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Livelihoods under Climate Variability and Change: An Analysis of the Adaptive Capacity of Rural Poor to Water Scarcity in Kenya's Drylands

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ABSTRACT

Water is the most limiting factor in crop and livestock production in Arid and Semi-Arid Lands (ASALs) of sub-Saharan Africa. This study was carried out in Kibwezi district of Kenya mainly inhabited by agro-pastoralists. Information on historical trends of climate variability, its effects on crops, livestock, pastures, water resources and the coping strategies adopted by the farmers was captured using structured questionnaire. In addition, family portraits were developed from 10 households to generate more information. Data was analyzed by subjecting it to descriptive statistical analysis. Most (98%) of the respondents mentioned increased dry conditions as the main unusual climatic events. Other impacts of climate change were increased crop failures, low forage, reduced livestock productivity and increased livestock and human diseases. In response, households had developed both short and long term adaptive mechanisms and this included planting of drought tolerant and early maturing varieties, early or dry planting, water harvesting, migration of men to urban centers to seek wage employment, de-stocking of herds and change of herd composition. The effects of climate change are already being experienced by communities living in drylands and water scarcity is the main constraint. The inexpensive and locally adapted techniques in rain water harvesting needs to be up-scaled to alleviate water scarcity in these areas.

Key words: Climate change, coping strategies, rain water harvesting

INTRODUCTION

Dry land areas which includes arid and semi-arid areas receives annual rainfall of less than 1500 mm and are characterized by limited water supply, low and highly variable rainfall and recurrent droughts. Around half a billion people live in such areas, where water is an unavoidable constraint (Winpenny, 1994). Global warming with its influence on climatic change is rendering the climatic conditions of some regions drier and all more variable and unpredictable (Parry, 1990). Even where surface waters accumulate, it is not easily retained due to high temperatures and intense precipitation that cause water loss to evaporation and run off, respectively (Little *et al*., 2001; IIRR, 2002).

Communities living in the drylands have been experiencing crop failures and diminishing household herd sizes, the latter being attributed to high mortality rates. Livestock loss in the drylands has mainly been due to severe and persistent droughts which have led to tremendous human suffering. These communities have developed traditional water harvesting systems in

response to the increasingly frequent droughts (Mude *et al*., 2007; Jama *et al*., 2005). Techniques such as half moon pits and contour stone bunds are popular among farmers (Nyangito *et al*., 2008). Water harvesting in dry lands has resulted in more vegetation cover, due to increased infiltration rate resulting from slowed water movement on land (Musimba *et al*., 2004). Improved run-off harvesting techniques has enabled vegetable production to meet household requirements and to provide surplus for sale to augment household incomes. In addition, farmers are able to diversify their crops from the traditional maize and beans to include potatoes, carrots, onions, soya beans, millet, bananas and fruit. This diversity has contributed to food security and wider nutrient base in these communities (Nyariki *et al*., 2005).

Water harvesting has contributed to land rehabilitation enabling communities to cope with highly variable climate, with the subsequent reduction of poverty (Orindi *et al*., 2008). The objectives of the study were to analyze the impact of climate change on the dry land farming systems using a case study approach; and identifying effective rain water harvesting techniques as an adaptation strategy to rainfall scarcity and with the aim of building capacity of the communities in effective rain water harvesting techniques.

MATERIALS AND METHODS

Study area: The study was carried out in Kibwezi district which is a semi-arid area located approximately 200 km South East of Nairobi. The district lies between the latitudes 2°6´ S and 3°S and longitude 37°36´ E and 38°30´ E, respectively and has a total area of 3400 km^2. It is inhabited by Akamba community who are mainly agro-pastoralists. The area is a typical semi-arid land characterized by low, erratic and unreliable rainfall. The average annual rainfall, evaporation and temperatures are 600, 2000 mm and 23°C, respectively. Due to its proximate position along the equator, the area experiences a bimodal pattern of rainfall with long rains from March-May and short rains from November-December. The short rains are more reliable in time than long rains and are therefore more important.

The semi-arid lands form part of the vast rangelands of Kenya, which occupy over 80% of the country's total land area. They are classified into Agro-Climatic Zones (ACZ) IV and V on the basis of the ratio of rainfall to open water evaporation (R/Eo).

