Climate Risks and Livelihoods Adaptation in the Sub-Africa: A Review

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Abstract
Climate change impacts all human systems including livelihoods of all regions of the world. The livelihoods activities of the sub-Sahara Africa in particular are already affected because of the fact that the region is highly dependent on natural resources, most of which are climate sensitive. This paper reviews attributes of livelihoods impacts of climate risks and provides highlights of adaptation strategies and monitoring tools that are available within the region.

1. Introduction

Global environmental changes including climate change and its impacts on human sustenance have gained wide range researches and methodological foci of analyses at micro and macro levels. According to the Intergovernmental Panel on Climate Change (IPCC, 2007), associated risks of global environmental change include all events of climate change and climate variability in our planet with more frequency and magnitude of extreme events. Natural and human systems which are tied to such events are more sensitive to the multiplier effects of the changes (Adeniji, 2008).

Each region of the world is facing its own lots of climate change at different scales. In Africa, there are interplay and interconnectivity between climate-associated risks and other web of risk factors which have the potentials of exaggerating the vulnerability of Africa (Boko et al., 2007). The challenges of climate risks on development and food security are enormous in the continent (Adger, 2006). High levels of vulnerability and low adaptive capacity in Africa have been linked to factors such as

limited adaptive capacity in terms of access to development resources and high poverty rates. For example, sub-Saharan Africa is predicted to be particularly hard hit by effects of climate change because it is already experiencing high temperatures and low (and highly variable) precipitation, the economies are highly dependent on rain fed agriculture with a very low system for adopting modern technology (Ellis, 2000; Kurukulasuriya et al., 2006). Risks also have a spatial dimension with location peculiarity depending on the risk factors (Ellis and Allison, 2005). For instance, coastal communities, urban slums and marginalized rural communities who depend on climate-sensitive resources for livelihoods are likely to share the hottest heat of the risk's flame (Adelekan, 2010; Boko, et al., 2007).

In the sub-Sahara Africa, the fall of rural livelihood provides some opportunities. Off-farm diversification included economic migration for piece jobs or wage labour in cities (Forum for Food Security in Southern Africa, 2004; O'Laughlin, 2002; Agrawal and Perrin, 2008). It is important to identify specific associated risks and livelihoods adaptation opportunities that are evident from the sub-Sahara Africa. This paper pursued this objective through documents review and analysis of backgrounds to livelihoods and adaptation studies, trends of climate risks on livelihoods and adaptation options that are available in the sub region.

2. Backgrounds to livelihood adaptation studies

Multiple definitions and conceptualizations of livelihoods have its root in rural development and agricultural economics (Carney, 1998; Chamber and Conway, 1992). Livelihoods can be thought as ways people live (Chambers, 1995), maintain wellbeing and use tangible assets for consumption (Ellis and Allison, 2005). It is also the combinations of the resources used and the activities undertaken in order to live (Krantz, 2001). From the literature, there were some important contributions of both economists and Marxist scholars, particularly in the fields of agricultural economics and geography, who offered a more nuanced view on livelihood concept. The village studies tradition, dominated by economic geographers such as Norman Long in his studies in Zambia with a focus on the micro-economics of farm production and patterns

of household accumulation combines both economic and geographical thoughts (Lon, 1984; cited in De Haan, 2000). The classic examination of rural change in northern Nigeria by Michael Watts (1983) cited in De Hann, 1998, "Silent Violence", offered important insights into patterns of livelihoods change in the sub-Saharan Africa.

Livelihoods concept was a strong theme in Chambers' book, "Rural Development: Putting the Last First" (Chambers, 1987). Also, livelihoods became a focus for a conference organised by the International Institute for Environment and Development (IIED) in 1987 through the initiative of Richard Sandbrook, (Conroy and Litvinoff, 1988). Livelihood includes the idea of coping with and recovery from external stresses in order to maintain or enhance existing capabilities and assets (Linderburg, 2002). Livelihood is also central to the definitions of resilience, adaptation, improvement, diversification and transformation (DFID, 1998; Scoones, 1998).

