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Smallholder Farmers' Livelihoods and Their Adaption Capacity to Climate Variability in Meru County, Kenya

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Abstract: The study targeted smallholder farming sector within the 7 major sub-agro ecological zones found in Meru, Kenya. About 80% of the Kenyan population directly and indirectly depends on agriculture. Climate variability can aggravate the vulnerability situation, especially where extreme conditions of temperature and precipitation leads to drought and floods, respectively. The study aimed at improving understanding of climate variability in Meru county of Kenya focusing on smallholder agro ecosystems and livelihoods. A household survey on smallholders focusing on asset portfolio and perceived effects of climate on livelihoods was done. Pragmatism was the theoretical underpinning of the study where both qualitative and quantitative data were collected and analyzed. Concurrent transformative research strategy was employed through land use information, focused groups; transect walk, key informants, in-depth interviews and household survey. Discussions and review of documents at various government levels, research institutions and non-governmental organizations was carried out. On the premises of household asset portfolio cluster and factor analysis was done and three distinct clusters were identified with over 73% of the respondents falling on the least economically endowed category. Income from crops, off farm, remittances and value of household assets and livestock significantly correlated with perceived attributes of climate variability. Smallholder farmers continue to adopt various coping and adaptation measures in order to attain resilience with irrigation being ranked as the single most important strategy. However, not without the consequences of long term significant decline in stream levels resonating into conflicts downstream.

Key words: Climate, ecological zone, ecosystem, farming sector, Kenya

INTRODUCTION

Smallholder farming is important in readdressing rural poverty in Kenya (GOK, 2002). Smallholder farming produces over 70% of agriculture sector GDP in Kenya (GOK, 2007).

Both short and long-term adaptation strategies in response to Eastern African regional climate change are beginning to emerge in a region that is rife with challenges. For every USD$1 spent preparing for disaster, USD$7 is spent recovering from disaster (Simms, 2005).

Assessing adaptation methods in geographically diverse locations within an area aims to increase the replicability so that the results can be transferred and employed to other similar areas around the globe (Hansen *et al*., 2003). Land use land cover analysis is important in identification of the most sustainable strategy. Conservation of agro ecosystems requires that adaptive management strategies are developed to minimize loss of natural systems to climate variability. Knowledge on smallholder livelihood platforms and coping management strategies to respond to expected climate change impacts is crucial within the region (Hansen *et al*., 2003).

Climate variability impacts to rural farming communities can be reduced by availing information to small farmers so that they can make more informed farming decision and adapt to the changing climate conditions (Case, 2006).

The climate change world conference held December, 2009 at Copenhagen presentations by developing countries Kenya included was a manifestation of their great expectations from developed world in terms of funding and policy direction (top-down) on what remedial measures will be taken. The argument in this study was that any strategies prescribed for adaptation in Kenya should focus on:

- Household livelihoods
- Consider the land use changes that have taken place and agro-ecosystems

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- Formulating management interventions that are founded on future scenarios

Therefore, in view of the above to appropriately target sustainable livelihood policies which emanate at household and community levels, there was need for more detailed location specific information on land use change, coping and adaptation strategies employed by smallholder agro-ecosystems within Meru county, Kenya to climate variability.

MATERIALS AND METHODS

Focus group discussions and participatory workshop: In each of the 7 AEZ, focus group discussions constituted different socioeconomic categories of farmers and 1 participatory workshop targeting extension workers, researchers and key stakeholders working with the smallholders in the study area. This was meant to enable assessment of livelihood, coping and adaptive strategies of various socioeconomic groups at community level.

A combination of various participatory techniques was employed among others; time line analysis, stakeholder analysis, risk and opportunity analysis, land use and livelihoods mapping.

Focus groups was used for scenario building activity to determine the impacts of more extreme climate conditions as predicted by various global climate change models. Exploration of livelihood of different social economic groups in the study area to the feasible harsher and best conditions in the future was done.

