. The process of leasing land to individual investors is not transparent. Currently, no one can say accurately how much land has been leased to investors. Many of these land lease deals are confidential and lack transparency. The local people expressed their concern over these contracts, as they do not specify any clear and binding commitments in respect of benefits for the local community. Thus, local communities have found themselves in conflict with the investors. It was reported during a focus group discussion that various investors have been filing complaints accusing local people of undertaking farming and grazing activities on their land.

Fig. 2: Riskscapes of government experts and local community members

Third, the riskscapes of experts and local communities affect the risk management practices that they promote and/or pursue. In the Ethiopian case, for example, climate hazards are addressed through large-scale watershed development, promotion of improved agricultural practices, and limited small-scale irrigation interventions. These interventions are highly political, in line with the broader developmental project of the state. The development policies of the Ethiopian state are characterized by strong ideological commitment to fight poverty and meticulous organization and mobilization of people, from federal to grass roots level (Gebresenbet 2015; Lefort 2012). A lot has been achieved in improving farmers' capacity to manage climate-related and non-climate-related risks because of these interventions. However, the fact that these interventions are highly politicized and are executed in campaign mode has made it difficult to tailor the interventions to suit local needs and aspirations. Some of the interventions, such as state promotion of fertilizer use in non-irrigated farms, are actually maladaptations for climate risk management, as they lead to moisture stress and drought hazards. Farmers manage such 'policy-related risks' by resisting them.

Local communities have their own autonomous climate risk management techniques. In the Ethiopian case, this involves soil conservation, irrigation, and adjustments in crop production techniques. Soil conservation mainly involves the construction of stone bunds, a common practice with both traditional and expert origins. Adjustment in farm production technique includes, for example, adjusting planting times and repeated ploughing. In the two lowland villages, customary risk management practices include self-help organization for flood diversion, and maintaining grazing enclosures. In the Tanzanian case, risk management practices included the planting of drought-resistant and early maturing crops, with crops like cassava, sweet potatoes and sorghum being preferred in the case of long dry spells. Planting these crops has helped local communities to withstand long dry seasons, because they are less affected by drought. It was reported during interviews in all six villages that planting drought-resistant and early maturing crops enhances food security and alleviates poverty. The following quote from a villager in Bugorora reflects this sentiment: "If you have not planted drought-resistant and early maturing crops such as sweet potatoes, cassava and cocoyam, you want your family to starve. We plant these crops with the expectation that it will help us during the drought seasons." Besides, it was revealed that local communities practise mulching to maintain soil moisture in the homegarden (*kibanja*) during long dry spells. It was reported during the interview that long dry seasons contribute to moisture stress, crop failure and food insecurity. In responding to this situation, farmers have developed indigenous practices, undertaking frequent

mulching to enhance soil moisture. Furthermore, if mulching is done properly, it prevents weeds from germinating and improves production throughout the year, irrespective of the prevailing drought conditions in between.

5 Conclusion

This paper set out to address the research questions: "How are climate risks produced from multiple sources of vulnerability by smallholder farmers in sub-Saharan Africa? Are there differences in the way local communities and experts give weight to the sources of vulnerability?" Even social vulnerability assessments which attempt to capture the source of risks beyond the bio-physical nature of disasters tend to place climate risks at the centre of their analysis and assume that sources of vulnerability could be measured using objective indicators (Taylor 2014; Ribot 2011). To redress this problem, we have used the concept of riskscapes developed by Müller-Mahn and Everts (2013) to situate climate risks within the multiplicity of other risks that rural communities in sub-Saharan Africa are facing, and we have shown how local communities and experts in Ethiopia and Tanzania attach different weight to the multiple sources of vulnerability.