Adger, (2006) and Assan et al., (2009) relate livelihoods to natural resources management and poverty deduction because, natural resources are used as sources of livelihoods and that the pursuit of livelihood activities depends on the available asset at disposal of people (Cooper et al., 2008; Shomorin, 2010). Assets are also considered to be stocks of different types of capital that can be used directly or indirectly to generate livelihoods (Box 1).

Box 1: Sustainable livelihood capitals

Livelihoods research has helped to explain the differences in responses using understandings of endowments, entitlements and capabilities, within organisational hierarchy and power principles or by individuals or

households (Chambers, 1987; Scoones, 1998; Thornton and Herrero, 2009). At the local level, Putnam et al. (1993) assert that social structures provide livelihood stability by binding individuals in a group together (bonding social capital), or by connecting people from social and economic strata (bridging social capital). Belonging to no discipline in particular, livelihoods approaches can allow a bridging of divides, allowing different people to work together – particularly across the natural and social sciences for participatory approaches to inquiry (Tuton, 2000a; Tuton, 2000b).

Livelihoods perspectives have been central to rural development thinking and practice in the past decade. These relate to localities (rural or urban livelihoods), occupations (farming, pastoral or fishing livelihoods), social difference (gendered, age-defined livelihoods), directions (livelihood pathways), dynamic patterns (sustainable or resilient livelihoods) and many more (Adejuwon, 2008; Shomorin, 2010). Livelihood strategies are the range and combination of activities and choices that people make in order to achieve their livelihoods goals (Adger, 2006). Livelihood strategies can be positive, helping households become more resilient and less vulnerable, or negative when they result in the further erosion and decrease of the asset base (Sen, 1999). Livelihood strategies of actors such as individuals, households and other social groups constitute '*genre de vie*' (Claval, 1974), that is, a system of livelihood strategies of a human group in a specific region, emphasizing the interaction between society and the natural environment.

In 1992, Chambers and Conway produced a working paper for the Institute of Development Studies (IDS) in which a definition of sustainable livelihoods emerged, to provide a clue on what is now seen as the starting point of what came to be known later in the 1990s as the 'Sustainable Livelihoods Approach (SLA)'. They stated:

> "A livelihood comprises the capabilities, assets (including both material and social resources) and activities for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining

the natural resource base" (Chamber and Conway, 1992:15).

A significant number of case studies have been carried out using the methodology of Sustainable Livelihoods Approach (SLA) both at household, community, city, region and national levels especially in climate change research for example, Chen and Ravallion, 2004; Eakin, et al., (2007), Erentein et al., (2009); Hahn et al., (2008); Linderberg (2002); Osbahr et al., (2008) and Sherbinin et al., (2008). SLA is a framework which also makes the relationship between the "vulnerability" context and the other elements in the framework clearer and more explicit (Figure 1). If the poor in the sub-Saharan Africa are able to access the livelihood assets they require and are adequately supported by service providers and enabling agencies, and if they are able to make markets, politics, rules and norms work to their advantage, then it should help them to cope with those elements of climate risks.

3. Climate risks and livelihoods in the sub-Sahara Africa

Statistics show that climate variation is getting more and more extreme in Africa sub-Sahara. For instance, an overview of the weather warning for the world water by the Dialogue on Water and Climate (DWC, 2006) showed that African countries are probably worse off because of the reduction or mean variation in precipitation and the significant influence of poverty and other vulnerability stressors (IPCC, 2008; Mehrotra, et al., 2009). Climate risks could also accelerate environmental degradation, poor agricultural performance and significant impacts on the availability of water for domestic consumption and other water-based activities (InterAcademy Council, 2004, Osbahr and Viner, 2006). In East and Central Africa (ECA) region, the combination of declining per capita agricultural capacity and increasing aridity is exacerbating vulnerability and rural poverty. Meaning that as the gap continue to grow between population increase and investment in agriculture, vulnerability and development poverty will become more pronounced (Funk et al., 2008).