Consistent with the participatory approach of the research, focus group discussion was also employed to determine the community's perspectives climate change and responses to the changing agro-ecosystems. The discussions were expected to enrich the content of survey questionnaire and indepth interview checklists. The video-recording of workshop provided opportunity for validating the data. It also provided an accurate verbatim record of the discussions.

Household survey: A household survey was conducted to characterize households and assess the effects climate variability and extremes on land use and smallholder livelihoods. What livelihood coping and adaptation strategies household members employ to cope with the effects of climate variability and change in long and short term?

Stratified sampling was used. Each AEZ was represented by a village. The structured questionnaire was administered using the local language to 280 farming household heads within the seven SAEZ.

In-depth interviews: In-depth interviews were done to validate and clarify the information collected in the survey and in the FGDs. It entailed asking questions, listening to and recording the answers and then posing additional questions to clarify or expand on a particular issue. Bernard (2002) lists 4 types of interviews: Informal interviewing, unstructured interviewing, semi-structured interviewing and structured interviewing. In this study, semi-structured interviews were employed. A list of questions and topics based on the outcomes of the quantitative survey and the focus group discussions was used to serve as a checklist to guide the interviewer. However, respondents were encouraged to express their perceptions in their own words. Audio-recording provided an accurate verbatim record of the interview.

RESULTS AND DISCUSSION

Livelihood capitals: Livelihoods based on smallholder farming are closely linked with and dependent on climate. Agriculture in general is by far the largest single source of livelihoods and income (Ohlsson, 2000). Meru central has predominately smallholder farming systems most of which are for subsistence or commercial enterprises. Results of the household survey established that majority (94.5% of the respondents) depended on farming as their basic source of income while 2.2% of the respondents, identified professional employment as their basic source of income. Respondents who identified casual labour as their main source of income were (1.5%) while 0.7% represented respondents who identified small business and brewing as their main source of income.

Smallholder farming as a livelihood practice comprises of resources or assets or capital (human, natural, social, physical and financial) (Table 1) and access to use them that through employment of appropriate strategies attain desirable outcomes such as well-being (Creswell, 1997; DFID, 2001).

The livelihood framework focuses on assets accessed, controlled or claimed by the household. Livelihood capital provides substantial contributions to the well-being of numerous small scale farmers. However, the level and degree of reliance on livelihood capital differ across households. Factors that contribute to the economic reliance of households on a particular economic activity in general and on livelihood capital in particular may vary depending on the type of resource endowment characteristic (Shang and Su, 2012).

Table 1: Livelihood assets and their corresponding variables

Factors	Variables
Physical assets	Personal household assets, total livestock value, total farm equipments value, total household assets value
Social asset	Membership in a community group
Financial capital	Access to loans, shares, insurance, remittances
Human capital	Size of household, education level of the houshold head, age of the household head, gender of the household head, use of hired labour
Natural assets	Size of suitable agricultural land

Livelihood assets are the primary building blocks upon which households are able to undertake production activities, engage in labour markets and participate in reciprocal exchanges with other households (Ellis, 2000). The assets portfolio of the study area was reviewed based on 5 categories.

Human assets: Human asset was defined by size of household, age of household head, education level of household head, sex of household head and labour (DFID, 1999). These valuables were used to define the factor of human assets for the purpose of this study. Meru central had a population of 580,319 people (based on census report for 2009) and it was one of the most densely populated in Eastern province with 619 people km^{-2}. It was established that the majority (66.2%) of the families had 0-5 family members, 27.6% had 6-10 family members while 4.8% had over 10 family members. The average age of the household head in the region was 47 years. Majority (28.0%) of the households had one member aged between 0-15 followed by 26.2% of households with 2 members aged between 16 and 35 years and 21.5% of households had 2 members aged between 0 and 15 years while 20.7% have 1 member aged between 36 and 45 years. To understand literacy status of the household heads further analysis was done on proportional distribution of the population based on highest education level attained (Table 2).

