International Journal of Science, Environment and Technology, Vol. 4, No 6, 2015, 1608 – 1617

ISSN 2278-3687 (O)
2277-663X (P)

FARMING HOUSEHOLDS' VULNERABILITY AND RESILIENCE TO CLIMATE CHANGE IN NAMBALE SUB-COUNTY OF KENYA

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Abstract: Climate change has numerous effects on livelihoods, animal and plant health, environment as well as on eco-system stability and resilience. These effects of climate change are increasingly being acknowledged as significant factors contributing to poverty due to its implications on agriculture. This study was done to determine the vulnerability of farmers in Nambale district to the effects of climate change and their adaptive capacity. Qualitative and quantitative data was collected from one hundred and twenty four (124) households selected using multi stage sampling procedure. The results indicate that 82% of the households are vulnerable to primary harmful effects of climate change. Multinomial logit model was used to identify factors affecting adaptation to climate change. The model outputs indicate that farmers with better education level, holding the position of household head of the family, access to credit and markets, better social network, access to agricultural extension services and understanding rainfall pattern exhibited greater level of resilience during and after climate change induced shocks. To sustain and enhance the livelihoods of vulnerable households and communities, there is need for government to support farmers by providing the necessary resources such as credit, information and extension workers to train farmers on climate change adaptation strategies and technologies, and investing in climate resilient projects such as, improving on existing or building new water infrastructure and building climate change monitoring and reporting stations.
Keywords: Vulnerability, Climate change, resilience.

INTRODUCTION

The problem of climate change in Africa has the potential of undermining sustainable development efforts if steps are not taken to respond to its adverse consequences. In Kenya, 68% of the total population lives in rural areas and their livelihoods heavily depend on agricultural activities. The agricultural sector is the engine of economic development in Kenya. This sector alone accounts for 25% of the GDP and employs over 80% of the Kenyan population (National Food and Nutrition Policy, 2011). In turn Kenyan agriculture depends almost 100% on natural precipitation, with only 105, 800 ha or 8.14% of national irrigation potential so far developed. Climatic changes and climate variability are increasingly witnessed and jeopardize agricultural yields and thus income from agricultural production.

*Received Oct 29, 2015 * Published Dec 2, 2015 * www.ijset.net*

Especially smallholder producers have always had to manage uncertainties and fluctuations in yield quality and quantity. They have developed their own coping strategies but their adaptive capacities in the face of climate change are limited. Prominent local vulnerabilities in Kenyan smallholder production systems enforce negative impacts caused by climate stimuli.

Small scale farmers of Nambale district face uncertain future in light of the changing climatic and economic conditions. Agricultural production has been innately impacted by shifts in mean climatic conditions and increases in climatic variability. The nature and occurrence of rainfall in the area provides more insight into the food production and water scarcity situations. The problem is aggravated by intra-seasonal and off-seasonal dry spells. Intra-seasonal dry spells occur due to inadequate rainfall during the growing period, while off-seasonal dry spells are due to rainfall cessation before crop maturity.

Vulnerability to climate change

According to the IPCC (2007) definition, vulnerability in the context of climate change is "*the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity"*. Thus, agricultural vulnerability to climate change can, for example, be described in terms of exposure to elevated temperatures, the sensitivity of crop yields to the elevated temperature and the ability of the farmers to adapt to the effects of this exposure and sensitivity by, for example, planting crop varieties that are more heat-resistant or switching to another type of crop.

Contributing to Households Vulnerability

According to Damas and Israt (2004) many factors contribute to vulnerability, and these factors act to undermine capacity for self-protection, blocks or diminish access to social protection, delays recovery or expose some groups to greater or more frequent hazards than other groups. The factors that contribute to vulnerability include rapid population growth, poverty and hunger, poor health, low levels of education, gender inequality, fragile and hazardous location, and lack of access to resources and services, including knowledge and technological means and disintegration of social patterns (social vulnerability). Damas and Israt (2004) further report that other causes of vulnerability include lack of access to information and knowledge, lack of public awareness, limited access to political power and representation (political vulnerability).When people are socially disadvantaged or lack political voice, their vulnerability is exacerbated further. Economic vulnerability is related to