Data collection

Individual interviews: A questionnaire containing dichotomous, multiple choice and open-ended questions germane to the objectives and hypothesis of the study was developed to aid data collection. Prior to the actual study, research assistants and enumerators from the local community were identified and trained. This was necessary to break the language barrier and to provide assistance to speed up the process of data collection. In addition, the training ensured that they did not deviate from the required protocol and thereby minimized bias in the data collected. The questionnaire was tested on a few households to ensure that the final questionnaire had only relevant and appropriately phrased questions. Each question was made simple and phrased in a manner that would imply the same meaning to all that were to be interviewed. The questions captured information on historical trends of climate variability, its effects on crops, livestock, pastures, water resources and the coping strategies adopted by the farmers. A sampling frame which included 5 households per sub-location, 3 sub-locations per location, 3 locations per division and 3 divisions per district was adopted to attain a sample size of 135 households.

Family portraits: A family portrait is a description and analysis of how a given family collectively organizes its social and material assets, in order to make a living. The portrait provides a great deal of detail on specific activities carried out by individual family members on a seasonal and historical basis and highlights the major constrains they face in their struggle to provide for themselves. It is a research tool, which presents an immediate human dimension to many of the issues surrounding livelihoods and climate variability and change. The family portrait is used to gain an in-depth understanding of broader livelihood issues and dynamics at community and higher levels. In this study, a total of ten households were selected, 5 of them which were practicing water harvesting techniques and five which were not.

Data analysis: The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version 12. Most of the data was subjected to descriptive statistical analysis to generate means, frequencies, which were then presented in graphs. The narrative information from the family portraits was summarized and used to support discussion under respective sections.

Communication/dissemination of the research findings: The project partners developed appropriate dissemination strategies including both formal and informal approaches. Informal approach involved meeting with households during project implementation to expose them to successful water harvesting techniques among the peers. The most successful techniques were documented in DVDs and converted into easily readable materials which can be communicated by farmer-to farmer. Formal communication approach involved communication packages such as scientific papers published in journals and other documentation emanating from the project.

RESULTS

The study showed that the main agricultural activity in the study area was mixed farming with crop production being preferred in the agro-pastoral areas, while livestock production forms the main source of livelihood in the pastoral areas (Table 1). The main crops grown in the area are maize, green grams, pigeon peas and beans, in that order. Livestock species kept in the area include cattle, goats and sheep, in order of importance.

Over 89% of the farmers reported increased frequency of droughts as one of the indicators of climate variability and change observed in the last 2-3 years (Fig. 1). The other unusual climatic events reported included increased floods, strong winds, changes in rainfall patterns and increased temperatures, in order of importance (Fig. 1). The reported climatic events have resulted in the drying up of surface and sub-surface water sources, thereby complicating lives of communities in these areas.

These events have affected both livestock and crop farming in the area. The main impacts on livestock production have been in terms of weight loss of the animals, increased diseases and subsequent death of livestock, reduced livestock fertility and milk production (Fig. 2).

Table 1: Main sources of livelihood for the respondents (N = 95)

Livelihood activity	Frequency of respondents	Percentage of respondents
Mixed farming	83	87.4
Livestock production	1	1.1
Crop production	11	11.6
Total	95	100.0

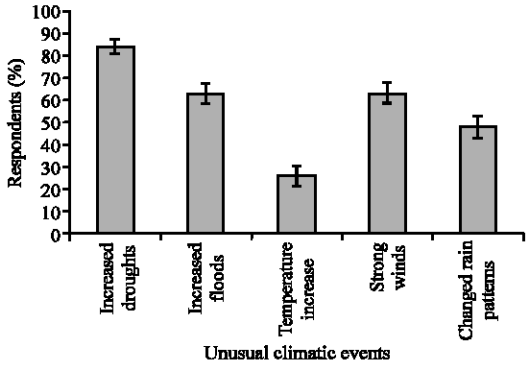

Fig. 1: Unusual climatic events reported by households

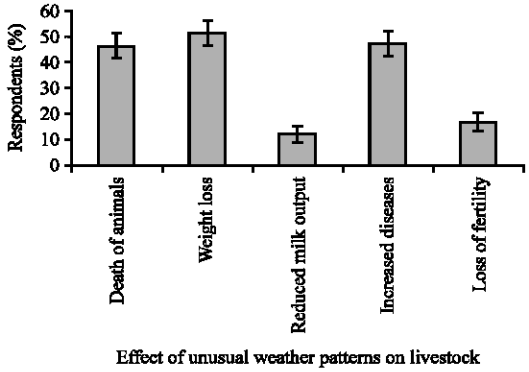

Fig. 2: Effects of unusual climatic events on livestock production in Kibwezi district

Table 2: Impacts of unusual climatic events on different kinds of livestock

Type of livestock	Rank in order of most affected	Percentage of respondents (N = 135)
Cattle	1	91
Sheep	2	91
Goats	3	95

Responses from 99% of the respondents indicate that all types of livestock have been severely affected by the climatic changes with exception of goats, which have showed more adaptability and tolerance to the anomalies (Table 2).