Results indicated that most (66.1%) of the household head had no secondary education. This influences the quality of decisions made at farm level. According to results of well being and socio-economic profile survey 11.8% of the poor population had never attended school which compares well with the survey findings of 11.6%. The household survey established that labour force was mostly domestic with 44.4% of the smallholders hiring workers.

The 8.4% attributable to employment on monthly basis and the 36% under casual arrangements. The general situation of labor force in the region as depicted in Table 3 shows that over 36% of the population are infants and school children while another 37% were teenagers and youth.

Table 2: Education level of house head

Education level	Frequency	Percentage
Not gone to school	32	11.6
Primary	150	54.5
Secondary	72	26.2
Post-secondary	21	7.6
Total (N)	275	100.0

Table 3: Meru central region population distribution of by age

Age groups	Population
0-14	213,324
15-19	53,780
20-24	55,705
25-29	56,435
30-34	47,591
35-39	38,110
40-44	28,179
45-49	22,676
50-54	16,340
55-59	13,080
60-64	10,517
Above 64	24,582
Total	580,319

CBS (2010)

Dependency ratio: The total dependency ratio which is also referred to as age dependency ratio is the proportion of population that is dependent (age 0-14 and 65 and above) on the working population (15-64) depicted in Table 3.

Child dependency ratio = Population of age (0-14)/ population of age (15-64)×100
= 213,324/342413×100 = 62.3

Aged dependency ratio = Population of age (above 65)/ population of age (15-64)×100
= 24,582/342413×100 = 7.1

Total dependency ratio = Population of age (0-14 and above 64)/population of age (15-64)×100
= 237906/342413×100 = 69.5

The household survey results fairly concurred with social economic profiles report depicting 72.7% of poor and 63.7% non-poor.

There are about 69 non working people depending on every 100 working people. However, with about 62 children depending on 100 working people implies much of the incomes goes to development of the infants, e.g., education hence an investment for the future whereby only 7 old persons depends on 100 working population. This analysis reveals that the Meru central had a sizeable population within the working age therefore important for farming activities to thrive since most of the tasks are labour intensive.

Majority (78.5%) of the household heads were male while the minorities (21.5%) were female. The low number of female headed farm household was as a result of cultural orientation where traditionally men had the right to inherit land.

Natural assets: Meru central covers an approximate area of 2,982 km^2 and most of the land is under arable farming and human settlement with Mt. Kenya and Imenti as the major forests in the area, covering 1,030 km^2. The study sought to establish how the 274 household heads acquired land. The majority (76.4%) inherited the land they owned, 8.7% were allowed to use the land by various authorities, 8.4% purchased the land while 0.4% hired, leased or got the land as a gift.

Study findings on the status of land ownership established that (55.1%) of the respondents had title deeds, 42.7% lacked title deeds reason being either succession process was incomplete or registration process was ongoing, especially in LM6 while 1.5% of the respondents had title deeds for some parcels of land. The average farm size was 1.29 ha per household. This varied from one agro ecological zone to another with zones on the lowlands having larger farm (Table 4).

The study area cuts across the tea, coffee and cotton zones along the Mount Kenya slopes, covering several agro ecological zones suitable for production of a wide range of crops and livestock.

The rapid rate of population increase has exerted pressure on land and environment. The general trend exhibited in Table 4 indicates there was more scarcity of land in upper midland and lower highland zones. The upper midlands had a higher population density. Historical profiles indicated that upper midland zones were the earliest settled areas. Delayed demarcation and adjudication in lower midland areas did not only hamper developments on the land but was also a security concern within the affected ethnic groups. Key informants and provincial administration indicated that boundary conflicts have been experienced in the past between Tigania and Imenti around Mugae (LM6, LM5, LM4); Imenti and Tharaka along LM4; LM3) and inter clan conflicts in Mweru area of Igoji division (LM3).

