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Climate Change adaptation practices for two communities in Southern Malawi

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Abstract
Climate change has caused extreme weather events such as frequent droughts, floods, heat and cold waves. Farmers and communities lack contextualized information on adaptation to climate change, however, farmers and extension workers need to understand causes of weather disruptions and strengthen their adaptation and coping mechanisms. The study assessed the climate change adaptation practices adopted by 92 households in Chikhwawa and Nsanje districts of Southern Malawi. A household survey was conducted in two villages in Chikhwawa and three villages in Nsanje District. The communities were practising conservation of catchment areas, construction of dykes, growing of drought-tolerant crops and early maturing varieties. Thus irrigation agriculture, winter cropping, crop diversification and growing of drought tolerant crops are adopted to improve survival and productivity of crops. Improved tillage practices to conserve moisture and soil including conservation tillage, planting of vetiver grass, crop residue management and ridge alignment and better crop husbandry practices including agroforestry technology are being practiced. Coping mechanisms to climate change impacts include sale of livestock, taking up casual labour and migration to other sites. The communities use indigenous knowledge to forecast early indicators of weather changes mostly using changes in the animal and plant behaviour and astronomical features.
Keywords: Adaptation, Climate change, Climate refugees, Coping mechanisms, Indigenous knowledge

1.0 Introduction

Climate change and weather variability is becoming a challenge to agricultural production and management of natural resources because it increases risks and uncertainties for farmers. Agricultural production activities are generally more vulnerable to climate change than other sectors (Ajetomobi and Abiodun, 2010). Thus in the long run agricultural practices and management of natural resources will have to adapt to the change to ensure food security and human survival. Adaptation to climate change refers to adjustment in natural or human system in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities (IPCC, 2001). Mainstreaming adaptation into development frameworks refers to the integration of adaptation objectives, policies, strategies such that they become part and parcel of national and regional development policies, processes and budgets at all levels in such a way that they complement the broader objectives of poverty reduction and sustainable development.

The Malawi's national adaptations programmes of Action (NAPA) report on Disaster Management for Malawi enlists Chikwawa, Nsanje, Balaka, Salima and Karonga districts as the most vulnerable districts to climate change effects of droughts, floods and cyclones (Government of Malawi, 2006). Key among the conditions for success in adaptation strategies is use of early warning signals for drought and floods. These assist in making an informed choice in the adaptation strategies by farmers and communities to reduce the impacts of climate change. In an effort to build capacity in adaptation strategies to climate change Bunda College selected Chikwawa and Nsanje districts. The Malawi NAPA aims to improve community resilience, restore forests, improve agricultural production and improve preparedness for floods and droughts and boost climate monitoring. The project activities are in line with objectives of Climate Change and Development- Adapting by Reducing Vulnerability (CCDARE) through enhancing knowledge, skills and partnership among stakeholders involved in reducing vulnerability to climate change in Malawi. The knowledge of adaptation methods and factors influencing the choice of methods could enhance policy towards tackling the challenges climate change is imposing on farmers (Sofoluwe *et al.,* 2011). The objectives of the study were to identify climate change adaptation practices and early warning signals used by communities in managing agriculture and natural resources.

2.0 Methodology

2.1 Study area and sampling of households

The study was carried out from November 2009 to January 2010 in two villages in Traditional Authority (TAs) Katunga in Chikhwawa and three villages in TAs Tengani and Nyachikadza in Nsanje district (Table 1). A standard statistical sampling framework as discussed in Edriss (2001) was used in determining the sample size. Based on data provided by District assemblies of the two districts, a three stage stratified random sampling strategy was used to select over 30 households from five villages. In stage one, the list of households in drought and floods affected areas was used as a sampling frame to randomly select 2 villages in Chikwawa and three villages in the area. In stage 2 the proportional allocation method was used to determine the number of households to be selected from each sampled village and the representation of male and female headed households in each sampled village. Statistical Package for Social Sciences was then used to sample the required number of beneficiary households in each sampled village to come with expected number of households which was found to be adequate at 95% confidence level. The qualitative data collection focused on the Participatory Rural Appraisals with communities and key informants and in depth understanding of the structured questionnaire for custodians of traditional knowledge relating to early warning signals for drought and floods. The team assessed and documented all observations on how farmers are adapting to climate change and the different coping mechanism used.