The main effects of unusual climatic events on crop production reported in this study, in order of importance, were changes in planting dates due to erratic rainfall, poor crop health resulting in reduced productivity. The frequent droughts have forced farmers to diversify and adopt drought tolerant crops (Fig. 3).

Over 95% of the farmers reported that food consumption at household level was affected with 73% of them resorting to skipping meals. Livestock prices would decline during the dry spell as most households seek to dispose off their animals however, the prices of milk would go up due to the scarcity of milk. The coping mechanisms adopted differed slightly between the livestock and crop farmers. Measures adopted to mitigate effect of climate variability on crop production included purchase of grains from the market, storage of previous harvests, planting of drought tolerant crops, spraying crops against pests, terracing to conserve soil and moisture, early planting and early land preparation (Fig. 4).

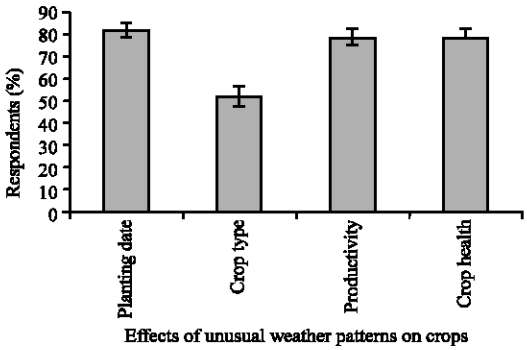

Fig. 3: The effects of unusual weather patterns on crop production in Kibwezi district

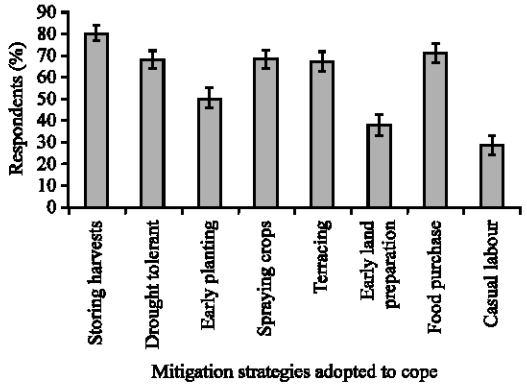

Fig. 4: Mitigation measures adopted by households to cope with the unusual climatic events

About 70% of the farmers felt that the measures they were adopting to mitigate the effects of climate change were not effective due to lack of resources at both household and community level. Measures taken conflicted with other household operations due to scarcity of resources. Some of the intervention measures by the government such as vaccination against animal diseases were successful as evidenced by reduced incidences of animal diseases according to 79% of the respondents.

Households adopted a number of strategies to mitigate the effects of unusual climatic events on their livestock. The measures adopted, in order of importance, were treatment of livestock diseases, stocking of drought tolerant breeds, purchase fodder, pasture conservation and destocking (Fig. 5).

Response to water stress was evidenced in terms of constructing dams, digging of shallow wells, rainwater harvesting using roof catchments, directing runoffs into the farms as well as buying water for domestic use. Quality of water was affected resulting in increased cases of waterborne diseases to both human and livestock. Measures undertaken by households to ameliorate water problem, especially during prolonged droughts were not satisfactory as reported by 87% of the respondents. Households that were using roof catchments to harvest rain water indicated that their efforts were hampered by lack of storage containers. Measures taken to cope with water scarcity conflicted with other household operations due to limited resources. Most of the government interventions were mainly targeted at community level, however 88% of the respondents felt that the government was not doing enough to address the problem.