For instances in Mugae (LM6) according to one of the land owners Mr. Zachary Murithi who concurred with the area chief Mr. Kai and Meru county land office; title deeds had not been issued as at July, 2012 because of the inter and intra ethnic rivalry.

Physical assets: The study area is served with a network of transport and communication infrastructure. Most of the major roads are tar-marked. The area is well served with the National grid electricity supply.

Table 4: Distribution of average land sizes in the seven SAEZ

Agro-ecological zone	Average land size (ha)
LM6 (Mugae)	2.93
LM4 (Makandune)	1.60
LM3 (Gachua)	1.20
UM3 (Ruiri)	0.75
UM2 (Mariene)	0.75
UM1 (Giumpu)	0.95
LH1 (Baitegeto)	0.86

Table 5: Number of licensed water project and their purpose

Purpose	No. of projects
Domestic use	186
Minor irrigation	160
General irrigation	458
Industrial	25
Hydropower generation	19
Fish rearing	4
Total No. of projects	852

MOW&I 2011

The area has 10 main streams and rivers with potential to meet domestic and irrigation needs. Results of FGD indicated that residents initiate water projects through cash and labour contributions enabling them access to piped water. An inventory on the existing water projects from the regional water office (Table 5) was indicative of the extent of exploitation.

Decrease of water volumes observed may be attributed to the evaporation and intensive irrigated agriculture practised upstream. A total of 34% of the farms undertook some irrigation. River Kithino was the only river that had adequate stream flow data available at local water offices that could allow hydrologic analysis. The regional irrigation officer categorised the River Kithino as one of the most exploited rivers in the region due its generosity in terms ease of abstraction. The effect of irrigation as a coping strategy was excessive exploitation of water resources such as rivers and streams. Field observations during September to early October and March some streams were drying downstream. River Kithino was also severely affected during dry spell because over 80% of the area was under irrigated bananas and Asian vegetables notwithstanding the high rates of evaporation.

Firewood was the major fuel used in the region. The rising pressure from population increase has led to massive cutting down of trees for timber, firewood and charcoal. In some areas, where agricultural productivity was low or has declined people turn to charcoal burning as an enterprise. In the study area, households have tried to solve the problem of fuel wood by planting Grevillea robusta trees (locally known as Mukima) haphazardly in farms. Grevillea was originally introduced in the area as a shade tree for coffee plantations as it does not compete strongly with adjacent crops because it is relatively deep-rooted (Dewees, 1995). It tolerates repeated heavy

pruning of its roots and branches enabling farmers to regulate the degree of competition with other crops. The tree branches are periodically harvested for firewood and the trunks used for timber or charcoal. Focus group discussions also attributed accelerated rate of diminishing farm tree cover to stopping of forest exploitation and expanded tea production rendering tea companies and timber dealers to the farms for their wood supplies.

Financial assets: Banks, SACCOS and microfinance institutions are common in this region. These institutions are major sources of credit and other financial facilities to farmers.

From the results of household survey out of a total sample of 274, 31.4% (86) of the respondents had acquired credit in the past 2 years.

This study further sought to find out the source of the credit and established that the majority (51%) accessed their credit from SACCOs, 27.4% acquired credit from commercial banks, 19.3% from microfinance institutions while the minority (2.3%) had credit from their groups.

The uses of the credit were diverse with the majority (45.6%) of the respondents indicating that bought farm assets, 22.6% used the credit to cover education expenses and 20% use the credit in off farm business while 9% covered medical expenses using the credit. The minority (2.8%) of the respondents used the credit for social obligations.

Social assets: There was a number of social networking done by smallholder farmers in the region. Group participation and reliance on support networks was a common practice in the region. From the results of the household survey (Table 6), 80.5% of the farmers are members of one or more social group with 67% of them attributable being members to more than one group. The general trend was that there was lower likelihood of having one being a member to many groups. This because of the level of commitment required in terms of time, financial contribution and service.

