Analysis of Rural Livelihood Challenges and Options under Climate Change Pressure in Kenya

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Abstract

Agriculture is the backbone of the Kenyan economy and it is the sector most hit by climate change as it is largely rain fed. This paper explores climate change challenges and adaptation strategies that may be applied in smallholder crop production systems, followed by an analysis of household adaptation capacity. Gender issues in climate change mitigation and adaptation are discussed as well as a narrative on expert and farmer perspectives of climate change challenges. The analysis is based on review of scientific and grey literature from various sources and knowledge from national and international research and advisory organizations visited. To triangulate the findings, farmers and stakeholders were engaged through participatory fora to obtain an insight into local and regional knowledge. The paper proposes coordinated collaboration and partnership to tackle climate change in a manner that will enhance the capacity of farmers to adapt.

Key words: Climate change, adaptation, smallholder

1.0 Introduction

The most direct implications of climate change for food security are through its impacts on food production worldwide (Ospina & Heeks, 2010).Agriculture is the sector most vulnerable to climate change owing to its high dependence on climate and weather. Adaptation[i] to variable climatic conditions has been an ongoing process; people are continually modifying their agricultural practices to suit their specific needs, available knowledge and resources. Governments and stakeholders play a critical role in improving farmers' capacities to adapt to climate change and climate variability by disseminating climate smart technologies and providing an enabling environment through policy and institutional framework. This paper starts with the premise that inadequate resources, irreconcilable conflicts and lack of coordination among stakeholders, and unfavorable changes in the institutional and political context are an impediment towards climate change adaptation.

[i] Adaptation refers to adjustment in natural or human systems in response to climatic effects, which might ultimately enhance resilience

In contrast, we argue that stakeholder collaboration may significantly contribute to climate change adaptation. Stakeholders can generate innovation by combining their indigenous knowledge; business interests, organizational skills and working together [ii]to enhance climate change adaptive capacity of rural livelihoods. Although agriculture is considered as a critical sector in the world economy contributing 24% of global Gross Domestic Product (GDP) and providing employment to 1.3 billion people or 22% of the world's population (Seyed, Hosseini, Mohammadi & Seyed, 2011), the livelihoods of households in countries dominated by farming and pastoralism are undermined by falling harvests and poor performance of the livestock sub sector. But agriculture is not only a fundamental human activity at risk from climate change, it is also a major driver of environmental and climate change itself (Zomer ,Trabucco, Bossio & Verchot, 2008).

In addition to land resources, agriculture is a major user of water. Approximately 95% of the total cropland is managed under rain fed conditions (Cullen *et al*, 2009); however, over 200 million ha of arable land is under irrigation, utilizing 2500 billion m^3 of water annually. This represents 75 percent of fresh water resources withdrawn from aquifers, lakes and rivers (Tubiello, 2012). Irrigation sustains a large portion of total food supply – about 40 percent in the case of cereals. Significant quantities of chemical inputs are applied to achieve high yields in intensive production systems including about 100 million tons of nitrogen used annually, leading to significant regional pollution (Zomer*et al*, 2008).

Climate change is critical in Sub-Sahara Africa as agriculture accounts for 35% of the GDP and employs 70% of the population (Lauxa, Jäckel, Munang & Kunstmanna, 2010). It is a major challenge for agriculture, food security and rural livelihoods (Mahendra Dev, 2011) and affects all four dimensions of food security, namely food availability, stability of food supplies, access to food and food utilization (Bouis, 2008). Beddington *et al* (2012) asserts that widespread uptake of sustainable practices in agriculture and food supply chains is requisite in meeting current and future threats to food security and environmental resilience. Farmers have to apply climate change adaptation strategies into their cropping systems since vulnerability to food insecurity declines with appropriate adaptation (Karfakis, Knowles, Smulders & Capaldo, 2011).