Table 1. Selected Villages and households for interviews in Chikwawa and Nsanje Districts

District	**Traditional authority**	**Village**	**Number of Households**
Chikwawa	Katunga	Kantefa	32
	Katunga	Mtombosola	26
Nsanje	Tengani	Chikhawo	14
	Tengani	Nyanthumbi	10
	Nyachikadza	Nyachikadza	10
Total			92

2.2 Focus Group Discussions

Focus group discussions were conducted with communities in the two districts including village headmen, community representatives in the Agriculture and Forestry sectors, leaders of Community Based Organizations including community leaders. In the focus group discussions respondents were recruited through volunteer groups and local leaders within the targeted villages. Men and women were interviewed separately to obtain adequate information from each group. Discussions addressed the issues of agriculture and food security; forecasting of drought and floods, climate risks, and climate change adaptation strategies.

2.3 Key Informant Interviews

The team consulted key and relevant stakeholders of the project including the District Commissioners for the two districts, District Disaster Preparedness Coordinators, District Agricultural Development Officers, Irrigation Officers, Agriculture Extension Development Coordinators (AEDC), District Forestry Officers, District Environmental Offices, Leaders of Faith Communities, Representative of Non Governmental Organisations, Education representatives, Village headpersons and chairpersons and committee members of Community Based Organisations among others. For each of the key informant interviews a standard checklist of questions were used to document information on climate change risks, early warning signals and adaptation practices for agriculture and management of natural resources.

2.4 Data analysis

Household survey data was analysed using Statistical Package for Social Scientists (SPSS) 14.0 package. Data was entered in Excel spread sheets, cleaned after test-running analysis to identify outliers. Frequencies, means and cross tabulations run on the cleaned data based on the variable and requirements for particular variable analysis. Focus group discussion and key informant interview data was entered in Excel spreadsheets. Responses were triangulated to establish a common trend of responses on weather forecasting, climate change risks, adaptation and challenges in adopting different adaptation strategies.

3.0 Results and Discussion

3.1 Socioeconomic characteristics

Chikwawa and Nsanje districts have been experiencing food shortages in the last five years and the communities cited climate change effects such as flooding, droughts and cyclones as the main causes of food shortages. The total number of households sampled was 92 and out of this sample 68% were male headed while 31.3 were female headed. The mean age of the respondents was 42.5 years and only 52% had at least attended primary school education while 21% had no formal education. The level of education has an implication on the perception and application of knowledge in adapting to climate change adaptation. The level of education suggests that just over 50% of the respondents would be able to acknowledge issues of acquisition, processing and use of information in climate change. More than 95% of the respondents were practicing crop farming and livestock production as their main source of livelihood. The most commonly grown food crops are maize, cassava, sorghum, millet; cotton is the major cash crop grown in the two districts. About 76% of the households raise livestock mostly cattle, goats, pigs and poultry. Major problems that people are encountering in the two districts include drought conditions, perennial floods which lead to outbreak of water-borne diseases such as cholera and dysentery among others. The districts also records high number of cases of crop pests' outbreak such as army worms which attack tender crops of maize, cassava and sorghum.

3.2 *Farmers' evidence of climate change*

Most of the respondents (89.4%) were aware of climate change and the risks and impacts associated with it as experienced over the past ten years. The majority of the respondents (38.6%) Table 2 reported increased flooding of rivers over the past ten years as a major risk of climate change. Regardless of the literacy level and socioeconomic status the communities are aware of the changes in climate. Most of the respondents being farmers claimed to have been severely affected by trend in weather patterns over the past years.