These groups were ranged from farmer groups, rotating savings and credit associations, burial society, neighbourhood/village committee, clan/family, religious group and water project groups. The key benefits associated with membership to the groups were, social/moral support, farm labour, irrigation water, cash/soft loan through group security and training/technological (Table 7). The impact of community groups and networking was evident in the water sector (Table 6) whereby villages team up to develop water services infrastructure.

Table 6: Distribution of number of groups an individual is a member

No. of groups one is a member	Frequency	Percent
0	51	19
1	78	28
2	65	24
3	47	17
4	23	8
5	8	3
6	2	1
Total (N)	274	100

Table 7: Distribution of type of services provided to group members

Services	Frequency	Percent
Social/moral support	43	16
Irrigation water	48	18
Cash/soft loan through group security	66	24
Training/technological support	12	4
Sponsorship	17	6
Buying of household assets and utensils	4	1
Selling of farm produce	23	8
Farm labour	61	22
Total (N)	274	100

Climate variability extremes: Results from the focus groups discussions revealed four major categories of climate variability extremes were identified and the zones with high frequencies of each of the categories were marked as being more vulnerable to the climate extremes. Vulnerability was defined following the general concentration of household capitals in the SAEZ. Further analysis indicated that availability of water for irrigation was inversely proportional to the vulnerability of livelihoods in the region. Meru county is relatively arable over 75% of the area under semi arid climatic conditions (UM3 leeward, LM3-LM6) dependant on the unreliable rainfed agriculture. Field observations indicated that areas in the leeward side of the mountain had one river across Timau and adjacent Buuri division but diminish downstream towards Isiolo. Therefore, rendering Buuri division water resource area scarce additionally irrigation infrastructure in the division was underdeveloped. While on the windward side there were nine rivers and streams a favourable terrain which allows flow of water through gravity therefore, easier to irrigate during dry season. Consequently, the vulnerability of those households to climate variability was perceived minimal. However, in cases of prolonged dry season (extending 4 months) the available streams dry up in low midland zones due to over exploitation up stream. Rivers such as Thinkwi, Kithino and Mariara had their volumes reducing downstream constraining irrigation on lowland (LM3). In LM4 smallholder irrigation infrastructure is minimal hence dependant on rainfed agriculture (Table 8).

Differences exists in heterogeneity of the farm households in terms of the livelihood activities, assets

Table 8: Climate variability extremes in Meru central

Climate variability	Most vulnerable SAEZ	Mostly affected crops
Delayed rainfall	LM6, LM5, LM4, LM3 and UM3, especially areas with no water for irrigation	Cereals andlegumes
El-Nino	Windward	Short season and shallow rooted
La-Nina	All	All
Short rainfall periods	All	All

endowments and adopted strategies. These differences also considerably determine how households' respond to various stresses and shocks. Thus, there is need to characterize and then classify smallholder households into sets of homogenous groups with similar characteristics to study their access to resources, response to constraints caused by climate variability in their livelihoods.

Literature on household classification exists. For example in a study conducted by used production activities, household objectives and the main constraints faced by farmers to characterise farms in assessing nutrient depletion and soil degradation in Western Kenya. Nguthi (2007) in her study on adoption of agricultural innovations by tissue culture farmers in Muranga characterized households using the five livelihood capitals. Salasya (2005) in a crop production and soil nutrient management economic analysis of households in Western and Central Kenya, used variables related to management decisions, structural farm household characteristics and distance to the nearest market to classify farms in her study.

Selection of variables used in this study was based on the 5 capitals of the livelihood framework.

CONCLUSION

The findings of the study would contribute to existing knowledge and generated ideas for further research. The study intended to provide information for policy development and land use planning.

Based on the findings, farmers would be advised on the best strategies to adopt without aggravating the effects of climate variability. Adopting best adaptation practices would increase agricultural productivity in a sustainable way leading to better life.

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