Smallholder Farmer Strategies to cope with Climate Change (SMACC) Project is a collaboration of research teams from Egerton University, Kenya; Kenya Agricultural Research Institute; University Of Natural Resources and Life Sciences (BOKU), Austria; Bahir Dar University, Ethiopia; Amhara Region Agricultural Research Institute, Ethiopia and University of Hohenheim, Germany. The three year project which began in November 2012 aims at providing field-to-market strategies for production intensification of selected key crops that are regionally adapted to help sub-Saharan regions cope with Climate Change. The project is implemented in Awi Zone of Bahir Dar region in Ethiopia and Mauche Ward of Njoro Sub-County in Kenya. Both regions have selected potato as the crop of focus which should serve as an example for other crop production intensification to cope with Climate Change.

This article is a review of literature and expert opinion that directs our understanding of climate change challenges and the coping strategies of rural people and communities that are “both victims and perpetrators of climate change” (Molnar, 2010). It outlines an understanding of rural livelihood challenges under climate change pressure; explores adaptation strategies that may be applied in smallholder crop production systems, followed by an analysis of household adaptation capacity. Gender issues in climate change mitigation and adaptation are discussed as well as a narrative on expert and farmer perspectives of climate change challenges and interventions to enhance resilience and adaptation capacities. A brief outline of climate change adaptation interventions by the organizations visited for expert interview is provided, finally followed by a conclusion of the literature review.

2. Methodology

Analysis of rural livelihood challenges and options under climate change pressure provides a broad knowledge base on vital and successful climate change related smallholder farming practices including a problem and actor analysis. The process was undertaken in December 2012 to August 2013 in three phases. The initial phase entailed analysis of scientific and grey literature from various sources that is relevant to the study, and is a continuous process.

[ii] Integration of emerging knowledge through a process of critical reflection within a Collective Learning Community onclimate change, which is a network of actors comprising of input suppliers, farmers, researchers, extension, transporters, traders, processors and consumers.

To fill the gaps in the literature review, the SMACC[iii] team at Egerton University identified key National and International research and advisory organizations working on agriculture and climate change in Kenya to be visited for expert opinion[iv] on climate change challenges and actor interventions. Review of local knowledge was conducted by engaging with the relevant potato value chain actors during the SMACC[v] inception workshop. Farmers' experiences were consolidated through brainstorming with farmer groups and application of a problem tree and objective tree analysis tool to concretize the climate change issue and triangulate findings.

3. Understanding rural livelihood challenges under climate change pressure in Sub-Saharan Africa

Understanding of climate change impacts would entail working with stakeholders to determine the level of vulnerability of a community to climate related changes which acts as a baseline to any proposed adaptation measures. Smallholder and subsistence farmers, pastoralists and fisher folk in sub-Sahara African countries may not be able to cope with climate change effectively as exhibited through cultivation of marginal land, unsustainable cultivation practices, increased land degradation, water scarcity and endangered biodiversity (Tubiello, 2012). Assessment of climate change vulnerability emphasizes on developing and integrating alternative strategies that may increase their resilience and enable them to better cope with climate variability and change. But the question is: are the farmers prepared to integrate the strategies in their farming systems?

While looking at the linkages between climate change adaptation, water and ICTs, Finlay & Adera (2012) noted that the impact of extreme climatic events and more intense variability on water resources poses multiple threats to food security and challenge the ability of vulnerable populations to withstand, recover from and adjust to change. The loss of crops and productive assets that results from unexpected periods of water surplus or deficit constrains the ability of vulnerable populations to access sufficient and adequate food security and incomes (Ringler, 2011). More intense and frequent precipitation periods also contribute to food insecurity through fluctuations in crop yields and local food supplies, as well as a decline in nutritional intake (FAO, 2008). Studies on impacts of climate change on rural livelihoods in Madagascar suggest that rain fed agriculture is most at risk (International Resources Group (IRG), 2008). Decline in agricultural production has led to increased vulnerability in food and water security, with direct impacts on human health. Nutrition, water-borne illness and cardiovascular disease are observed more frequently with increased infant mortality reported during drought. Low yields and high food prices plunge households into poverty straining relations within and among households (Roncol, Okoba, Gathaara , Ngugi & Nganga, 2010). Large-scale migrations may occur when rural poor populations who highly depend on the environment abandon regions that no longer can support livelihoods, food and fuel (Warnecke, Tänzler & Vollmer, 2010). This scenario is witnessed particularly in cases where climate change adaptation projects may not be able to cope adequately with current climate variability, creating the risk that services provided will be inadequate.

