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Collaborative Adaptation Research Initiative in Africa and Asia

ASSAR
Adaptation at Scale in Semi-Arid Regions

The development-adaptation spectrum in dryland East Africa: mapping risks, responses and critical questions for social research

CARIAA-ASSAR Working Paper

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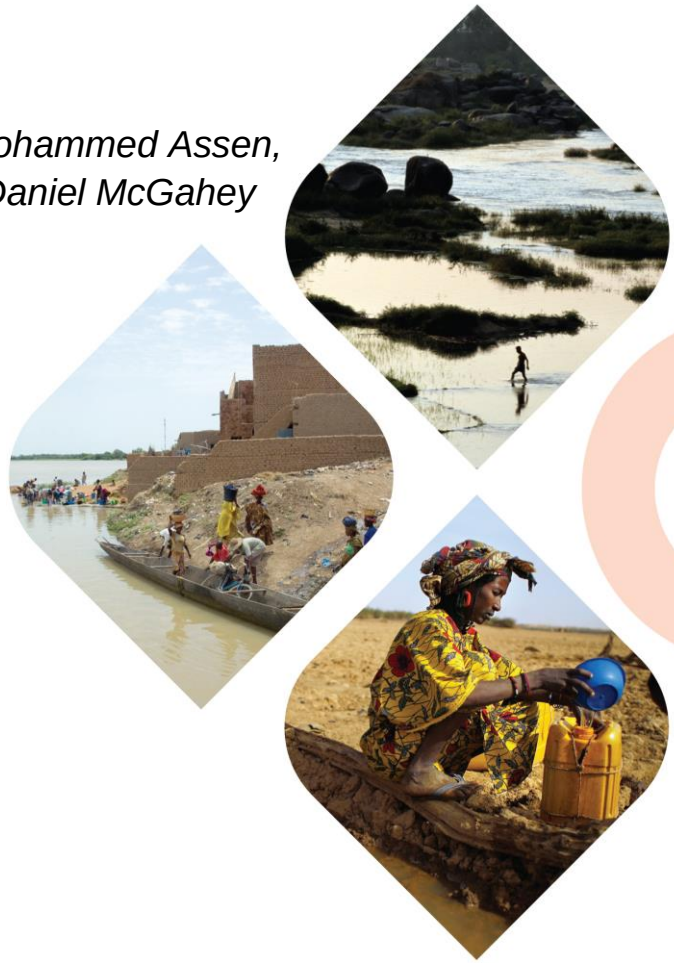

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About CARIAA Working Papers

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Abstract

Semi-arid regions across the world face high potential impacts of climate change, but the risks posed by a changing climate interconnect with a web of related risks and dynamics. The drylands of East Africa, in particular, are crucibles of change in terms of patterns of land and water access and use, natural resource degradation, human development, economic opportunity, social and gender stratification, migration and urbanization. Both risks and the responses to them should therefore be understood as located within a sphere of activity in which adaptation and development merge. The purpose of this paper is to review responses to climate-related social-ecological risks in semi-arid areas of East Africa, in order to lay out an agenda for future critical research. By drawing on a wide range of academic and non-academic sources, the paper maps out the main forms of response to the inter-linked risks in the region, and considers how they might be viewed in terms of a spectrum of development-adaptation actions. In doing so, the discussion highlights key implications of existing and potential responses for people's livelihoods and wellbeing, particularly in terms of equity and sustainability, and identifies a series of critical questions that need to be posed about response options both within research and practice.

About ASSAR

All authors of this working paper are team members in the ASSAR (Adaptation at Scale in Semi-Arid Regions) project, one of four hotspot research projects in CARIAA. The international and interdisciplinary ASSAR team comprises a mix of research and practitioner organisations, and includes groups with global reach as well as those deeply embedded in their communities. The ASSAR consortium is a partnership between five lead managing institutions - the University of Cape Town (South Africa), the University of East Anglia (United Kingdom), START (United States of America), Oxfam GB (United Kingdom) and the Indian Institute for Human Settlements (India) – and 12 partners – the University of Botswana, University of Namibia, Desert Research Foundation of Namibia, Reos Partners, the Red Cross/Crescent Climate Centre, University of Ghana, ICRISAT, University of Nairobi, University of Addis Ababa, Watershed Organisation Trust, Indian Institute for Tropical Meteorology, and the Ashoka Trust for Ecology and the Environment.

Working in seven countries in semi-arid regions, ASSAR seeks to understand the factors that have prevented climate change adaptation from being more widespread and successful. At the same time, ASSAR is investigating the processes – particularly in governance – that can facilitate a shift from ad-hoc adaptation to large-scale adaptation. ASSAR is especially interested in understanding people's vulnerability, both in relation to climatic impacts that are becoming more severe, and to general development challenges. Through participatory work from 2014-2018, ASSAR aims to meet the needs of government and practitioner stakeholders, to help shape more effective policy frameworks, and to develop more lasting adaptation responses.

Why focus on semi-arid regions?

Semi-arid regions (SARs) are highly dynamic systems that experience extreme climates, adverse environmental change, and a relative paucity of natural resources. People here are further marginalised by high levels of poverty, inequality and rapidly changing socio-economic, governance and development contexts. Climate change intersects with these existing structural vulnerabilities and can potentially accentuate or shift the balance between winners and losers. Although many people in these regions already display remarkable resilience, these multiple and often interlocking pressures are expected to amplify in the coming decades. Therefore, it is essential to understand what facilitates the empowerment of people, local organisations and governments to adapt to climate change in a way that minimises vulnerability and promotes long-term resilience.

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1. Introduction

Semi-arid lands across the world have been identified as zones of heightened human vulnerability to climate change (Tucker et al., 2015), yet this vulnerability exists in indivisible connection with exposure and sensitivity to a range of related risks, shaped and re-shaped by social and environmental dynamics. Focusing on three countries of East Africa - Ethiopia, Kenya and Uganda - the paper reviews existing literature on risks, vulnerability, adaptation responses, development dynamics and gaps to effective adaptation across the region's drylands. Generating this platform of understanding, we contend, is a crucial step toward the development of adaptation pathways. Understanding the future 'adaptation space' requires first an understanding of historic and contemporary responses (Eriksen et al., 2005; Thornton et al., 2007). How have and how are people and society responding to the risks? And what critical questions should we ask in relation to the sustainability and equity of these responses?