African livelihoods are particularly impacted by climate change vulnerability because of wide inequitable land distribution and weak adaptive capacities

in relation to policy institutions, economic and infrastructure development (Tschakert, 2007). African dependence on natural resources for livelihood support is huge. Over two-third of African's 600 million people rely on forest for their livelihoods and food security, with wood as primary source of energy for at least 70% of households in Africa (AfDB, 2004; Shomorin, 2010). In some countries (Burkina Faso, Mali, Ghana, Niger and Senegal), available data shows that these countries have between 60 and 90 percents of their labour in the rural areas with contribution of 16 and 45 percent of the Gross Domestic Product (Rockstrom, 2004).

Interference of climate change on African livelihoods is expected to produce both positive and negative effects on the rural poor with the negative effects being more significant (AfDB, 2004) because impacts of climate change is intricately connected to food security and could further adding stresses to a deteriorating situation (Burret et al., 2001; Adejuwon, 2008). The negative effects are observed as risks such as loss of biodiversity, rapid deterioration in land cover, decrease in available water quality and quantity with impacts on all rural primary productions such as farming, fishing, forestry and pastoral activities in the continent (Prowse, 2008; Ehui and Pender, 2005). For example, projected decrease in rainfall in East and Central Africa could influence some marginal lands to be more productive than they were before (Assan et al., 2009; van de Steeg et al., 2009) while shorter and drier growing season will result into decrease in agriculture and fishing in West Africa in particular (Nyong and Kanaroglou, 2001, Adejuwon, 2012).

Generally, the implications of climate change in the African sub-Sahara include:

Floods: In recent decades humans have become more exposed to flood risk (Adger, 2006). Different pressures have combined to increase population densities in flood prone areas. In particular, informal settlements have occurred in endangered zones around mega cities in the Africa sub-Sahara (ActionAid, 2006; Tall, 2009). The intensity and frequency of flooding in West Africa in the last five years exacerbated the vulnerability of the poor (Adelekan, 2010). Contrary to public perception, the occurrence of a large flood in Ibadan city (Nigeria) in

2011 and 2012 repeatedly does not mean that it will be a long time before a flood of similar size will occur again in the same place, although the impacts could include livelihoods, transportation, health, agricultural produce lost, death and collapse of infrastructure

Droughts: Droughts have both direct and indirect consequences on human livelihoods (UNESCO, 2004). A direct consequence is crop loss, which can cause starvation. Indirectly, water shortage contributes to the spread of disease, because people lack water for basic hygiene (DWC, 20006). Drought can also inhibit regional development, by contributing to a cycle of poverty because it can occur in relation to lack of precipitation per se but in conjunction with other variables. For example, projected decrease in rainfall in East and Central Africa could influence some marginal lands to be more productive than they were before (Assan et al., 2008) while shorter and drier growing season will result into decrease in agriculture and fishing in West Africa; impacted the yield of some cereals crops, milk production from livestock and ultimately the available nutrient for human consumption in East Africa (Adejuwon, 2008; Throrntol et al., 2009).

Other Extreme Climate Phenomenon: There are a number of weather extremes other than floods and droughts. These include; wind storms, hail storms, heat waves, land cover changes and wildfires (Oloukoi, 2012). These extremes occur on a variety of spatial and temporal scales which impacts human insecurity of already distressed population (Olorunfemi and Onwuemele, 2011).

4. Livelihoods adaptation options in the sub-Sahara Africa

Adaptation is the process through which people reduce the adverse effects of climate on health and well-being, and take advantage of the opportunities that their climatic environment provides (Burton, 1996). It includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system (Smith et al., 1996; cited in Smit et al., 2000). Adaptation strategies are also considered as, coping strategies, resilience development and flexibility (Fussel and Klein, 2006). Coping refers to strategies that have evolved

over time through peoples' long experience in dealing with known and understood natural variation that they expect in seasons combined with their specific responses to the season as it unfolds (Thomkins and Adger, 2004). In contrast, adaptive strategies refers to long-term (beyond a single season) techniques that are needed for people to respond to a new set of evolving conditions (biophysical, social and economic) that they have not previously experienced (Adger, 2006; Bigsen, 1996).