Vulnerability assessments and resilience analyses will reveal the need for a large range of strategies to enhance regional resilience (Marshall, Marshall, Tamelander, Obura, Malleret-King & Cinner, 2009). The analysis of smallholder Irish potato farmers' livelihood challenges under climate change pressure highlights "hotspots" of vulnerability in order to facilitate development of strategies by the relevant chain actors to address them (Morton, 2007). These strategies should not only focus on "technical fixes"(Maina, Newsham & Akoti, 2013),but solutions arrived at under a value chain innovation system facilitated by a Collective Learning Community.

4.Cropping systems oriented strategies to cope with climate change

Adaptation to climate change takes place through adjustments to reduce vulnerability or enhance resilience. Farmers can no longer rely on the wisdom of their ancestors since the structure of seasons has been devalued by climatic changes (IRG, 2008). Adaptation is nothing new: individuals and communities adapt all the time – hence adaptation should be considered a constant articulation of change rather than an event (Finlay & Adera, 2012).
There is need to link resources and practice to local knowledge when implementing climate change mitigation and adaptation strategies.

[iii]SMACC is an acronym for "Smallholder Farmer Strategies to Cope with Climate Change" project

[iv] List of organizations visited and interviewees is provided in annex 1

[v]. The inception workshop was done at Mauche ward of Njoro sub-County on 8.8.2013. Participants included farmers,input suppliers, extension, researchers, Egerton university, processors, transporters, traders, local administrators and faith based organizations.

These strategies should be wide ranging in their approach, and to address development priorities holistically rather than with a single, frequently reactive approach that only considers climate-related impacts on communities.

While assessing farmer's perception of impacts of climate change on food crop production in Ogbomoso Agricultural zone of Nigeria, (Ayanwuyi *et al*, 2010) noted that farm level climate change adaptation strategies entail establishing crop/livestock mixed systems, using a mix of crop species, cultivar types and sowing dates, combining less productive drought - resistant cultivars and high yield but water sensitive crops. Comparatively, the most popular adaptation strategies in Murowa Ward, Zimbabwe included planting short season varieties, crop diversification, and varying planting dates (Mutekwa, 2009). Other adaptation strategies entail growing legumes (such as beans) towards the end of the rain season when cereals fail, mainly due to excessive rainfall. Crop diversification improves household food security since different crops are affected differently by the same climatic conditions. Management practices include mulching, mixed cropping; row orientation with respect to slope and conservation tillage practices which can increase farm system resilience and improve the capacity of farmers to adapt to climate change (McCarthy *et al* 2011; Milder *et al* 2011; Silisi, 2010). Supplementary livelihoods, reforestation, investing in small scale construction of dams for irrigation during water limited seasons sustains crop productivity and household incomes (IRG, 2008).

To approach the issue of climate change appropriately, one must take into account local communities' understanding of climate change (Apata, Samwel & Adeola, 2009). The assumption is that these communities have an inborn, adaptive knowledge and are able to develop strategies to cope with an erratic climate change, severe pest attack, changing agricultural policies and other natural factors. It is necessary to obtain information on the positions of rural farmers and what they know about climate change, in order to integrate this knowledge with available technologies and come up with relevant climate change adaptation practices (Mutekwa, 2009). Thus, community responses are critical to understanding and estimating the effects of climate change on production and food supply for ease of adaptation. Beddington *et al*, 2012) asserts that widespread uptake of sustainable practices in agriculture and food supply chains is requisite in meeting current and future threats to food security and environmental resilience.