Our review takes an integrated approach in that we conceive of vulnerability and adaptation existing within a complex web of climatic and non-climatic conditions and dynamics. There are many different risks associated with environmental dynamics, of which climate change is only one of several interlinked drivers of change in East Africa. As Davidson et al. (2003) underline, the effects of climate change will be compounded by widespread poverty, human diseases and high population growth rates that are expected to intensify demand for food, water and livestock forage within the region. For example, drought, as a causative factor in affecting human wellbeing, has to be put into the context of dynamics of other socio-economic, political and environmental factors that can limit livelihood opportunities and impact on food security, including the intra-household allocation mechanisms that mediate outcomes. When analyzing risks, we therefore need to root our understanding in a wider and complex context of stresses and risks such as high levels of poverty and economic crisis in some areas, HIV/AIDS, low diversity of livelihoods, dependency on climate change sensitive activities such as tourism in Kenya, and poor and poorly maintained infrastructure and services (Hepworth and Goulden, 2008; Roncoli et al., 2010).

Given the multi-sectoral nature of the risks, it is also the case that response needs are broad in scope. Even if we were to narrow the analysis to specific dynamics caused by climate change risks we would also see the need for a broad terrain of response measures, because the environmental and social impacts of climate change alone are so complex (see e.g. Noble et al., 2014). In Ethiopia, for example, impacts cut across food and water security, infrastructure, public health, natural resources, and biodiversity (Conway et al., 2005; Deressa et al., 2009; Robinson et al., 2012; Boelee et al., 2013). This underlines that climate change adaptation cannot readily be viewed in isolation from wider societal and environmental concerns, and hence this paper refers to responses within a development-adaptation spectrum. As discussed in Section 5, this has close parallels with the concept of a 'continuum' of adaptation activities proposed by McGray et al. (2007) and elaborated by Tanner and Mitchell (2008). Within the spectrum of responses we can see a diversity of actions according to spatial scale, types of actors (private, public, civil society), the time-frame of response, and whether the response is reactive or anticipatory in nature - though in practice few of these distinctions are clear-cut.

The paper is structured as follows. Section 2 describes the methodology of the associated literature review. Section 3 outlines major climate-related risks in East Africa and how these inter-relate with development trends to shape vulnerability. A mapping and critique of response options to manage these risks follows in Section 4, and Section 5 then discusses these responses, relating them to risks, locating activities on a development-adaptation spectrum, and recognising some key implications for the equity and sustainability of adaptation processes in the region. Section 6 discusses an agenda for further research.

2. Review methodology

The main component of the research methodology was an academic and grey literature review, conducted as part of a programme of research scoping under the Adaptation at Scale in Semi-Arid Regions (ASSAR) project. A range of documents were collected for East Africa (Ethiopia, Kenya and Uganda) that cut across the research themes of climate and non-climatic risks, vulnerability, social-economic, political and governance dimensions and adaptation. While not being a full systematic review the approach taken was to follow some of the tenets of a systematic review, by defining relevant search terms clearly, using a range of search strategies, described below, and reviewing systematically the most relevant literature.

The grey literature search produced an initial listing of identified documents and their major highlights. In total, there were 109 grey literature documents that were found to be relevant: Kenya (47); Ethiopia (20); Uganda (18); Regional (24). These were further screened and then reviewed.

The academic literature search consisted of review of all relevant literature (peer reviewed articles and book chapters) published between 2005 and 2014. The search included Web of Science/ Web of Knowledge bibliographic database, using a range of potentially applicable keywords and their combinations: ‘climate change adaptation AND east Africa’; ‘climate change adaptation AND Ethiopia/Kenya/Uganda’; ‘climate change AND vulnerability AND east Africa’; ‘semi arid AND east Africa AND adaptation’; ‘semi arid AND east Africa AND climate change’.

Non-relevant literature and duplications were discarded. In total 150 relevant academic publications were identified for further review. These were the categories of literature based on their country of focus: Kenya (67); Uganda (14); Ethiopia (43); and Regional (26).

The articles identified in the academic review were diverse, covering: a wide range of biophysical and socio-economic issues; a number of sectors (e.g. agriculture, environment/resource management, disaster risk reduction, development, infrastructure, water, health, communication), various themes (e.g. adaptation, impacts, vulnerability, enablers and barriers), geographies (rural, peri-urban, urban) and climatic trends (past and future scenarios). While these articles focus on east African nations of Uganda, Kenya, and Ethiopia, there are also some articles referring to other parts of eastern Africa (e.g. South Sudan, Somalia, Tanzania) or other parts of sub-Saharan Africa. The review also drew on broader articles on themes of climate change, vulnerability and development that do not have a regional focus.

3. Inter-related risks

As a preface to the next section, this section briefly sets out the key risks and impacts facing vulnerable groups in the drylands of East Africa that are highlighted in the literature. It also considers how different sources of vulnerability overlap and interact both positively and negatively with development trends across the region.

Based on the literature review we identify a set of eight inter-related risks that strongly affect people's livelihoods and wellbeing in semi-arid areas of East Africa (see e.g. Conway et al., 2005; Liu et al., 2008; Amsalu and Adem, 2009; Kabubo-Mariara, 2009; Demeke et al., 2011; Okoba et al., 2011; Mubiru et al., 2012; Schilling et al., 2012; USAID, 2012; Biazin and Sterk, 2013; Degefu and Bewket, 2014). We refer to these as climate-related social-ecological risks, recognizing that each is a product of multiple factors and causes. Each of these risks is briefly summarised in Table 1, but for a full description and review please see Few et al. (2015).

Table 1: Climate-related social-ecological risks to wellbeing in the drylands of East Africa

Rainfall variability	Manifests as delay in onset and/or early end of rains, intermittence, long or short dry spells; impacts on rain-fed agricultural production, food security and water resources for ecosystem services.
Drought	Frequent and often prolonged in the region, compounded by rising temperatures and evaporation rates; severe impacts on food and health security; emergency coping measures can erode long-term livelihood security.
Flood hazard	Significant and increasingly prevalent hazard to lives and livelihoods; includes rapid-onset flash floods derived from intense local rainfall or slower-onset river floods accumulating from heavy rain across large river basins.
Resource degradation	Environmental changes in the region include rangeland degradation, increased soil erosion and siltation of watercourses, and exposure to invasive species; undermines the natural resource base for livelihoods.
Resource conflict	Increasing competition and conflict over water and land resources between communities and forms of land use threatens livelihoods and physical security of people; complex causal factors but including environmental stresses.
Food insecurity	Food production, distribution and access crises create widespread food insecurity; impacts on nutrition, health and wider human development; associated with a range of environmental, economic and social factors.
Human health	Environmental change has the potential to increase health burdens; disease risks accentuated under poor water and sanitation conditions such as in rapidly urbanizing environments, flood zones or drought-affected areas.
Plant and animal diseases	Changes in temperature and humidity may increase animal and plant diseases such as vector-borne and helminthes infections in livestock; losses, lowered productivity and reduced crop yields impact on livelihoods and human health.