Options for livelihoods adaptation during climate risks are subdivided into: policy instruments, technological and structural measures, risk, sharing and spreading; and change of land use (DWC, 2006). Other livelihoods adaptation strategies are classified into a set of four analytical types: mobility, storage, diversification, and communal pooling (Halstead and O'Shea1989). In addition, where households and communities have access to markets, market-based exchange can substitute for any of the four classes of adaptation strategies above (Agrawal, 2008). Burton (1996) classifies adaptation strategies to cover financial re-budgeting, behavioural change, on-site operation, market-based, research and education in relation to capacity building. Where successful, these responses either reduce spatial, temporal, asset-related, and/or community-level risks directly, or reduce them by pooling uncorrelated risks associated with flows of livelihoods benefits from different sources. Whenever rural livelihoods fall, diversification is commonly evident in which people move to other adjoining towns and urban areas for support and changing to other economic activities, Off-farm diversification included economic migration for piece jobs or wage labour in cities as evident in the exodus from Chad Basin when Lake Chad was drying up (Crawford, 2008). Also in Mozambique, following severe cyclone-generated floods in February 2000, 700 people were killed in Gaza Province and 500,000 people temporarily relocated to camps (Forum for Food Security in Southern Africa, 2004). Livelihood diversification has always played some part in providing a "pathway" out of poverty for poorer groups of people. Since the mid-1980s, it has become evident that livelihood diversification has increased as a response to economic and social changes.

Diversification within and beyond agriculture is a widely recognised strategy for reducing risk and increasing well-being by spreading risk (O'Laughlin, 2002; Ellis and Allison, 2005). For example, key drivers of diversification in Nwadjahane (Mozambique) were historical processes (both economic and political), contemporary policy changes and climatic disturbances. In arid environment of the sub-Sahara Africa, farmers and pastoralists are now developing adaptation strategies to buffer against the uncertainties induced by season-to-season variation in water supply and the socio-economic drivers which impact on their lives (Crawford, 2008). In the northern Kenya for example, parts of adaptation strategies are, changing of livelihood activities, redistribution of household responsibility and development of new settlements especially in the pastoral communities (Omolo, 2010).

Depending on the dimensions of risks and vulnerability assessment, livelihood adaptation choices available to farming households are categorised into the following:

1. Ex ante risk management options: this include, choice of risk tolerant varieties, investment in water management, diversification of both farming and other associated livelihood, enterprises before the onset of the season.
2. In-season adjustment of crop and resource management options in response to the nature of the rainfall season as it unfolds.
3. Ex-post risk management options that minimize livelihood impacts of adverse climate shocks such as selling of assets, cutting expenditure on non-essential items (Bigsten, 1996; Ertegun, 2002).

In some locations, where there are limited resources, livelihoods diversification is done through temporary changes of activities (Cooper et *al*., 2008) For instance, in East Africa splitting of animals into district herds and mobility is often used, mixed species herds in response to seasonal variation in pasture productivity and change of livelihood (Omolo, 2010). Other people take refuge in social networks and financial institutions. For example, in West Africa, Kadi et al., (2011) show that farmers in Niger, Mali, and Burkina Faso are already establishing group networks during the wet season to review the climate, water, food

(access, availability, quality and trade), agriculture and health situation of the their countries in preparation climate shocks. Havemann (2011), Kloeppinger-Todd and Sharma (2010) add that climate-induced risks are managed with responsive infrastructure development, insurance and other informal credit facilities for small farm holders.