Post harvest technologies could be considered for improved food security and household income (Bie, Mkwambisi & Gomani , 2008). Enhancing smallholder participation in high-value and emerging markets requires upgrading farmer's technical capacity, risk management instruments and collective action through producer organizations (Anandajayasekeram & Berhanu, 2009). Addressing the stringent sanitary and phytosanitary standards in global markets is even a bigger challenge. Small-scale producers also must follow these rules if they are to go ahead. The potential for rural economic development would remain very limited if the production and marketing strategies are based exclusively on traditional agricultural production, frequently oriented in selling surplus rather than market.

Climate change may also require shifts in emphasis in already known and practiced coping mechanisms to take advantage of any positive effects of climate change, and adapt to apparently negative effects thus minimizing negative impacts (Bie *et al*, 2008). Adaptation strategies can be effective in theory but infeasible in practice (Marshall *et al*, 2009). Strategies for reducing vulnerability might be economically challenging, hence there is a need for creation of synergy in resource mobilization and knowledge sharing by actors to develop good practices for adaptation to climate change

5. Analysis of household climate change adaptation capacity

Climate change will have different impacts on different households. Whether or not climate change affects the livelihood of a household depends on its vulnerability and capacity to implement adaptation strategies (Rafisura & Srinivasan, 2010); Kelly & Adger, 2000). Vulnerability has been discovered to be determined by household exposure and sensitivity as well as its ability and opportunity to adapt to change. The sensitivity of households that rely on ecosystem goods and services is determined by how strongly they depend on the specific goods and services which will be affected by environmental change (Marshall *et al*, 2009). Adaptive capacity is the ability of an affected system, region, or community to cope with the impacts and risks of climate change through learning, developing new knowledge and devising effective approaches (Mahendra Dev, 2011). Enhancement of adaptive capacity can reduce vulnerability and promote sustainable development. Institutions and policies can either constrain or facilitate climate change adaptation (Bie *et al*, 2008).

They can enhance, or on the other extreme, undermine people's capacity to cope. Coping capacities can be eroded by repeated climate shocks**.** No matter how robust some community coping strategies are, these can collapse or be weakened by successive or repeated and prolonged exposure to climate shocks. Critical knowledge gaps exist on how losses or benefits from gradual or extreme climate events are distributed among households (Karfakis, Lipper & Smulders 2012), hence the need to analyze climate change adaptation capacities among the smallholder households.

6. Gender issues in climate change mitigation and adaptation

While adaptation research and activities targeting vulnerable populations are increasing in number, limited attention has been given to understanding and addressing gender differences (Lambrou & Nelson, 2010). Such differentiation would facilitate efficient and effective interventions to strengthen livelihoods and food security from external shocks. Women are disproportionately vulnerable to climate change as they make up a large number of the poor in communities that are highly dependent on local natural resources for their livelihood (European Institute for Gender and Equality, 2010). Their limited access to resources and decision-making processes increases their vulnerability to climate change. Women in rural areas in developing countries have the major responsibility for household water supply and energy for cooking and heating, as well as for food security (Sisto, 2007), and are negatively affected by drought, uncertain rainfall and deforestation. They experience increased burden of water and fuel collection, and resulting health problems, due to increased incidence of drought or other changes in climate (Haigh & Vallely (2010).