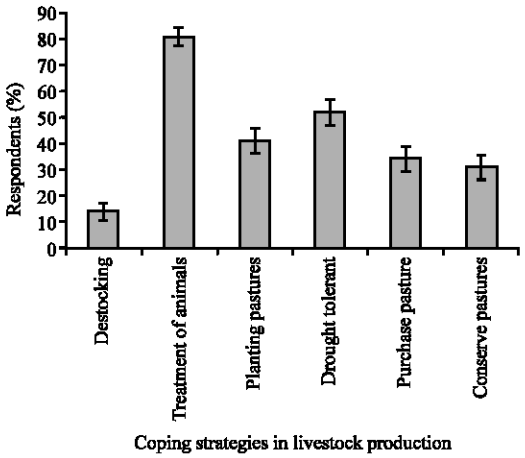

Fig. 5: Coping strategies adopted by households to mitigate the effects of unusual climate on their livestock

DISCUSSION

The extreme weather conditions affect the agro-pastoralists more than the pastoralists. due to the opportunistic strategy of nomadic pastoralism, which enables pastoralists and their stock to track forage and water in space and time (IIRR, 2002). Pastoralism involves highly fluid production systems responding flexibly to variable and unpredictable arid and semi arid rangeland environments. Herd mobility allows pastoralists to escape natural shocks therefore making them less vulnerable to climate variability (Nyariki *et al*., 2005). This renders nomadic pastoralism to be the best adapted production system in the arid and semi arid lands. These observations were echoed by Proud (2009) who observed that pastoralists play an important role in managing the world's dryland ecosystems due to mobility, which assures that livestock can make the best possible use of dryland biomass.

Farmers in the study areas had developed both short and long term mechanisms to cope with the adverse dry conditions brought about by the unusual climatic patterns in an effort to alleviate food insecurity. These measures are meant to cope with the inherent seasonal variability and planned strategies to cope with the predicted long-term anomalies. The study showed that the main effect of unusual climatic events was water scarcity and most farmers responded to this through rain water harvesting. Various methods of rain water harvesting have been used by dryland communities in an effort to cope with water scarcity in these areas (Madeley, 2009).

Other response to climate variability includes increased migration of men to urban centers to seek wage employment, destocking of herds, change of herd composition. Goats are increasingly being preferred because they are more drought tolerant and suited for the browse species that survive extended dry conditions and droughts (Musimba *et al*., 2004). Ways of coping with water scarcity for livestock in the study area included rainwater harvesting using roof catchment, sinking of boreholes and digging shallow wells in dry river beds. The water harvesting measures are being done at both household and community level for both agro-pastoralists and pastoralists communities. These are the common practices by communities living in drylands and the choice of method is dictated mainly by the resources available (Medeley, 2009).

The unusual events brought about by the climatic variability has taught and influenced farmers in a great way and all the respondents acknowledged the need to conserve water. All the

farmers expressed that they had heard about climatic change and they were already being affected by the unusual events it has brought about. All the respondents were in agreement on the need to take up measures individually and collectively to address the problem of water shortage. Other studies have shown that, dryland communities are aware and willing to take up measures to cope with ravages brought by climate change (Watson, 2003; De La Rocque *et al*., 2008).

Water was reportedly to be a major constrain in both crop and livestock production and farmers had adopted different mitigation strategies for coping with this problem. This agrees with other findings by other researchers (Thornton *et al*., 2009). Water scarcity is compounded by the fact that most of the rivers in the area are seasonal and the predominantly sandy soils allow percolation of water with very low retention. Rainwater harvesting was one of the most successful mitigation measures as attested by availability of pastures and crops for those farmers who had adopted the technology. These farmers were able to generate income through the sale of grass for fodder and grass seeds. This conforms to reports by Ellis (1998) that diversification of farming activities renders communities in fragile ecosystems less vulnerable to the vagaries of nature.

CONCLUSIONS

The effects of climate change are already being experienced by the farmers and especially those in dry lands and there is need to upscale the technologies of rain water harvesting to alleviate water scarcity in such areas. Since, most of the farmers are resource poor, there is need to avail capital support to help the farmers construct reservoirs for rain water harvesting. Training is needed to equip the farmers with other inexpensive, locally tested ways of run-off harvesting which is already in use by some of the farmers.

A lot of time is wasted by women and children in search of water which in most cases is poor in quality. Successful rainwater harvesting will go a long way in improving access of the community to safe drinking and curbing the problem of crop failures and death of livestock due to water scarcity. Concerted effort is therefore, imperative to help households living in the dry lands to construct dams, sink boreholes and acquire water storage facilities.

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