Table 2. Respondent's evidence of climate change over the past ten years

Climate risk	Trend	Percent
Flooding	Increased	38.6
Drought	Increased	31.8
Rains	Late rains	14.4
	Shorter rains	8.0
Winds	Hailstorms	6.1
	Calm and hot	2.3
	Extremely heavy	8.1
Temperature	Very hot	16.4
	Extended cold season	9.5

3.3 Methods of forecasting weather changes

The local communities rely on both conventional and indigenous methods of forecasting weather changes namely drought and rains that will result in floods. Farming communities and key informant interviews indicated that they are aware that climate has been changing over the years; however there is limited information as regarding impending droughts and floods. Information is mostly obtained from radio after the floods or drought has already hit the areas. Communities have tended to use indigenous methods to predict good or bad years, for example 16.3% of households indicate to use massive fruiting of mangoes as signal for floods in the season while 8.6% use calm and too much heat as a signal for impending rains and floods. On the other hand, presence of a very bright star surrounded by many small stars during maize planting season (November December) suggests a year of very good rains followed by floods. Only 7.6% of the households indicated to have relied on radio messages or conventional weather forecasts for floods otherwise most of the households (52.2%) forecast floods through observation of continuous (Figure 1). The practice of awaiting heavy rains to forecast floods has resulted in failure to adapt as communities have failed to relocate to upland areas in good time resulting in loss of crops, livestock and other household goods in times of floods. Communities have bemoaned unreliability of conventional weather forecasts aired through radio stations. At times farmers have been moved to upland areas in anticipation of looming floods which have failed in some cases resulting in farmers scrambling for pieces of abandoned lowland areas for cultivation and these have resulted in resistance by communities to relocate even in the face of strongest messages to relocate.