We can perhaps view these risks as funneling out in scope/causality from those that are essentially climatic/hydro-meteorological such as rainfall variability, through those that are essentially ecological (with multiple causes including climatic change) such as resource degradation, to those that are essentially about human wellbeing (with an even wider suite of causes including climatic

change) such as food insecurity. However, the key argument we are making here is that these dynamics are inherently inter-related and therefore defy being depicted as a linear progression. For example, food insecurity can lead people to undertake coping actions that place extra strain on natural resources and that exacerbate water shortages. Hence, we prefer to depict the relationship between these risks as multi-directional, as depicted in Figure 1.

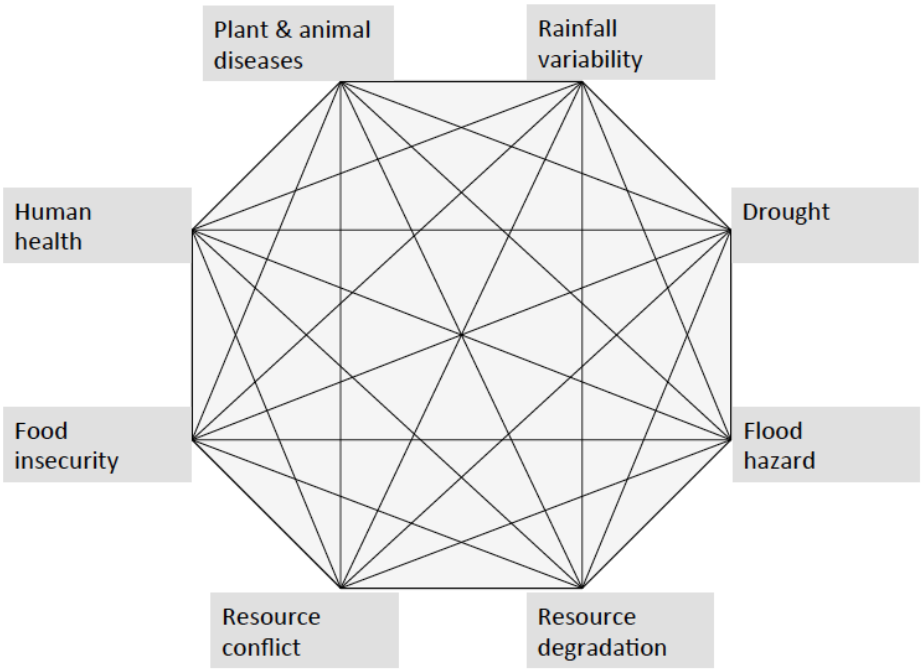

Figure 1: The inter-related nature of these social-ecological risks

Fundamental to any consideration of risks has to be the recognition that vulnerability is highly differentiated socially, both in terms of exposure and underlying susceptibility. Many authors have highlighted the equity dimensions of risk in the semi-arid areas of East Africa, and an increased vulnerability most specifically of poorer and politically marginalised groups (e.g. Eriksen et al., 2005; Gachathi and Eriksen, 2011; Gebresenbet and Kefale, 2012). But, for most of these risks, it is equally important to take a finer-grained account of vulnerability differences related to gender, age and disability that intersect broad differences based on livelihood, class or ethnicity. The gendered differentiation of vulnerability both in terms of susceptibilities and capacities is increasingly emphasized in research in the region (e.g. Baguma et al., 2013; Figueiredo and Perkins, 2013; Rovin et al., 2013).

Development trends are of course changing vulnerability to these risks in semi-arid areas: as livelihood strategies and access to resources and assets respond to broader development changes taking place, these can have an impact on climate-related risk and knock-on effects on people's (differentiated) ability to cope and adapt. Key processes in the semi-arid lands of East Africa include transitions to agro-pastoralism, changes in land distribution, agro-industrial development, population growth, migration and urbanisation (ODI, 2010; USAID 2012). Many authors argue that a

policy focus on promotion of irrigated cash crops and a relative marginalisation of support for dryland-compatible land use options has impacted on pastoralist livelihood security, exacerbated conflicts around access to land, and increased vulnerability to climate variability (e.g. Eriksen and Lind, 2009; Galvin, 2009; Owuor et al., 2011). The interlinking of different sources of vulnerability is illustrated by the way political unrest in semi-arid areas underpins and runs alongside other sources of vulnerability. Decades of conflict in Karamoja, Uganda, for example, have been a major cause of land use change as herders either seek protection by congregating together around settlements or disperse to higher mountainous areas where settlements can be hidden and agro-pastoralism can be practiced (Naimir-Fuller, 1999).

4. Identifying and interrogating responses

Based on review of literature for East Africa, we identify a number of fields of activity that are articulated as responses to the climate-related risks identified in Section 3. The intention here is to map out response options rather than definitively analyse progress within each field. However, we do note some critical uncertainties and questions associated with the responses, which have implications for a more overarching analysis of adaptation-development issues presented in the later sections of the paper.

Responses to risks take many forms, including emergency coping actions such as the sale of assets and livestock by households and temporary migration to urban areas, as well as emergency food relief provided by organisations. Crisis response measures such as these (although they may have deep roots in cultural practice) risk undermining livelihood security (Smucker and Wisner, 2008; Speranza, 2010; Opondo, 2013). They are not the focus in this discussion, which is oriented mainly toward activities that aim for the longer-term management of risk.

In the following two subsections we distinguish conventional sectors of activity from broader approaches designed to support livelihoods and wellbeing of the most vulnerable, though it should be noted that all these fields are overlapping in scope rather than discrete categories.

4.1 Sectoral strategies

These refer to fields of activity that typically match the core sectoral responsibilities of institutions working on the management of resources, agriculture and a range of hazards affecting production, health and wellbeing. These include interventions by a range of actors as well as the adaptive mechanisms undertaken by individuals and households.

Ecosystem protection

Many organisations and authors within the region and elsewhere see a route to vulnerability reduction through more sustainable natural resources management and ecosystem conservation, via changes including decentralisation of resource management and recognition of the value of ecosystem services (e.g. Alterra, 2010; EAC, 2011; Mango et al., 2011). This builds on a wide range of

existing resource conservation programmes and initiatives in East Africa on soil and forest rehabilitation, reforestation and conservation of watershed forests, and wetlands protection, often undertaken through the collective labour mobilisation of local communities (IBRD/World Bank, 2010; Brown et al., 2011). Ecosystem-based Adaptation is one approach, so far little utilised in the region's drylands, that places biodiversity conservation and ecosystem services at the heart of an overall social-ecological adaptation strategy (UNEP, 2015).