Because of their roles, unequal access to resources including credit, extension services, information and technology and limited mobility, women in many contexts are disproportionately affected by natural disasters, such as floods, fires, and mudslides (FAO, 2010). Women in the South are particularly vulnerable to the impacts of disasters due to skewed power relations and inequitable cultural and social norms. They are also more vulnerable to organized criminal traffickers as a result of communities being scattered, and protective patterns in families and society being disrupted (Nellemann, Verma & Hislop, 2011). Moreover, women are often discouraged from learning coping strategies and lifesaving skills, such as how to climb trees or swim. Men and women are affected differently in all phases of climate-related extreme weather events, from exposure to risk and risk perception; to preparedness behaviour, warning communication and response; physical, psychological, social and economic impacts; emergency response; and ultimately to recovery and reconstruction (Cohen, Tirado, Aberman & Thompson, 2010). Women are largely under-represented in decision-making processes regarding climate change (Nellemann *et al*, 2011). They suffer disproportionably when erratic weather brings droughts or flood. However, there is also a wealth of evidence which underlines that women play an important role in supporting households and communities to mitigate the effects and adapt to climate change due to their knowledge, multiple and simultaneous responsibilities (Nellemann *et al*, 2011).

At the local level, women provide particular kinds of social capital for mitigation, adaptation and coping with environmental change, actively organizing themselves during and after disasters to help their household and community. Women are most of the world's farmers, household resource managers, caregivers and leaders in many of the most innovative responses to environmental challenges. Within a community exists different sub-groups, e.g. housewives, children, and the elderly, each group representing different degrees of exposure to risks, vulnerabilities, and capacities to manage (Cohen *et al* 2010). Housewives and the elderly as well as children, might be more vulnerable than others. It would be good to examine the vulnerabilities and capacities of vulnerable groups, especially from the point of view of rights and gender. Climate policies should consider various gender-related aspects of climate change: the impact of climate change on women and men, their different contributions and perceptions of climate change and the solutions women and men prefer for mitigation and adaptation (European Institute for Gender Equality, 2012). It is important to identify gender-sensitive strategies for responding to the environmental and humanitarian crises caused by climate change (Lambrou & Nelson, 2010). Adaptation efforts should systematically and effectively address gender-specific impacts of climate change in the areas of energy, water, food security and health among smallholder Irish Potato farmers.

7. Enhancing climate change adaptation capacities in Kenya

Kenya, which is a signatory to the United Nations Convention on Climate Change (UNCCC) and has ratified the Kyoto Protocol[vi], is on the process of coming up with a National Climate Change Policy Framework to enhance climate resilience and adaptive capacity; to promote low carbon growth;

And to mainstream climate change into planning processes. However, some broad strategies to address the challenges and impacts of climate change are mentioned in key sector strategies. The Kenya Vision 2030 identifies integration of environmental protection in agricultural production (GOK,2007); the Ministry of Agriculture Strategic Plan for 2008-2012 has committed to promote sustainable land use and environmental conservation and to address the impacts of climate change and has proposed interventions which include promotion of soil and water management as well as farm forestry (MOA, 2009);The Agricultural Sector Development Strategy for 2010-2020 focuses on improvement of environmental conservation and enhancement of conservation and management of resources (GOK, 2010a); the National Climate Change Response Strategy (NCCRS) provides a framework for specific interventions in the areas of adaptation and mitigation, capacity building, research and technology generation (GOK, 2010b).

The NCCRS was launched in 2010 and it recognizes the importance of climate change impacts for Kenya's development. As Kenya's first climate change agenda guide, it provides a basis for strengthening and focusing nationwide action towards climate change adaptation and mitigation and has provision for addressing climate change in all sectors. The rationale is that all sectors should find ways and means to adapt to the unavoidable changes that are already occurring and those that will occur in the near future. The National Food and Nutrition Policy (2011) advocates for climate change adaptation and mitigation to enhance food and nutrition security (GOK, 2011b).