The use of the concept of riskscapes enables us to provide a more nuanced understanding of climate risks and risk management practices in our case study areas. First, we are able to capture a multiplicity of risk settings to explain the perpetual food insecurity and poverty in the study areas. The risk settings identified have both material and discursive dimensions, which, as we have argued, are equally important. Second, important points to note are that, (a) experts and local communities converge as well as diverge in the weight they give to the different risk settings; this has implications for what is considered as climate change adaptation action, and how such actions are implemented; and (b) the livelihood impacts of climate risks are a result of interaction between climate-related and other risks which often manifest themselves in a unique way in different places. Our case studies show that climate risks interact differently with other risk settings in Ethiopia and Tanzania. The implication of this is that understanding the impacts of climate change in sub-Saharan Africa requires giving due attention to how climate-related and non-climate-related risk settings interact in different contexts and how these interactions are viewed by actors with a strong stake in the success of climate change adaptation measures.

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References

Aggarwal, P. K.; Baethegan, W. E.; Cooper, P.; Gommes, R.; Lee, B.; Meinke, H.; Rathore, L. S. and Sivakumar, M. V. K. (2010): Managing climatic risks to combat land degradation and enhance food security: key information needs. In: Procedia Environmental Sciences 1, 305–12. https://doi.org/10.1016/j.proenv.2010.09.019

Appadurai, A. (1990): Disjuncture and difference in the global cultural economy. In: Theory, Culture & Society 7 (2-3), 295–310. https://doi.org/10.1177/026327690007002017

Bewket, W. and Conway, D. (2007): A note on the temporal and spatial variability of rainfall in the drought-prone Amhara region of Ethiopia. In: International Journal of Climatology 27 (11), 1467–77. https://doi.org/10.1002/joc.1481

Birkmann, J. (2012): Measuring vulnerability to promote disaster-resilient societies and to enhance adaptation: discussion of conceptual frameworks and definitions. In: Birkmann, J. (ed.): Measuring vulnerability to natural hazards: towards disaster resilient societies. Tokyo, Bristol, 9–78.

Birkmann, J.; Cardona, O. D.; Carreño, M. L; Barbat, A. H; Pelling, M.; Schneiderbauer, S.; Kienberger. S.; Keiler, M.; Alexander, D.; Zeil, P. and Welle, T. (2013): Framing vulnerability, risk and societal responses: the MOVE framework. In: Natural Hazards 67 (2), 193–211. https://doi.org/10.1007/s11069-013-0558-5

Black, R.; Bennett, S. R G.; Thomas, S. M.; and Beddington, J. R. (2011): Climate change: migration as adaptation. In: Nature 478 (7370), 447–49. https://doi.org/10.1038/478477a

Blaikie, P. M. (1985): The political economy of soil erosion in developing countries. London.

BoA (Bureau of Agriculture) (2010): Strategic plan (2010-2015) of Amhara Region. Bahir Dar, Ethiopia (unpublished).

– (2013): Annual plan (2013/14) of Amhara Region. Bahir Dar, Ethiopia (unpublished).

Conway, D. (2000): Some aspects of climate variability in the north east Ethiopian highlands - Wollo and Tigray. In: Ethiopian Journal of Science 23 (2): 139–61.

Cutter, S. L. (1996): Vulnerability to environmental hazards. In: Progress in Human Geography 20 (4), 529–39. https://doi.org/10.1177/030913259602000407

Dessalegn, R. (2003): Littering the landscape: environmental policy in Northeast Ethiopia. In: Bassett, T. J. and Crummey, D. (eds): African savannas: global narratives & local knowledge of environmental change. Oxford, 205–224.

Eakin, H. and Luers, A. L. (2006): Assessing the vulnerability of social-environmental systems. In: Annual Review of Environment and Resources 31 (1), 365–94. https://doi.org/10.1146/annurev.energy.30.050504.144352

Gebresenbet, F. (2015): Securitisation of development in Ethiopia: the discourse and politics of developmentalism. In: Review of African Political Economy 41 (sup1), S64–S74. https://doi.org/10.1080/03056244.2014.976191

Getnet, U. (2013): Spatial and temporal uncertainty of rainfall in arid and semi-arid areas of Ethiopia. In: Science, Technology and Arts Research Journal 2 (4), 106–13. https://doi.org/10.4314/star.v2i4.19

Giddens, A. (2009): The politics of climate change. Cambridge, Malden (MA).