To date, however, there has been little critical assessment of the potential for ecosystem protection approaches to deliver equitable and sustainable development gains in dryland zones, although wider analysis is highlighting the social-ecological trade-offs that may well exist in practice in interventions aimed at both poverty alleviation and ecosystem services (Sikor, 2013). A review by Howe et al. (2013) of the current state of understanding on the causal relationships between climate change, ecosystem services and poverty alleviation demonstrates a current failure to consider the complex linkages, feedbacks and multidimensionality of these three factors. Without such understanding it is difficult to establish strong conclusions regarding the likely effect of climate change on ecosystem service-poverty relationships, particularly in the dryland biome which is considered particularly vulnerable to climate change. Others have emphasized the apparent constraints to implementing Ecosystem-based Adaptation effectively due to the lack of information and uncertainties regarding how ecological processes will react to climate change and management under increasingly warmer scenarios (Colls et al., 2009).

Pastoralism support

Strengthening pastoral institutions, supporting innovation and diversification, but also reinstating resource rights necessary to enhance livestock mobility are seen by many as a key to facilitating resilience building within the pastoral system of East Africa (Catley et al., 2013; Headey et al., 2014; Tessema et al., 2014). A number of initiatives, for example, have sought ways to strengthen customary rangeland governance as a means to build adaptive capacity (Roba, 2014). Owuor et al. (2011) reported that flexible interactions between agro-pastoralists and pastoralists in the Kenyan eastern drylands, through trade, mobility and natural access helped these groups manage times of prolonged drought. Their study recommended that fundamental changes in governance regime are needed to move towards approaches that strengthen positive interactions between pastoral and agro-pastoral groups. Others argue for a fundamental rethinking of pastoral policy towards approaches that better support emerging market opportunities, local growth, pro-poor economic diversification and provision of livelihood options outside pastoralism (see Catley et al., 2013). The availability of formal markets for livestock products is poor across much of the region and most livestock sales are through burgeoning informal markets and trading networks. Speranza (2010) found that limited responses to market dynamics and the collapse of livestock markets during droughts resulted in disadvantageous sales, resulting in declining incomes for pastoralists and increased vulnerability.

Greater understanding of the social dynamics of pastoralism such as changing mobility patterns and of the trade-offs associated with these pastoral development trajectories has to be a foundation for the design of effective responses. Several authors have stressed the importance of a more longitudinal analysis of the complex, interactive factors related to past and future pathways of change

within the region's pastoral system (see e.g. Ericksen et al., 2013; Letai and Lind, 2013). Evidence remains patchy across the region as to the mechanisms, processes or factors determining whether poor pastoralists fall into poverty as a result of climatic shocks. Bene et al. (2014) stress the importance of focusing more on capacity (absorptive coping, adaptive and transformative) as a means to understanding resilience in the pastoral context. Morton and Barton (2002), for example, stressed the importance of clarifying the pressure points within drought cycles where access to effective destocking projects can provide a critical means to improve the purchasing power of vulnerable households.

Crop production

Risk management in the agricultural sector in East Africa generally hinges on efforts to restore degraded lands, use drought resistant seed varieties, harvest rainfall, adopt irrigation, plant trees, develop index linked micro-insurance schemes and use seasonal forecasts and drought early warning systems to optimise farm management (Leary et al., 2007; Gebrehiwot and van der Veen, 2013). Within these efforts, planning for climate change adaptation should consider change and uncertainty in the onset and ending of seasonal rains, length of growing season, dry and wet spells and effects of evapotranspiration (Demeke et al., 2011). Much depends on investment in new agricultural practices – either developed externally or adopted by communities independently (Kansiime, 2012). However, dryland farmers have long used crop diversification and informal systems of seed collection, saving and exchange to ensure food security in drought prone regions (Brooks, 2014), and some interventions have sought to build upon these systems, for example to organise seed fairs in Kenya to facilitate the exchange of locally adapted seeds following drought periods (Orindi and Ochieng, 2005).

It is stressed that, to be effective, external investment in projects that target improved agricultural productivity and resilience to climatic/environmental change need to recognise that some smallholder farmers might have difficulties to apply new production techniques such as drought tolerant maize varieties (Scoones and Thompson, 2011; FAO, 2013; Brooks, 2014). Policies that focus on increasing resistance of agriculture to climate variability through promotion of drought tolerant crops, for example, may reinforce the exclusion of marginalised social groups in dryland East Africa, who are challenged by high labour requirements and low market value of these varieties (Eriksen et al., 2005). Where new approaches have been tried, such as programmes in Kenya that have attempted to bridge formal and informal seed systems (Brooks et al., 2009), independent analysis is vital to understand how effectively they have been taken up.

Water management

Improvement in micro-scale water management in semi-arid areas can help communities to achieve food and health security, become less rainfall dependent and reduce drought impact (Conway et al., 2005; Slegers and Stroosnijder, 2008). Soil and Water Conservation approaches, including creation of sand dams, soil bunds, stone bunds, waterways, trees, contours and irrigation, are reported to have significant positive impacts on yields in low-rainfall areas, and can help reduce rainfall dependency within rain-fed agriculture (Demeke et al., 2011). Rainwater harvesting is another multipurpose strategy being implemented in the region, providing opportunity to cultivate vegetation near to

farmers' homes, as well as supplying water for domestic consumption and animal watering during long dry spell periods (Pacey and Cullis, 1986; FDRE, 2011).

Again, it is crucial to understand the social barriers to undertaking proposed water management adaptations. In parts of Ethiopia, Bryan et al. (2009) found that barriers to Soil and Water Conservation strategies and technologies included: insufficient information, lack of credit/money, shortage of labour and lack of access to water for irrigation. Investment in infrastructure to support small-scale irrigation and water resources development also needs to be carefully planned to ensure that it is sustainable under varying patterns of rainfall, and does not introduce other risks. According to Boelee et al. (2013), for example, promotion of rainwater harvesting and water storage can expand the open water surface in susceptible areas and lead to increased transmission of water-related diseases.

Disaster risk management

Much of the focus in the drylands of East Africa is inevitably on drought, and reducing farmers' vulnerability to drought has been a key aspect of many projects (NMA, 2007; Amsalu and Adem, 2009; Gray and Mueller, 2012). Schilderinck (2009) tested the effectiveness of The Drought Cycle Management model at household level in four districts of Kenya and identified four strategies that appeared to be effective in reducing drought risk to livelihoods: establishing a livestock management structure; diversifying household income; taking measures to conserve water; and accessing credit facilities at the community level. Flood risk is also severe in some river basins of the region, and arguably strengthening of measures such as watershed management, land use planning, flood control infrastructure, and flood early warning systems should be prioritised too, given that rainfall intensity may increase (Bryan et al., 2009; IBRD/World Bank, 2010; Haile et al., 2013; Opondo, 2013).