a number of interacting elements, including its importance in the overall national economy, trade and foreign exchange earnings, aid and investments, international prices of commodities and inputs, and production and consumption patterns. Environmental vulnerability concerns land degradation, earthquake, floods, hurricane, drought, storms, water scarcity, deforestation, and other threats to biodiversity (Damas & Israt, 2004). Makoka and Kaplan (2005) argue that vulnerability is caused by a broad range of political, institutional, economic, environmental and socio-cultural factors such as insufficient knowledge, organizational gaps, lack of personal and financial resources and inadequate legislation. As a result, vulnerability must not be restricted to a simple cause-effect relationship. According to Dirway (2010), income from selling livestock, remittances, household size, education level of the head of the household, skills acquired from training and age of the household head influence participation of farmers in massive food production. Inayatullah, Munir, Khan, Shakeel and Tariq (2012) report that age of the household head, education of the household head, job experience of the head of the household, number of working members in the household, index of livestock holding and per capita income of household affect rural livelihood and hence vulnerability status of households. An educated and older household head is likely to be employed and thus having consistent income. The more employed members in a household the better in the sense that it would have a steady income inflow. Livestock ownership benefits households in that they may sell and generate income, get food from the animals, manure and use the animals for power. Large households are likely to have more dependents hence likely to be vulnerable to external shocks.

Measures of Vulnerability

Vulnerability may be measured using economic approach, indicator approach and the household Vulnerability Index (HVI). The econometric approach method uses household level socio-economic survey data to analyze the vulnerability levels of different social groups. It includes three assessments namely vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and vulnerability as uninsured exposure to risk (VER). These approaches measure welfare loss as a result of shocks, but differ in that VEP and VEU measure the ex-ante probability of a household's consumption of falling below a given minimum level in the future due to current or past shocks, while VER measures ex post welfare loss due to shocks. The most commonly cited shocks are climatic, economic, political, social, legal, crime and health conditions (Hoddinott & Quisumbing, 2003). The disadvantages of the VEP method is that estimates across a single cross-section requires an

assumption that the cross-sectional variability captures temporal variability, whereas the weakness of the VEU method is that it is difficult to account for an individual's risk preference, given that individuals are ill-informed about their preferences especially those related to uncertain events (Kanbur, 1987). The other limitation of the VER method is the absence of panel data, it is typically impossible to measure impact of shocks in the absence of panel data as ex-ante and ex-post consumption and income data are generally not included in cross-sectional data sets.

The indicator approach is another method that could be used to measure vulnerability. This is based on developing a range of indicators and selecting some of them through expert judgement, principal component analysis, or correlation with past disaster events. Each of these selection procedures is used to choose the indicators that account for the highest proportion of vulnerability. The selected indicators may be used at the local, national, regional or global scales (IFPRI, 2009). The indicator approaches are important in monitoring trends and exploring conceptual frameworks. However, this approach is constrained by being subjective in the selection of variables and their relative weights, the availability of data at various scales, and the difficulty of testing or validating the different metrics (Luers, 2005).

FANRPAN developed the household Vulnerability Index (HVI), which is a statistical tool for measuring household vulnerability. The HVI measures the vulnerability of households and communities in relation to the impact of diseases and shocks such as HIV and AIDS, erratic weather patterns and poverty (Sibanda, Chipfupa & Kureya, 2008). According to Sibanda et al. (2008), the HVI categorizes a household by assessing external vulnerability that is induced by shocks and internal vulnerability of such a household to withstand shocks, then, classifies the household as coping, acute, or in an emergency situation depending on the household's ability to cope. The tool achieves this by assessing a household's access to five livelihood capital assets: natural assets such as land, soil and water; physical assets such as livestock and equipment; financial assets such as savings, salaries, remittances or pensions; human capital assets such as farm labour, gender composition and dependents; and social assets such as information, community support, extended families and formal or informal social welfare support. To compute the index, 15 variable classes (called dimensions) are assessed together, and a statistical score is calculated for each household. External vulnerability introduced by a shock is assessed separately and used to introduce weights on the household's access to the five capital assets. The output is the classification of households into three categories according to the level of vulnerability. The first category is low vulnerability, which means

that the household is in a vulnerable situation but is still able to cope without external assistance. The second category is moderate vulnerability, which classifies households that need urgent, but temporary external assistance for them to recover when hit hard by a shock. Lastly, there is the high vulnerability category, which is a class of households that are in a situation of almost a point of no return but could be resuscitated only with the best possible expertise (Sibanda *et al*, 2008).