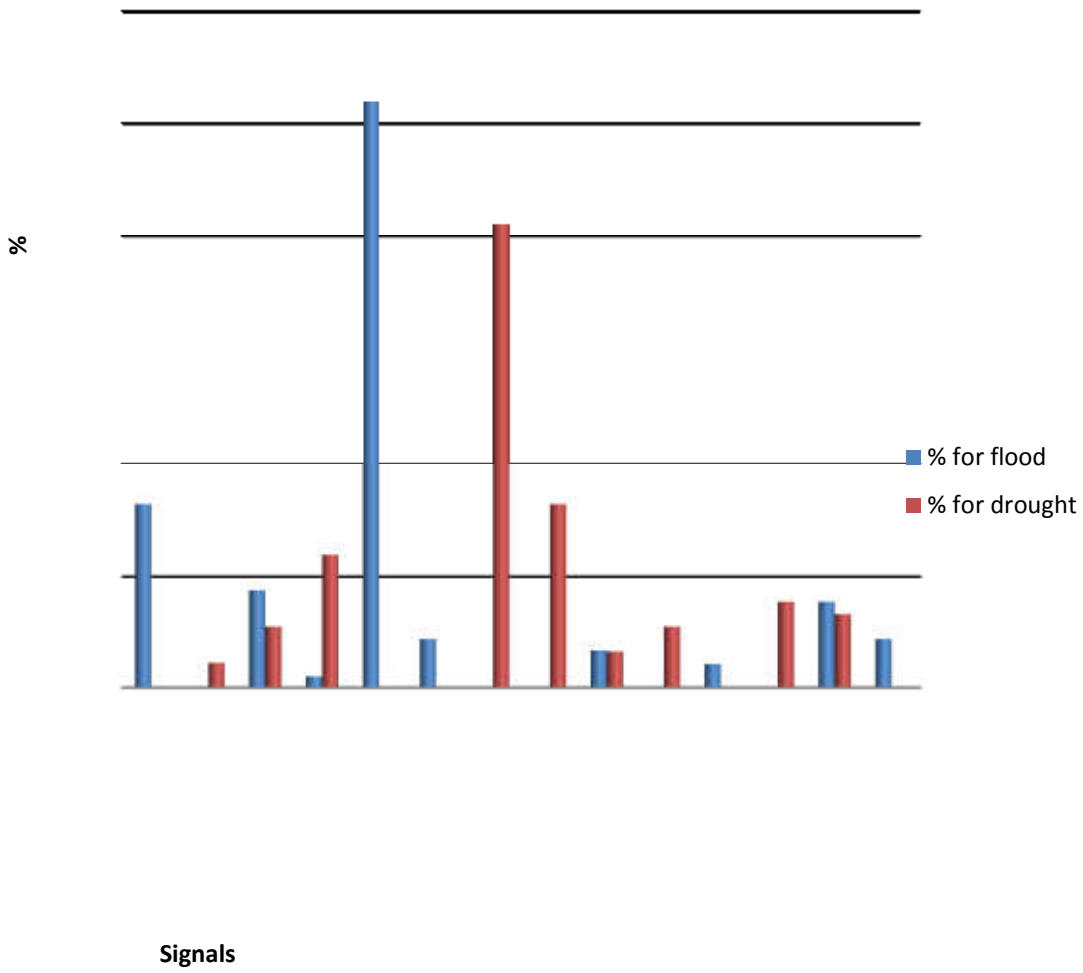


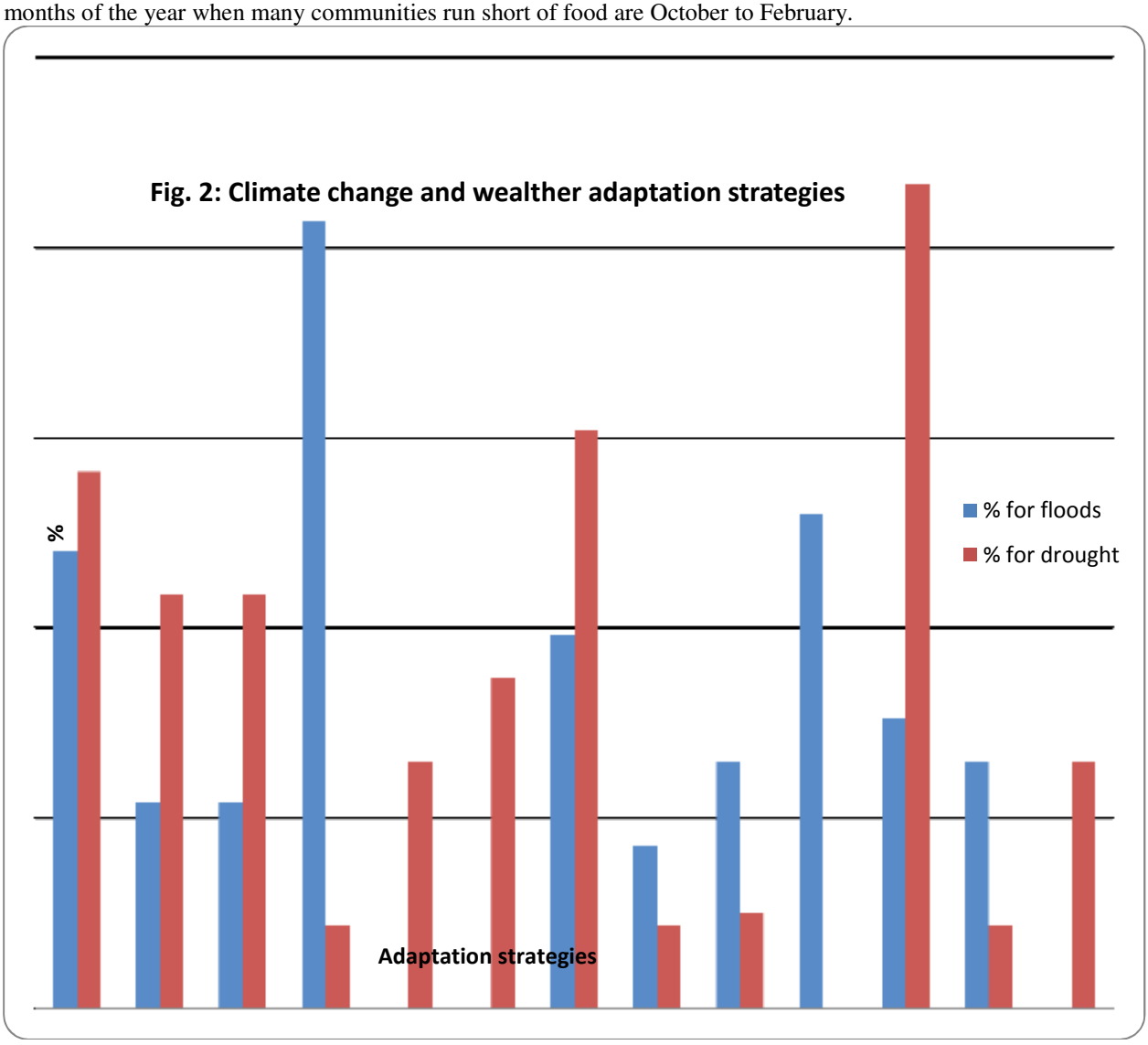
Fig. 1: Early warning signals for floods and drought