Gleick, P. H. (2014): Water, drought, climate change, and conflict in Syria. In: Weather, Climate and Society 6 (3), 331–40. https://doi.org/10.1175/WCAS-D-13-00059.1

Hackmann, H.; Moser, S. C. and Clair, A. L. (2014): The social heart of global environmental change. In: Nature Climate Change 4, 653–655. https://doi.org/10.1038/nclimate2320

Headey, D.; Dereje, M. and Taffesse, S. A. (2014): Land constraints and agricultural intensification in Ethiopia: a village-level analysis of high-potential areas. In: Food Policy 48, 129–141. https://doi.org/10.1016/j.foodpol.2014.01.008

Hurni, H.; Abate S.; Bantider, A.; Debele, B.; Ludi, E.; Portner, B.; Yitaferu, B., and Zeleke, G. (2010): Land degradation and sustainable land management in the highlands of Ethiopia. In: Hurni, H. and Wiesmann, U. (eds.): Global change and sustainable development: a synthesis of regional experiences from research partnerships. Berne, 187–207.

Knutson, T. R.; Mcbride, J. L.; Chan, J.; Emanuel, K.; Holland, G.; Landsea, C.; Held, I.; Kossin, J. P.; Srivastava, A. K. and Sugi, M. (2010): Tropical cyclones and climate change. In: Nature Geoscience 3 (3), 157–63. https://doi.org/10.1038/NGEO779

Lefort, R. (2012): Free market economy, 'developmental state' and party-state hegemony in Ethiopia: the case of the 'model farmers'. In: Journal of Modern African Studies 50 (04), 681–706. https://doi.org/10.1017/S0022278X12000389

Levira, W. P. (2009): Climate change impact in agriculture sector in Tanzania and its mitigation measure. In: IOP Conference Series: Earth and Environmental Science (6), 372049. https://doi.org/ 10.1088/1755-1307/6/7/372049

Marino, E. and Ribot, J. (2012): Special issue introduction: adding insult to injury: climate change and the inequities of climate intervention. In: Global Environmental Change 22 (2), 323–28. https://doi.org/10.1016/j.gloenvcha.2012.03.001

Miles, M. B. and Huberman, A. M (1994): Qualitative data analysis: an expanded sourcebook. Thousand Oaks.

Mngumi, J. (2016): Perceptions of climate change, environmental variability and the role of agricultural adaptation strategies by small-scale farmers in Africa: the case of Mwanga district in northern Tanzania. PhD thesis. Glasgow.

Mongi, H.; Majule, A .E. and Lyimo J. G. (2010): Vulnerability assessment of rainfed agriculture to climate change and variability in semi-arid Tanzania. In: African Journal of Environmental Science and Technology 4 (6), 371–381.

MoWR (Ministry Of Water Resources) (2007): Kobo-Girana pressurized irrigation system study and detail design project. Volume V: Annex IX, Socio-Economics (unpublished).

Msalilwa, U.; Augustino, S. and Gillah, P. R. (2013): Community perception on climate change and usage patterns of non-timber forest products by communities around Kilolo district, Tanzania. In: Ethiopian Journal of Environmental Studies and Management 5, 507–516.

Müller-Mahn, D. and Everts, J. (2013): Riskscapes: the spatial dimensions of risk. In: Müller-Mahn, D. and Everts, J. (eds): The spatial dimension of risk: how geography shapes the emergence of riskscapes. London, 22–36.

Ndaki, M. P (2014): Climate change adaptation for smallholder farmers in rural communities: the case of Mkomazi sub-catchment, Tanzania. PhD Thesis. Oldenburg.

November, V. (2008): Spatiality of risk. In: Environmental Planning A 40 (7), 1523–27. https://doi.org/10.1068/a4194

O'brien, K.; Eriksen, S.; Nygaard, L. and Schjolden, A. (2007): Why different interpretations of vulnerability matter in climate change discourses. In: Climate Policy 7 (1), 73–88. https://10.1080/14693062.2007.9685639

O'Brien, K.; Leichenko, R.; Kelkar, U.; Venema, H.; Aandahl, G.; Tompkins, H.; Javed, A.; Bhadwal, S.; Barg, S.; Nygaard, L. and West, J. (2004): Mapping vulnerability to multiple stressors: climate change and globalization in India. In: Global Environmental Change 14 (4), 303–313. https://doi.org/10.1016/j.gloenvcha.2004.01.001

O'keefe, P.; Westgate, K. and Wisner, B. (1976): Taking the naturalness out of natural disasters. In: Nature 260 (5552), 566–67. https://doi.org/10.1038/260566a0

OoA (Office of Agriculture) (2013): Annual Plan (2013/14) of the Office of Agriculture of North Wollo administrative zone. Woldia, Ethiopia (unpublished).