METHODOLOGY

The study was used descriptive quantitative method to assess vulnerability of households to climate change. The study also investigated the factors that influence vulnerability of households. The ultimate sampling units were households and information was collected from the members of the household using a structured questionnaire. Multi stage random sampling approach was used to identify respondents. A total of 124 households were interviewed for this study. The overall sample size for the various populations was calculated using Fischer's *et al* ((1998).The data analysis comprised both qualitative and quantitative techniques. Descriptive statistics such as percentages and frequencies were used to analyze the data. The Statistical Package for Social Sciences (SPSS) version 16 and Microsoft excel were used to analyze the data. The factors influencing vulnerability were analyzed using multinomial logit model.

The study was conducted in Nambale Sub-county of Busia County. The district has five locations with a population of 94,637 (Census 2009). The average annual rainfall precipitation is between 900 and 1500 mm distributed throughout two main rainy seasons, long rains are between March and June and short rains between September and December. The underlying problem has been the unpredictability of the rains and distribution which either too much or too little to sustain plant growth. Annual temperatures in the country's districts range from 17 to 30^{o}C with mean annual temperatures between 24 and 26^{o}C. Since the district is in LM1 and LM2 AEZ, crop and animal production is the major economic activity. Other activities include small businesses and trade across Kenya-Uganda border. Bicycle and motor cycle taxis (Bodaboda) and brick making are other of farm activities. Major crops grown are maize, beans, sorghum, sugarcane, vegetables, sweet potatoes, cassava and cotton. The predominant extreme weather occurrence throughout the district is drought. Previously the drought would occur about every ten years but the trend has changed and now it occurs on annually.

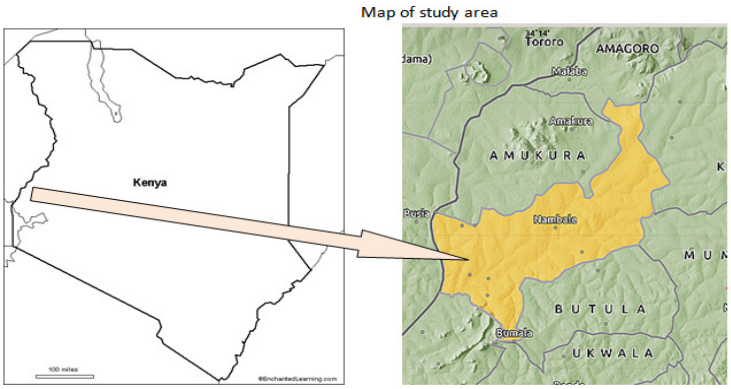

Figure 3.2: Map of study site

RESULTS AND DISCUSSION

Factors affecting Farming households' vulnerability and resilience to climate change

Level of Education- From the interaction with and simple observation of the respondents, the researcher found that those households that were more receptive to trainings and practiced modern farming belonged to household heads that had acquired secondary and tertiary levels of education. The educational level of household head was found to be significant determinants of resilience to climate change induced shocks. Heads with higher level of education have better level of planning, access and understanding of early warning information, better decision making skills during natural shocks, alter agricultural operation, and adopt extension packages and more. Thus education is one of the key factors in building the resilience level of house- holds to climate change impacts.

Table 1: Result of marginal effects of explanatory variables from MNL adaptation model.

Explanatory variables	Estimates	Standard error	P-value
Age	0.0756	0.7080	0.288
Gender	0.0647	0.6110	0.243
Marital status	0.0745	0.0712	0.254
Level of education	**0.0213**	**0.0087**	**0.012***
Household head	**0.0354**	**0.0177**	**0.051***
Years of farming	-0.0051	0.0022	0.125
Access to credit and markets	**1.476**	**6.0213**	**0.014***
Access information	**0.0214**	**0.0078**	**0.019***

Access to extension	**0.0212**	**0.0612**	**0.016***
Farm size	0.0452	0.0429	0.289
Land tenure system	**0.0541**	**0.0612**	**0.598**
Rainfall pattern	**0.0321**	**0.0775**	**0.044***
Source of income	-0.004	0.0026	0.109
Ownership of assets	0.076	0.0720	0.288

Notes: *** significant at 1%, ** significant at 5%, * significant at 10%

Household head- Female-headed households are more likely to take up adaptation options. The possible reason for this observation is that in most rural smallholder farming communities in the region much of the agricultural work is done by women. Since women do much of the agricultural work and men are more often based in towns, women have more farming experience and information on various management practices and how to change them based on available information on climatic conditions and other factors such as markets and food needs of the households. The important policy message from this finding is that targeting women groups and associations in smallholder rural communities can have significant positive impacts for increasing the uptake of adaptation measures by smallholder farmers.