Drought is main cause of shortage of food in Traditional Authority Katunga in Chikhwawa district. The area receives less rainfall as it is also on the leeward side of the Thyolo escarpment. For the past three years the study area in Chikhwawa has received less that 600 mm per annum and the crops that have survived include sorghum and cotton. For the purpose of forecasting dry spells and drought most of the households rely on weather related signals, for example 41.3% indicate that less and erratic rains were a major attribute for occurrence of drought while 16.3% of respondents rely on existence of heavy Southerly storms *(Mwera)* winds as a signal for drought. Other indicators of drought are mainly phenological appearance of plants where late flowering of trees as indicated by 2.2% of the respondents is an indication of dry spells. Higher fruit production of wild fruits of *nyenze* and *nkolobwe* is a signal of looming drought in the season. These results agree with findings of Chang'a et al. (2010) where heavy flowering of *Brachystegia speciformis* and *Erythrina abyssinica* in July to November as an indicator of well distributed rainfall which may be followed by floods. Behaviour, appearance and movement of wild and domesticated animals are associated with weather changes. Appearance of large swarms of ants from November to December is indicative of imminent drought.

3.4 Farmers adaptation to climate change

During droughts or floods when farming fails, farmers engage in a diversity of adaptation methods. Droughts and floods in the two districts has brought major problems which have resulted in low agricultural production due to damage by hail storms, destruction of land, pest and disease outbreaks, washing away of crops and

livestock, crop failure because of permanent wilting. A higher number of respondents 14.1% engaged in crop diversification for drought and 12.0% for floods. Crop diversification is used as an insurance against drought and floods. The main food crops are early maturing varieties of maize, sorghum, rice, millet and sweet potatoes. Very few respondents (2.2%) opt for conservation agriculture in the face of drought. This entails that most farmers have not yet taken up conservation agriculture technology as it is a new technology that is being promoted in selected districts in Malawi. Winter cropping is taken up by 6.5% of the respondents as an adaptation strategy while another 6.5% practice irrigated agriculture to avert drought conditions (Figure 2). Farmers are using simple irrigation techniques such as furrow and canal irrigation and use of watering canes. The lower percentage of farmers engaged in irrigation is attributed to high costs of accessories required by high technology of some irrigation system like sprinkler irrigation. This is in agreement with assertion by Mendelson and Williams (2004). About 20.7% of the respondents migrate or relocate to upland areas when the area gets flooded. Most men migrate to sugar plantations to secure casual labour that can take the families through the agricultural season. In case of floods the highly affected sector is the farming communities followed by the education sector is where school going pupils stop attending classes, furthermore most schools and churches are turned into relief centres to accommodate victims who lose their buildings to floods. In both districts worst months of the year when many communities run short of food are October to February.