Inherent in many of the responses advocated above is the recognition that response to disaster risk entails much more than management of emergencies, crucial though that remains (Wisner et al., 2004). Potential increases in the impacts of extreme weather events in the East African drylands emphasise still further the importance of effective disaster prevention and mitigation as a means to reduce the chances of disasters arising from hazards. Measures to move toward more holistic disaster risk reduction through strengthening capacity to reduce underlying vulnerability are strongly called for in the region (UNISDR, 2012; FAO, 2013). This reflects the need for a tighter interlinkage between disaster risk reduction, climate change adaptation and broader development pathways (e.g. Conway et al., 2005; Ericksen et al., 2013), together with critical research on the enablers and barriers to closer integration.

Climate information services

Authors such as Osbahr et al. (2011), Conway and Schipper (2011) and Dinku et al. (2014) note a continued need for investment in climate services to improve the quality and accessibility of climate data, information products and the integration of climate information into policy and practice. Existing sources for climate information, forecasts and early warning in East Africa include national meteorological agencies, plus the regional Drought Monitoring Center in Nairobi and the Famine Early Warning System Network which provide a range of climate and sectoral information to

ten countries in the Greater Horn of Africa. The channels for dissemination of climate and weather forecast information are diverse. In addition to mass media, in the semi-arid parts of Kenya, for example, mobile phone services and local extension service networks play a key role (Cherotich et al., 2012).

A key question for the social research agenda is to understand how effectively and equitably these various channels for dissemination reach out across the population, plus the extent to which the information is absorbed and subsequently acted upon. The efficiency of all these means in reaching vulnerable groups, especially in remote rural farms and rangelands, is not well established (Deressa et al., 2009; Dinku et al., 2014). For example, the current enthusiasm expressed in many quarters for the effectiveness of mobile phone communication as a mechanism for vulnerability reduction needs to be backed up by rigorous assessment of who is receiving the information, who they are in turn informing, and how people are utilising the information they gain (Wall, 2015).

4.2. Support for livelihoods and wellbeing

Alongside sectoral measures the literature describes a range of more generalised approaches to the management of climate-related risk at the grassroots level associated with building capacities and assets of the most vulnerable, seeking alternative livelihoods and life choices, and securing access to support (Leary et al., 2007).

Livelihood diversification

One key strategy often raised in connection with uncertainty over future climatic and other risks is the facilitation of livelihood/income diversification as a mechanism to reduce vulnerability (Bryan et al., 2009; Deressa et al., 2009; Gachathi and Eriksen, 2011). Many interventions in the region target support to livelihood diversification, and farmers in rural East Africa use both on-farm and off-farm income diversifications (Wanyama et al., 2010). The on-farm income diversification includes planting different crops and raising different animals, while off-farm income generation include casual labour, petty trading, and sale of natural resources (especially wood and charcoal) (Eriksen et al., 2005; Amsalu and Adem, 2009).

It is important to recognize that options for diversification in the region are inherently socially differentiated, related to factors such as access to capital and credit, proximity to towns and markets, and gender divisions in income opportunities (Amsalu and Adem, 2009; Wanyama et al., 2010). Research in Ethiopia on the determinants of rural household livelihood diversification, for example, suggests male headed households are more likely to diversify than female headed households (Yizengaw et al., 2015). Even if households have opportunities in cash cropping and nonfarm activities, pricing and inefficiency in production and marketing negatively limit the extent to which this can raise them out of poverty and food insecurity (Barrett et al., 2001; Gachathi and Eriksen, 2011). Further, there is a distinction between diversification through choice and through necessity, and questions remain about the wellbeing implications of enforced diversification.

Social safety nets

Three main social safety net programmes cover semi-arid areas in Kenya, Ethiopia and Uganda: Kenyan Hunger Safety Net Programme, Ethiopian Productive Safety Net Programme and Northern Uganda Social Action Fund. These particularly target food insecure populations in dryland regions, aiming at reducing poverty through regular cash transfers and related mechanisms. The Ethiopian Productive Safety Net Programme aims to serve a dual function in that public works are implemented in drought-affected rural areas through food-for-work and cash-for-work schemes. The intended goals of the programme include reducing flood risks and soil erosion, enhancing soil moisture and ground water resources and restoration of ecosystem services (Weldegebriel and Prowse, 2013).

Evaluations of social safety net programmes have underlined their potential to support food security in the region (Berhane et al., 2011; Merttens et al., 2013), but such critical reflection also recognizes that in practice they can face a number of equity and sustainability challenges. For example, the use of community-based targeting can create tensions if allocations are perceived as unfair, and may impact negatively on children who take on the tasks of adults to free them to participate (Camfield, 2014). Where compensation is given in cash rather than grain this can distort local grain markets, increasing prices for all, and households may receive diminishing amounts of food over time (Emirie et al., 2009; Berhane et al., 2011). An important research task is therefore to track the wider implications of social safety net programmes for local economies, existing informal transfer networks and intra-household relations (Merttens et al., 2013), as well as the effectiveness of environmental protection works undertaken.

Gender-focused approaches

Gender-focused approaches work specifically to address the differentiated vulnerability of women, men and youth, and to recognise the capacities, particularly of women, in addressing environmental change. Oxfam has initiated an advocacy campaign entitled ‘Our land, our lives’ which uses rural women’s assemblies and women’s land tribunals/hearings and long marches to assert women’s land rights and build women’s movements in the context of increasing resource scarcity in East African drylands of Kenya and Tanzania (Oxfam, 2012). Approaches in the region have aimed to strengthen the involvement of women in local institutions, such as in water management (see e.g. Baguma et al., 2013; Figueiredo and Perkins, 2013). Others have specifically targeted the strengthening of economic livelihoods, often through women’s collectives and credit groups (see e.g. Gabriellson and Ramasar, 2013; Caretta, 2014).

There is a need to critically assess the effectiveness of gender-focused approaches. Interventions need to be very carefully grounded to recognise, and in some cases challenge, the often complex gender roles and relations in existence on the ground. For example, married women may be excluded from profitable activities due to local taboos as well as domestic responsibilities (Eriksen et al., 2005). This illustrates the importance of taking intersectionality into account and looking at the way other identities related to age/ life stage, class, and ethnic or religious group might intersect with gender. As with any intervention, it is vital to assess the wellbeing impacts in terms of equity across social groups and sustainability of gains made (Baguma et al., 2013; Caretta, 2014). This should include the

distribution of both benefits and work within the household and a critical exploration of social, cultural and practical barriers to uptake by women.