Other forms of livelihood adaptation options include intensification of eco-systems based activities and migration of rural men and women to seek additional income-generating activities to support the family (Kloeppinger-Todd and Sharma, 2010). Pastoralists in Tanzania, for instance, have adopted crop cultivation to supplement livestock keeping (FAO, 2003). In West Africa, charcoal production is commonly adopted as a trade off for crop farming during climate risks (Oloukoi, 2012; Fasona et al., 2012). In the long run, this may result into loss of human capital for farming activities; with detrimental impacts on environmental resources- indiscriminate felling of forest products has laid watersheds bare, threatening forested lands (Fasona et al., 2012).

Adaptive capacity on the other hand is the sum total of forces, drivers and abilities that determine the extent of coping of a system (person, household, community, region) in times of stress without breakage which is a reflection of broader conditions (Smit and Pilifosova, 2002). Adaptive capacity is location specific and varies from one locality to another, one region to another and even across nations among social groups and over time (Smit and Wandel, 2006). The extents of responses of individual or community to climate-related risks depend on their available adaptive capacities which are directly linked with their access to livelihood capitals (see figure 1). For instance, a study by Adeniji-Oloukoi and Afolabi, (2011) shows that, access to education and climate information, involvement in economic-based activities and membership of a social network indicate strong and significant contribution in building women's adaptive capacity in Nigerian rural communities. The presence of institution (formal and informal) as mechanisms that shape social and individual expectations, plays a role in the ways rural households respond to climate change and informing what livelihoods shifts will be adopted during environmental risks (Agrawal and Perrin, 2008).

A depletion in one livelihood asset or capita which is actually a capacity driver can also affect the equilibrium of a system to cope with the stress (Adger, 2006; Mehrotra et al., 2009). For example, Adeniji and Oloukoi (2011) show that adaptation options are precluded by political and institutional inefficiencies especially at local government level, and resulting resource inequities in marginalised communities in Nigeria. Socio-ecological systems also influence livelihoods adaptation often for responsive rather than planned actions at both cross-level and cross-scale (Agrawal, 2008). Socio-economic characteristics of the population also have influences on livelihood adaptation, especially in the choice of coping options during water variability (Máñez Coasta et al., 2011; Adeniji-Oloukoi et al., 2012). The highlighted influential factors point to the fact that unless the socio-economic poverty and other multi-dimensions of environmental stressors are addressed, building a sustainable livelihood adaptation in Africa sub-Sahara might remain a mirage.

5. Conclusion

Climate risk impacts sub-Sahara African livelihoods because of the problems of pervasive poverty, dependence on rain fed agriculture, weak institutions, increased population growth, depletion of capitals, and the degradation of the natural resource base in turn impinges on the livelihoods of all, but particularly rural, communities. This review shows that there a number of livelihoods adaptation strategies which are already in at various locations and scales in the region; although many of such are not informed by specific researches nor integrated into a policy framework in climate service and adaptation portfolio.

There is a need to develop focused or tailored climate services based on specific request of users in agriculture and food security in particular. Risk maps for food security and rural livelihoods would be useful for early warning, contingency planning and action in the agriculture and food security under climate variability. The climate and research communities are challenged to develop the interdisciplinary databases and undertake research for adaptation to climate variability and change while financial industries rise to respond the challenges. Because livelihood strategies in a globalizing era take place in different locations, research has to be multi local too. This makes high demands on both the organization and techniques of research and on researchers.

In recent times, resources and tools are available for risks analysis for agriculture livelihoods in particular. For example;

- Agricultural Production Systems sIMulator (APSIM) www.apsim.info/apsim/
- CLIMWAT http://www.fao.org/WAICENT?FAOINFO?AGRICULT?AGLW//cropswat.stm
- Collaborating on Climate Adaptation (weADAPT) www.weadapt.org/
- CROPWAT http://www.fao.org/ag/AGL/aglw/cropwat.htm
- DIVA-GIS www.diva-gis.org/
- Agriculture Catchments Research Unit (ACRU)
- http://www.beeh.uno.ac.za.acru

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