A cross section of organizations dealing with agriculture and climate change was sampled for expert opinion on the challenges associated with climate change and adaptation interventions in place with particular reference to potato production. The Kenya Agricultural and Livestock Research Institute (KALRO) Tigoni has identified constraints faced by Irish potato farmers that have become complicated due to climate change. These include bacterial wilt, early and late blight, drought, marketing, lack of clean potato seed and Insect pests eg aphids. The Institution has come up with farming strategies which may enhance adaptive capacity in the face of climate change and climate variability. A respondent at KALRO Tigoni outlined some of the strategies undertaken at the institution such as sprouting of seed potato as a basis of mitigating climate change. Early sprouting leads to fast establishment, hence early maturity to avoid late season drought. Several blight tolerant varieties have been developed and released such as

K. Sherekea, K. Mavuno and Purple gold. Other strategies include development of heat and drought tolerant varieties; mulching to reduce soil temperature and moisture loss; early planting; manipulation of seed size at farm level - smaller seeds tend to have increased seedling mortality as opposed to large seeded material. Larger seeds results into fast establishment of the canopy. Pit storage of potatoes for food has also been used to sustain adequate supply during the dry spell. Inter-cropping potato with other crops eg maize, peas, beans etc. Inter-cropping of potatoes with other crops is a common practice in Central Province around Limuru. Seeds are buried to enhance seed sprouting so that when planted should be able to establish fast enough. Hormones are used to suppress sprouting to sustain supply of potato for relatively long time, whereas diffused light is used in seed storage to enhance availability of seed almost all the times. Another innovative research activity at KALRO Tigoni is the use of hydroponics to produce miniature seed for further multiplication by seed producers such as Agricultural Development Corporation, Molo.

The International Potato Centre (CIP) in Nairobi has partnered with the Government of Kenya to promote the potato as a strategic food security crop. The CIP respondent reiterated that so far there is no drought tolerant potato variety that has been released, but several lines are being evaluated for drought tolerance. The State Department of Agriculture has put in place a Climate Change Unit (CCU) whose overall objective is to roll out the Department's part of the NCCRS and mainstream Climate Change adaptation and mitigation in all agricultural programmes, projects and activities. A key informant at the CCU of the State Department of Agriculture explained as follows:

[vi] The Kyoto Protocol places great emphasis on mitigation efforts whether through the reduction of GHG emissions or the creation of GHG sinks in the terrestrial biosphere.

"*NCCRS has provided for establishment of climate change focal points in government ministries and agencies with a view to networking, collaborating and sharing information in meetings and for a on matters of climate change adaptation and mitigation. The shared resolutions are then customized for implementation by respective ministries or agencies to enable them meet their goals as well as ensure sound environmental management, climate change adaptation and mitigation*".

According to the CCU, climate change related challenges in Kenya are widespread and include environmental hazards such as floods, landslides, prolonged droughts and attacks by crop pests which have contributed to increased frequency of crop failure and the country's food insecurity. The worst drought in Kenya was experienced in 2000-2001 and it was declared a national disaster on 13th June, 2000. The prolonged drought caused widespread crop failure, famine and malnutrition which affected 4.7 million people. The most recent drought was experienced in the country in 2008/2009 and more than 10 million people experienced starvation. The Government imported over 2.6 million bags of maize worth 6.7 billion Kenya Shillings to bridge the food deficit. Dry spells in Kenya are invariably followed by floods. The flooding of 2003 was particularly intense and was declared a national disaster on 6th May, 2003. The most recent floods were experienced in 2009 and affected the pastoral plains of the northern and northeastern part of the country, the Nyando River and Nzoia River plains in the western part of the country.

On all occasions, the floods submerged farmland, reduced crop yields and exacerbated food insecurity occasioned by drought. Although the State Department of Agriculture has committed to promote sustainable land use and environmental conservation to address the challenges and impacts of climate change, the CCU is faced with challenges including inability to fulfill its mandate due to inadequate resources and lack of structural arrangement.[vii]

There is an attempt to harness actor synergy by the National Potato Council of Kenya (NPCK). A key informant described NPCK as a Public Private Partnership (PPP) and a multi-stakeholder outfit that has the responsibility of planning, organizing and coordinating activities along the potato value chain. Its range of stakeholders includes local and international research institutions, extension, farmer organizations, potato seed and ware producers; financial institutions, universities, agribusiness entities including processors and entrepreneurs; and development partners. Its intervention in climate change mitigation and adaptation is creation of a platform for information management, capacity building for various potato value chain actors and policy debate. The main climate change related potato production challenges include blight, bacterial wilt and aphids. NPCK promotes climate change adaptation technologies such as the aero-phonic technology, potato seed plot and positive selection[viii], in collaboration with KALRO Tigoni.