Relocation and migration

One response to managing risk is to use migration: reducing exposures to climate-related hazards by relocating, either temporarily or permanently (Leary et al., 2007). After floods in Kenya in 2011, for example, Opondo (2013) reported households engaging in temporary migration. Migration and population mobility is also a response mechanism to drought, as falling agricultural and animal production pushes households and individuals to seek new opportunities elsewhere (Gray and Mueller, 2012). As a fundamental practice of pastoral communities, mobility is also a common drought and resources shortage coping and adaptation mechanism in the arid and semi-arid areas of Ethiopia (Desta, 2006) and Kenya (Homewood et al., 2009; Kaimba et al., 2011).

Key tasks for research include understanding the dynamics of mobility and migration, both externally imposed and internally generated, and exploring how migration patterns and their implications are socially differentiated. Changing internal aspirations may challenge adherence to mobile lifestyles, for instance, but pastoralist mobility is increasingly constrained by competing land uses that restrict the long-distance movement of livestock and access to former seasonal pasture (Bossio et al., 2012; Butt and Turner, 2012). Social patterns of migration are again shaped by complex push (livelihood stresses) and pull (opportunity) factors that may work differently according to gender, income, land tenure and social networks (Gray and Mueller, 2012; Abebe, 2014).

Risk sharing

Another key facet of risk management is the spreading of risk through a variety of means, including kinship networks, pooled community funds, and weather insurance (Leary et al., 2007). The potential of micro-insurance is a theme high on the international adaptation agenda. Writing on Ethiopia, Bezabih and Di Falco (2012) see crop insurance to minimise drought-induced shocks as a key way in which climate policy could be effectively linked with development policy, and encourage asset accumulation. Within Kenya, local savings and credit associations also act a form of informal insurance, as do Iddir (traditional burial societies in Ethiopia) whom some have proposed can play a greater role in risk sharing (Aredo, 2010).

As with all responses, critical questions need to be asked of risk sharing mechanisms. An inherent danger is that if the poorest and most vulnerable are not enabled to access services such as micro-insurance schemes this results in further cementing existing exclusion (Mitchell and Tanner, 2008). Providing access through existing informal structures and social institutions also risks further entrenching relationships of power serving to perpetuate exclusionary behaviour. Peterson (2012) also found that while climate index-linked micro-insurance schemes may benefit some farmers, they have the potential to alter coping strategies and introduce farmers to new market risks including variable premiums.

Knowledge and skills development

Capacity has many 'enabling' facets beyond technical skills, yet building awareness and knowledge about risks and how to adapt to reduce vulnerability remains key, especially if the rural poor are to move beyond short-term coping measures in response to climate shocks and to invest in long-term anticipatory strategies (Kabubo-Mariara, 2009; Okoba et al., 2011; Bryan et al., 2009). This is currently built into a wide range of climate and non-climate interventions in the region. In Kenya, Uganda, and Ethiopia, for example, pastoralist field schools are one mechanism through which pastoralists learn through observation and experimentation how to deal with risks and hazards affecting their livelihood (UNISDR, 2012). Several authors call for a strengthening of extension services in agriculture, veterinary health and preventive human health, in part as a mechanism of knowledge development for adaptation (Bryan et al., 2009; Deressa et al., 2009; Kabubo-Mariara, 2009; Hisali et al., 2011).

But it is also vital to recognise that those who use the land already possess stocks of detailed knowledge and coping mechanisms to current climate hazards that should not be overlooked in adaptation policy development. Indeed, projects that seek to impose new forms of knowledge and training run the risk of failure in their objective unless they actively recognise and work with existing knowledge and management practices (Huq et al., 2005; Hisali et al., 2011; Ogalleh et al., 2012).

Documenting the potential of local and 'indigenous' knowledge to enhance capacity is frequently mentioned, yet appears to be under-researched in practice. While many developments around new technologies exist, there is also greater potential for pre-existing adaptive practices to be documented and tested in new contexts.

5. Discussion: adaptation, development, equity and sustainability in semi-arid East Africa

This discussion section reviews the range of responses to social-ecological climate-related risks, locates activities on a conceptual development-adaptation spectrum, and discusses how equity and sustainability dimensions are integral to interrogating the effectiveness of responses.

Table 2 considers the 12 response fields noted in Section 4, suggesting which of the main climate-related social-ecological risks identified in Section 3 they are primarily aimed at addressing – based on published analyses of current practices and interventions in Ethiopia, Kenya and Uganda – and summarising some of the critical research questions identified for them. The mapping of risks with responses is complex, as for example, social safety net programmes such as the Ethiopian Productive Safety Net Programme can have the dual aim of supporting human wellbeing under conditions of environmental stress while simultaneously looking to mitigate resource degradation and disaster risk. Moreover, we present the mapping cautiously, recognising in practice that just as risks interact so these fields of response also tend to cut across risks in their application. Hence, for example, sustainable rangeland management approaches should have implications across most risks even though it is primarily aimed at preventing resource degradation and conflict.

Table 2: Risks, responses and critical questions

Response field	*Applied especially to the following risks…*	*Key critical questions (summarised from Section 4)*
Ecosystem protection	Flood hazards, Resource degradation, Food insecurity	Can ecosystem protection approaches enhance wellbeing and a more equitable access/use of ecosystem services? Are there inherent social-ecological trade-offs? Do ecological uncertainties associated with climate change undermine ecosystem-based adaptation?
Pastoralism support	Rainfall variability, Drought, Resource degradation, Resource conflict, Food insecurity	How are the livelihoods, aspirations and practices of pastoralists changing? What implications does this have for adaptive responses? Can reinforcement of pastoralist institutions reduce resource degradation/conflict in the face of a changing environment?
Crop production	Rainfall variability, Drought, Resource degradation, Food insecurity	Are adaptive responses for agriculture accessible for poorer farmers or do they risk exacerbating differential vulnerability? How effective in practice are innovative approaches in securing livelihoods? Are changes in production methods sustainable in the long-term?
Water management	Rainfall variability, Drought, Resource degradation, Resource conflict, Food insecurity, Human health, Plant/animal diseases	Are adaptive responses for water management accessible for poorer households? What are the limits of water use intensification in a changing climate? Do new mechanisms for water management risk creating unsustainable dependencies and/or health risks?
Disaster risk management	Drought, Flood hazards, Food insecurity, Human health	How can disaster risk management approaches serve to reduce risk and underlying vulnerability? What are the enablers/barriers to closer integration of disaster risk reduction, adaptation and development? Are structural mitigation measures robust in the face of changing extremes?
Climate information services	Rainfall variability, Drought, Flood hazards	What is the effective reach of climate services, especially in remote rural areas? How can information be made appropriate to and usable by non-specialists? How effectively and equitably do new communications technologies function in practice?
Knowledge & skills development	Rainfall variability, Drought, Human health, Plant/animal diseases	How well does training and skills development translate into action? Can important insights into adaptation be gained from a deeper analysis of existing practices? How can scientific knowledge