Access to information- Noticing climate change increases the probability of uptake of adaptation measures. Farmers who are aware of changes in climatic conditions have higher chances of taking adaptive measures in response to observed changes. Raising awareness of changes in climatic conditions among farmers would have greater impact in increasing adaptation to changes in climatic conditions. It is therefore important for governments, meteorological departments, and ministries of agriculture to raise awareness of the changes in climatic conditions through appropriate communication pathways that are available to farmers such as extension services, farmer groups, input and output dealers, radio and televisions among others. This needs to be accompanied by the various crop and livestock management practices that farmers could take up in response to forecasted changes in climatic conditions such as varying planting dates, using irrigation, or growing crop varieties suitable to the predicted climatic conditions.

Access to agricultural extension services considerably increases the likelihood of taking up adaptation options except moving from faming to non-farming. Extension services provide an essential source of information on climate change as well as agricultural production and

management practices. Farmers who have significant extension contacts have better chances to be aware of changing climatic conditions and also of the various management practices that they can use to adapt to changes in climatic conditions. Improving access to extension services for farmers has the potential to significantly increase farmer awareness of changing climatic conditions as well as adaptation measures in response to climatic changes.

Access to credit and markets- Access to affordable credit increases financial resources of farmers and their ability to meet transaction costs associated with the various adaptation options they might want to implement. With more financial and other resources at their disposal farmers are able to change their management practices in response to changing climate. For instance, with financial resources and access to markets farmers are able to buy new crop varieties, new irrigation technologies, and other important inputs they may need to change their practices to suit the forecasted and prevailing climatic conditions.

Rainfall pattern- increases the probability of farmers changing their management practices, in particular, timely operations like early planting, growing crop varieties that suit the prevailing and forecasted precipitation. Less precipitation increases the probability of farmer to efficiently use water resources for food production and other uses. Use of water conservation techniques increases with decreasing precipitation because farmers have learnt from drought experiences to conserve rainwater in times of good rains so that it is available for future use in dry periods. Increasing knowledge and empowering communities to use water conservation techniques such as water harvesting can significantly help farmers cope with changing rainfall and temperature regimes.

Land tenure system or ownership- Farmers who own their farm have a higher propensity to invest in adaptation options compared to no ownership. The implication of this finding is that it is important for governments to ensure that even in the communal systems that characterize most of the smallholder farming systems in the region, tenure arrangements are secure to facilitate investments in long-term adaptation options by farmers. Ownership of land act as a positive incentive in facilitating farmer investments on their farms that include investments in adaptation and good crop and livestock management practices. Conservation technologies have a higher chance of uptake when farmers feel secure about land ownership.

CONCLUSION

Vulnerability to climate change in Nambale is very much related to poverty. Integrated rural development program aimed at alleviating poverty can play the double role of reducing poverty and increasing adaptive capacity to climate change. In addition, investment in

irrigation can increase the district's food supply. This supply could then be reserved used during drought periods Strengthening the ongoing micro-level adaptation methods of governmental and nongovernmental organizations, such as water harvesting and other natural resource conservation programs, can also improve the adaptive capacities of farmers.

Government policies should therefore ensure that farmers have access to affordable credit and to increase their ability and flexibility to change production strategies in response to the forecasted climate conditions. Access to water for irrigation increases the resilience of farmers to climate variability, irrigation investment needs should be reconsidered to allow farmers increased water control to counter adverse impacts from climate variability and change. However, to promote efficient water use, emphasis should be on pricing reforms and clearly defined property rights, as well as on the strengthening of farm level managerial capacity of efficient irrigation. More importantly, effects of climate change is affecting all the farmers, therefore, increasing farmers' access to extension services is of great need in the district. Furthermore, government should improve off-farm income-earning opportunities.

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