Pratt, A. C. (1995): Putting critical realism to work: the practical implications for geographical research. In: Progress in Human Geography 19 (1), 61–74. https://doi.org/10.1177/030913259501900104

Ribot, J. (2010): Vulnerability does not fall from the sky: toward multiscale, pro-poor climate policy. In: Mearns, R. and Norton, A. (eds.): Social dimensions of climate change: equity and vulnerability in a warming world. Washington, 173–198.

– (2011): Vulnerability before adaptation: toward transformative climate action. In: Global Environmental Change 21 (4), 1160–1162. https://doi.org/10.1016/j.gloenvcha.2011.07.008

Rowhani, P.; Lobell, D. B.; Linderman, M. and Ramankutty, N. (2011): Climate variability and crop production in Tanzania. In: Agricultural and Forest Meteorology 151 (4), 449–460. https://doi.org/10.1016/j.agrformet.2010.12.002

Seleshi, Y. and Zanke, U. (2004): Recent changes in rainfall and rainy days in Ethiopia. In: International Journal Climatology 24 (8), 973–83. https://doi.org/10.1002/joc.1052

Sen, A. K. (1984): Poverty and famines: an essay on entitlement and deprivation. Oxford.

Shemsanga, C.; Omambia, A. N. and Gu, Y. (2010): The cost of climate change in Tanzania: impacts and adaptations. In: Journal of American Science 6 (3), 182–196.

Sørensen, E. (2010): Producing multi-sited comparability. In: Scheffer, T. and Niewöhner, J. (eds): Thick comparison: reviving the ethnographic aspiration. International studies in sociology and social anthropology 114. Leiden, 55–77.

Taylor, M. (2014): The political ecology of climate change adaptation: livelihoods, agrarian change and the conflicts of development. Abingdon.

Trenberth, K. (2012): Framing the way to relate climate extremes to climate change. In: Climate Change 115 (2), 283–290. https://doi.org/10.1007/s10584-012-0441-5

Tschakert, P. (2007): Views from the vulnerable: understanding climatic and other stressors in the Sahel. In: Global Environmental Change 17 (3-4), 381–396. https://doi.org/10.1016/j.gloenvcha.2006.11.008

Turner, B. L.; Kasperson, R. E.; Matson, P. A.; Mccarthy, J. J.; Corell, R. W.; Christensen, L.; Eckley, N.; Kaspersonb, J. X.; Luerse, A.; Martellog, M.; Polskya, C.; Pulsiphera, A. and Schiller, A.(2003): A framework for vulnerability analysis in sustainability science. In: PNAS 100 (14), 8074–8079. https://doi.org/10.1073/pnas.1231335100

URT (United Republic of Tanzania) (2012a): National climate change strategy. Vice President Office, Division of Environment. Dar es Salaam.

– (2012b): Population and housing census 2012. National Bureau of Statistics, Ministry of Finance. Dar es Salaam.

Watts, M. J. and Bohle, H. G. (1993): The space of vulnerability: the causal structure of hunger and famine. In: Progress in Human Geography 17 (1), 43–67. https://doi.org/10.1177/030913259301700103

Wheeler, T. and von Braun, J. (2013): Climate change impacts on global food security. In: Science 341 (6145), 508–13. https://doi.org/10.1126/science.1239402

Wisner, B.; Blaikie, P.; Cannon, T. and Davis, I. (2004): At risk: natural hazards, people's vulnerability, and disasters. London, New York.

Yeung, H. W. C. (1997): Critical realism and realist research in human geography: a method or a philosophy in search of a method? In: Progress in Human Geography 21 (1), 51–74. https://doi.org/10.1191/030913297668207944

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