The Kenya National Farmers' Federation (KENAFF) is the umbrella farmers' federation representing interests of 1.8 million farm families. Besides being the legitimate farmers' voice in Kenya, KENAFF has taken on board the climate change issue through its Department of Environmental Management and Renewable Energy. The Department focuses on environmental preservation, conservation and increased use of renewable energy as a way of mitigating and adapting to climate change. It also coordinates implementation of the Kenya National Domestic Biogas Programme (KENDIP) by promoting the installation of over 15000 domestic biogas plants by 2014.

There are a substantial number of institutions and actors in Kenya currently working on climate change issues but are not coordinated. This results in duplication of efforts, lack of efficiency and effectiveness in resource targeting. There is need to have a centralized coordination mechanism for climate change mitigation and adaptation under the guidance of the National Climate Change Response Strategy. It is necessary to put in place policies and institutions that will address and prepare the country to address the challenges and impacts of climate change by putting in place appropriate mitigation and adaptation strategies.

7. Conclusion

This review reveals that the livelihoods of households in Kenya are most hit by climate change as falling harvest and poor performance of the livestock sub sector undermine household and national food security.

[vii] Fragmented roles of the State Department of Agriculture with regard to climate change which falls under the docket of the Ministry of Environment and Mineral Resources.

[viii] Seed plot and positive selection entails intensifying potato production in a small plot with smaller spacing of 30x30 cm to get a higher yield.

Kenya's economic and livelihood systems are highly dependent on farming, pastoralism and natural resources, which are very sensitive to any slight changes in climatic conditions. This makes the country very vulnerable to climate change associated with increased post-harvest losses; pressure from invasive species, pests and diseases such as the Maize Lethal Necrosis Disease in the maize growing areas of the country, which is a threat to food security.

Expert opinion indicates that diseases and limited access to clean planting material are the main factors that limit Irish potato production in Kenya and these problems have become more complicated due to climate change. Limited on-farm storage results in low prices during the peak production periods and hence low returns to farmers. Climate change and climate variabilty also affects food security, human health, infrastructure and the ecosystem.

Despite the climate change mitigation and adaptation initiatives by the diverse actors and organizations in Kenya, awareness is still low especially in the rural areas where there is high dependency on rain fed agriculture and climate sensitive natural resources. This calls for coordinated effort to enhance climate change awareness and improving farmers' capacities to reduce risk or make optimal use of climate variability by applying strategies developed collaboratively by actors in a Collective Learning Community.

Acknowledgement

The authors acknowledge the financial support of Egerton University, Kenya; University of Natural Resources and Life Sciences, Austria and University of Hohenheim, Germany through the SMACC project.

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Annex I: List of Visited Organizations and Key Informants

Organization	**Key Informant**	**Position in the organization**
International Potato Centre, Nairobi	Bruce Ochieng	Plant Pathologist
Kenya Agricultural Research Institute, Tigoni	Dr. Lungaho	National Coordinator for Potato research
Kenya National Federation of Agricultural Producers	Peter Mwangi Gitika Daphne Muchai	General Manager Resource Mobilization Manager Institutional Development and Organizational Strengthening
Ministry of Agriculture – Climate Change Unit	Nelson Gatonye Rose Gwaro	Project Development Specialist Agriculturalist
Kenya National Potato Council	Wachira Kaguongo	Chief Executive Officer