		be effectively integrated with sources of traditional knowledge?
Livelihood diversification	Rainfall variability, Drought, Food insecurity	How does the potential for livelihood diversification differ among social groups? Under what conditions does diversification raise incomes rather than simply spread risk? What are the well-being implications of enforced diversification (vis-à-vis customary patterns of accumulation)?
Social safety nets	Drought, Flood hazards, Resource degradation, Food insecurity, Human health	What are the equity implications of social safety nets, both within and across communities? How does their existence impact on local economies and long-term income/food security? How can the quality/effectiveness of associated public works for risk management be assured?
Gender focussed approaches	Rainfall variability, Resource degradation, Food insecurity, Human health	Do interventions take account of the full complexity of gender roles and relations? Are barriers that may constrain response options fully recognised? Is the approach sensitive to social differences that intersect with gender related to age, ability, income/class, ethnicity/religion?
Relocation and migration	Drought, Flood hazards, Resource conflict	How are patterns of mobility and migration changing, and why? Who is more likely to migrate because of push factors (e.g. livelihood insecurity) or pull factors (e.g. economic opportunity)? Can migration undermine wellbeing/create exposure to new forms of risk?
Risk sharing	Drought, Flood hazards, Plant/animal diseases	Are risk sharing mechanisms accessible/affordable for the most vulnerable groups? Do existing informal structures entrench or challenge power differentials and social exclusion? Can engagement in risk transfer mechanisms undermine wider vulnerability reduction?

Within the 12 response fields a range of actual and potential activities are feasible, corresponding to different categories of action. Figure 2 draws on some of the specific activities described across the response fields in Section 4 and suggests where each might be considered to lie on a development-adaptation spectrum. The concept of a continuum of responses was initially raised by McGray et al. (2007), who viewed the breadth of adaptation activity as running from mainstream development practice to actions targeted specifically to climate change impacts. Tanner and Mitchell (2008) built on the continuum idea, seeing one end oriented to 'vulnerability' and 'climate-resilient development' and the other to 'impacts' and 'discrete adaptation', with a gradation of forms in-between. The spectrum presented here closely follows these ideas, suggesting that the responses to climate-related risks described above for the drylands of East Africa span overlapping categories from activities aimed at strengthening livelihoods, through management of environmental resources, and actions targeted to climatic hazards, to activities that specifically tackle the impacts of climate change. In this

case, there is some funneling implied, from activities of more generalised benefit for livelihood/wellbeing toward activities that more specifically tackle climatic risks. Nevertheless, it should be reiterated that, whether general or specific in this sense, all are viewed within the literature as potential means to strengthen resilience to climate-related social-ecological risks.

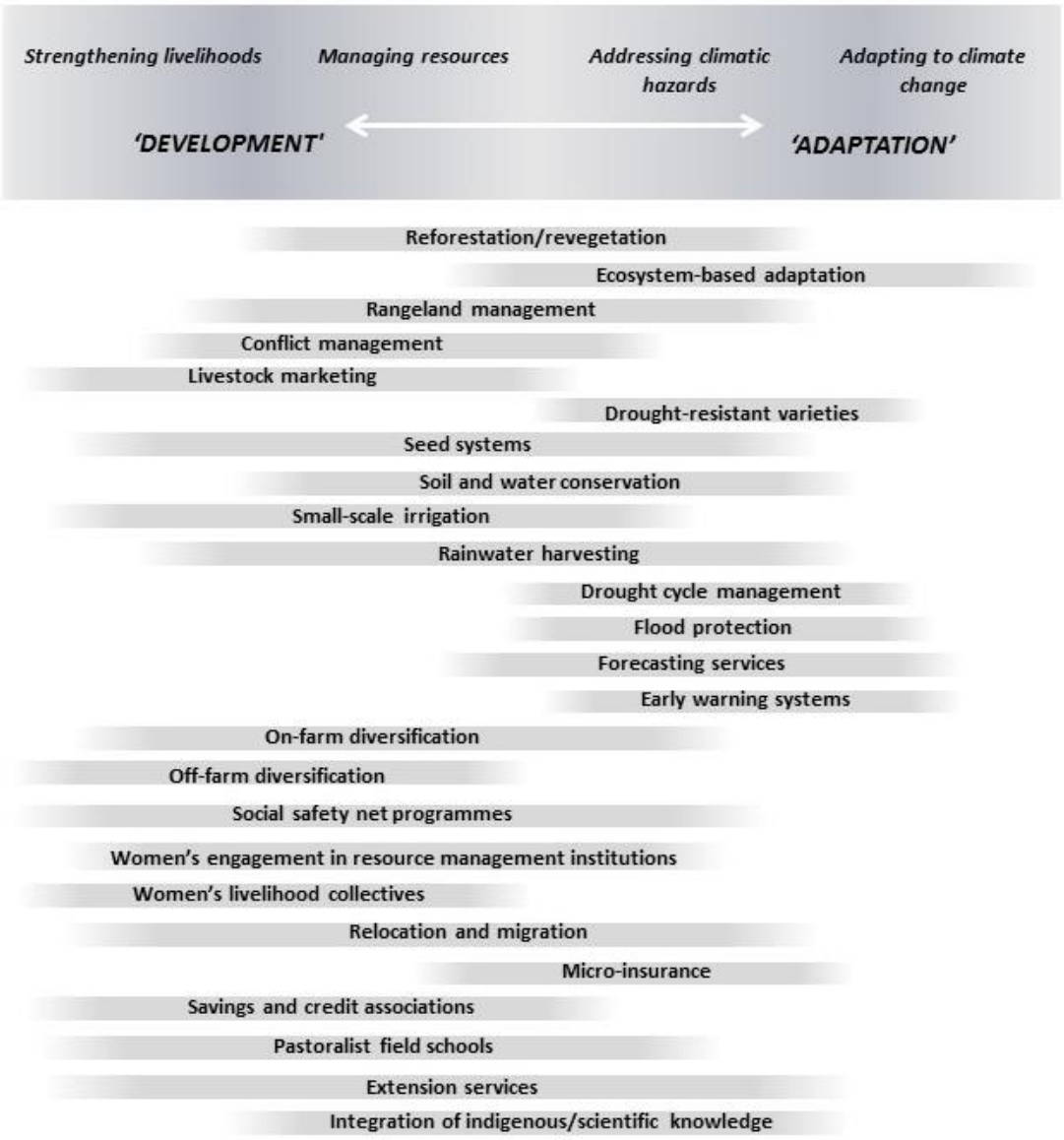

Figure 2: Locating responses on a development-adaptation spectrum

The span plotted for each activity in Figure 2 is intended to be indicative rather than precise, and is of course open to debate. However, it remains notable in the diagram that for the East African drylands much of the 'adaptation' response agenda lies to the left and centre of the spectrum, with few planned and proposed activities narrowly associated with climate change adaptation. Arguably, since the bulk of responses are driven by the water scarcity that is inherent in dryland environments,

most are centrally concerned with addressing what is essentially a development and resource management issue: water security and its impact on food and income security (exacerbated but not necessarily initiated by extreme climatic events, and likely to be intensified but not introduced by the effects of climate change).