Other sectors that get equally affected by floods are health sector-(clinics), water sector (boreholes, irrigation pipes), transport- poor road infrastructure and the market structures. The common coping strategies in the face of flood, drought and food shortages include provision of casual labour, food for work, migrating to sugar plantations to offer labour services. Apart from employing sustainable adaptation practices farmers also engage in unsustainable climate change coping mechanisms such as charcoal production (13%), sell of livestock

(10.9%) and sale of household assets 6.5%. There is increased consumption of wild plants by 15.2% of the respondents as a coping mechanism. Reportedly Nsanje and Chikhwawa districts have recorded highest consumption of orchids, wild yams and related roots, tubers and water lilies such as *Nymphae caerulea (Nyika)* and these have been associated with cases of death through poisoning. Diversification is a key strategy for coping with and adapting to the consequences of climate change some farmers in Chikwawa reduce vulnerability by engaging in collective action for income-generating activities such as seed pass on programme. Some communities that have relocated to upland areas have farm gardens on high ground for when there is a lot of rain and on low ground for when there is little rain; they also use river depressions for cultivation in the aftermath of rains. People typically grow a diversity of crops and fruits and vegetables in addition to maize and also use communal forest areas for grazing livestock and extracting forest products. Other local adaptation strategies include switching crops, adaptation of the agricultural calendar to the changing cycle of seasons, conservation and development of local genetic diversity of crops such as sorghum and millet require change in Government policies that enable, rather than inhibit local adaptation options, implying a shift away from adaptation policies that prescribe practices to those that enable greater local freedom to choose appropriate practices in empowering local populations in their relations with policy makers

3.5 Challenges in adapting to climate change

The existence of climate change adaptation strategies is no guarantee of successful adaptation in terms of securing basic needs in the face of climate variability and change. Farmers cited five major constraints to towards adaptation to climate change and the constraints are: lack of capital for procurement of inputs as indicated by 29.5% of the respondents; lack on information on appropriate strategies (13.6%); low food supply forcing many people to go for casual labour; high incidence of pests and diseases and high soil degradation. Most people lack skills, labour or capital necessary to specialize in another activity that can take the place of agriculture and eventually resort to a range of opportunistic activities such as charcoal sale.

4.0 Conclusion

Local communities in Southern Malawi use different methods in forecasting changes in weather mostly floods and droughts. Most of the methods are based on indigenous knowledge with focus on the phenology of plant species and behaviour of different animal species. Astronomical and weather related knowledge is also used to predict occurrence of floods and drought in the different seasons. Crop diversification is the common adaptation method practiced by farmers in the face of climate change. In particular during droughts or floods when farming fails, farmers engage in a diversity of climate change adaptation activities including; planting drought tolerant crops such as millet and sorghum and adopting early maturing varieties, migrating to upland areas after floods, engaging in irrigated agriculture and winter cropping and use of wild plants as food among others. Communities seek to survive hardships of weather variability by engaging in several coping mechanisms such as sale of livestock, sale of household assets, provision of casual labour, engage in food for work and charcoal production. However the farmers face many challenges in adapting to variability in weather; lack of capital and inadequate information on best adaptation strategies are the most important constraints in militating against adoption of strategies. Systematic collection, documentation and analysis of indigenous knowledge used in forecasting drought, floods and other environmental changes is required for validation with conventional weather forecasts. Thus global conventional seasonal weather forecasts should be obtained based on such parameters as Predicted Sea Surface Temperatures (SSTs) in the Tropical Indian Ocean, the outgoing Long Wave Radiation (OLR) and other El-Nino Southern Oscillation (ENSO) indices to develop models that will validate early warning signals observed for specific seasons and relate that to the actual weather conditions at the particular period of time. There is need for more awareness creation on climate change and adaptation methods, and improving access of agricultural inputs including credit for income generating activities, increasing investment on yield improvement technology such as irrigation, conservation agriculture, agroforestry technologies and use of drought tolerant crops and livestock.

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