In setting out the response options, Section 4 raised critical questions for research and practice. These recognise not only that responses need to be robust in the face of environmental change, but also that consideration of responses cannot be isolated from issues and dynamics of culture, gender, knowledge, power, livelihood assets, entitlements, participation and governance – all are key facets of human development that can reinforce or undermine attempts to strengthen resilience across society (Leach et al., 1999; Wisner et al., 2004; Gallopin, 2006; Lopez-Marrero and Tschakert, 2011). A conventional (discipline-based) view of the spectrum presented in Figure 2 might assume that responses to the 'development' end may have greater implications for sustainability, while those towards the 'adaptation' end may more likely raise issues of equity. However, we would resist any rigid characterisation of this, noting that the complexity of equity and sustainability issues raised above are imbued through the continuum much like other aspects.

The idea of 'maladaptation' refers to responses to climate-related risks that have perverse effects: serving ultimately to increase rather than reduce vulnerability. Strictly-speaking, virtually all practical responses are likely to entail at least some marginal maladaptive effect for someone – a purely positive form of adaptation is probably notional only. However, cases are already emerging in the region of maladaptation that is far from marginal in its impact, especially on the poor.

Maladaptation can result from inertia in risk management practices. Silvestri et al. (2012) argue that traditional coping and adaptation strategies to deal with climate variability may become less effective under future climate changes. Current practices, processes, systems and infrastructure that are more or less adapted to the present climate may easily become inappropriate as the climate changes and more fundamental adjustments will be needed. At grassroots level, some established and new coping strategies may already be damaging under current conditions (Smucker and Wisner, 2008; Opondo, 2013). Speranza (2010), for example, suggests that agro-pastoralists' responses to drought are commonly reactive and mainly involve intensifying exploitation of shared resources. However, it would be wrong to cast emergency coping activities as inherently negative for livelihoods. Eriksen et al. (2005) found that households that specialise in a favoured coping activity (such as charcoal production) were less vulnerable than households that engaged in a diversity of low-intensity coping activities. We would argue that understanding the dynamism of coping and vulnerability is critical to developing adaptation measures that support people as active agents.

Moreover, maladaptation can also be the outcome of interventions undertaken in the name of adaptation. In some cases, for example, there is a danger that communities become dependent on grant-funded projects that only work well as long as the funding continues: they may in fact increase vulnerabilities if people have switched to livelihood activities that cannot be sustained. But it is also crucial to recognise that there are likely to be winners and losers from adaptation programmes (Brooks, 2014), not the least because unequal distribution of resources and power may result in increasing stratification between households. Equally, within a sector it is the net effect of adaptation policies and intervention that needs to be assessed (Huq et al., 2005). Trade-offs may arise between

increasing the buffer capacity of individual farmers and that of the sectoral economy as labour-savings on-farm can translate to reduced job availability in the rural economy (Speranza, 2013).

Ultimately there may be a limit to the effectiveness of 'incremental' approaches to adaptation (Feola, 2015). For example, severe pressures on the agricultural resources base interacting with increasingly intensive climate change may indicate a need for larger-scale systemic and transformational changes. There are also suggestions for a range of ways in which other forms of transformational change can be made, such as shifts in diets, food supply chains, sites of agricultural production, systems of land allocation, and incentives for linking land and water use to ecosystem service functions (Vermuelen et al., 2013). Yet, transformation too is likely to have winners, losers, benefits and trade-offs.

6. Conclusion

Our review indicates the range of both current and potential responses relevant to the East African region and to the drylands of Ethiopia, Kenya and Uganda in particular. Some are strategic in nature, designed to reduce underlying vulnerability of people and society in semi-arid areas; others are more akin to coping responses, through which actors attempt to deal with the immediate ramifications of shocks and stresses.

At the start of the paper we argued that an understanding of historic and contemporary responses to risks is a critical step in informing how we adapt in the future. Understanding this is important not just in terms of generating a baseline of current response modes, but also because progress in adaptation can conceivably come through the reinforcement of pre-existing adaptability (Deressa et al., 2009). Some authors highlight that mobile pastoralism, itself, can be seen as an 'indigenous' adaptation strategy, in that as a livelihood system it is inherently responsive to climate variability under dryland conditions (e.g. Catley et al., 2013; McGahey et al., 2014). Many historic and contemporary responses can be described as reactive, but by no means all.

Despite a wealth of research and investigation reported in both academic and grey literatures for the drylands of East Africa, we contend that deficiencies in knowledge on vulnerability and response to climate-related social-ecological risks remain wide and diverse. Many facets of these issues and their dynamics remain poorly explored. Particular gaps surround, for example, the impacts on land use of the spread of invasive plants, the impact of climate variability and change on crop and livestock diseases, and the changes in environmental health conditions under situations of drought. Equally there are broad gaps in terms of what shapes differential vulnerability to the range of risks, such as the influence of socially differentiated access to land and water resources, and how that helps define both relative vulnerability and adaptive capacity[1].

There is a need in particular to expand critical multi-disciplinary research aimed at further understanding of the complexities of adaptation-development dynamics in the region's drylands in order to inform adaptation and development pathways. Important knowledge gaps relate to the ways in which risk response and adaptation activities are undertaken and lessons communicated. That includes understanding the diversity and roles of local institutions, and the extent with which they can shape practices and decision-making. The degree to which national policies have been

implemented in practice, and have been scaled down to local levels –in conjunction with processes of decentralisation - is a key area for further exploration. Two linked aspects of adaptive response that were particularly weakly evidenced in our review were the themes of urban planning and environmental health for adaptation in East African drylands.

Underlying much of this identification of knowledge gaps is the fundamental need to approach the social dimensions of vulnerability and adaptation research in a critical manner (Mitchell and Tanner, 2008; Tucker et al., 2015). That means seeking to understand: how to effectively link adaptation to development that aims to reduce poverty and improve wellbeing; the likely trade-offs that exist in responses to risk, whether endogenous or exogenous; and, ultimately, what the enablers and barriers are to achieving a widespread, sustainable and equitable adaptation.

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Notes

[1] Many of the critical questions and research agendas identified through the review are being taken forward within the ongoing empirical work of the Adaptation at Scale in Semi-Arid Regions (ASSAR) project in four regions of Africa and Asia. See www.assar.uct.ac.za