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Exploring opportunities for climate change adaptation in semi arid areas of Tanzania: A case of Nzega District in Tabora region

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Climate change and associated impacts are now widely acknowledged by most communities, institutions and organizations in the World to be affecting people's livelihoods. The University of Dar es Salaam in Tanzania through the Institute of Resource Assessment (IRA) implemented a three years research program to study the implications of climate change on natural and social systems in three agro ecolocilal zones in Tanzania. The present paper presents finding obtained from one of the zones studied namely semi arid central and western part. The study was conducted in two villages namely Upungwe and Mbogwe located in Nzega District, Tabora region. A sample size of 99 people; that is, 10% of the total number of households was used for household interviews. A total of 40 people strategically selected were involved in focus group discussion, 20 from each village. Findings show that different ethnic groups have moved into villages in response to climate change impacts in their areas of origin. Climate change impacts in particular increased pests associated with temper rise and resulted in loss on various crop yields ranging from 46 to 80%. Most crops affected are in the order cotton, rice, cassava, sweet potatoes, groundnuts and maize, respectively. Different adaptation options were also reported but the most important was found to be different forms of linkages such as rural-urban reported to be more viable by 39 to 68% of respondents while 48 to 62% reported such linkages to be viable on adaptation. To strengthen adaptation rural-urban, urban-rural and rural-rural linkages needs to be facilitated so that products and information can flow from all ends.

Key words: Adaptation, climate change, Mbogwe, Upungu, linkages.

INTRODUCTION

Global change, especially climate change, is one of the greatest challenges to human beings and natural systems in the 21th century (Hulme, 2001; IPCC, 2007). Although climate change is a global phenomenon, the distribution of impacts remains uneven, and will be severely felt by vulnerable communities with few safety nets and limited capacity to absorb climate variability and related shocks (Adger et al., 2005). In eastern and Southern African countries including Tanzania and Malawi, the National Adaptaion Programs of Action have identified agricultural sector to be one of the most vulnerable sectors to impacts associated with climate

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Table 1. Sample size distribution used in this study.

Data collection tools	Village		Total
	Upungu	Mbogwe	
Household survey	48	51	99
Focus Group Discussion	20	20	40
Discussion with key informants	5	5	10
Transect walk	20	20	40
Total sample size			**189**

change (Lema and Majule, 2009; Kalinga-Chirwa et al., 2011).

Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges, particularly in those parts of societies dependent on rainfed agriculture that is more sensitive to changes in climate (Mongi et al., 2010). Risks are apparent in agriculture, fisheries and many other socio-economic components that constitute the livelihood of rural populations in developing countries (Watson et al., 1996). In most cases, documented vulnerability is in the form of severe and repeated droughts, unpredictable flood and irregular rainfall. For example droughts and floods result in crop damages and failure (Liwenga, 2003; Nelson and Stathers, 2009).

The traditional rain-fed subsistence agriculture is extremely vulnerable to changing patterns of climate variability such as through shifts in growing season conditions. Since most rural communities rely on their agricultural produce to generate income, poverty is directly coupled to agricultural production. It is however not well understood how households or communities cope or adapt to climate induced extreme variability. Similarly, sea water rise is a result of climate change and increased temperatures, which lead into the flooding of coastal lines often resulting in disasters.

Different studies have shown that all societies are fundamentally adaptive and there are many situations in the past when societies have adapted to changes in climate and to similar risks (Paavola and Adger, 2005; Gwambene, 2007). But some sectors are more sensitive than others and some groups in society are more vulnerable to the risks posed by climate change than others. Yet all societies need to enhance their adaptive capacity to face both present and future climate change outside their experienced coping range (Watson et al., 1996; McCarthy et al., 2001).

Experience suggests that the best way to address climate change impacts on the poor is by integrating adaptation responses into development planning. This is fundamental for achieving the Millennium Development Goals (World Bank, 2005). Effective adaptation strategies should build upon, and sustain, existing livelihoods and thus take into account existing knowledge and coping strategies of the poor. As pointed earlier, both social economic and biophysical characteristics as well as social infrastructure and linkages between two or more social economical settings determine societal vulnerability.

In agriculture sector in particular crop farming systems more recommendation has been made on using most drought resistant crops such as sorghum (Majule et al., 2009) without considering on other options such as the introduction of new crops.

In light of the issues raised, this study was conducted in a semi arid area of Tanzania in particular to examine implications of climate change on community livelihoods and the role of current existing adaption options in the agricultural sector as a response mechanism to climate change impacts.

MATERIALS AND METHODS

A multidisciplinary approach was used to generate relevant information from the different disciplines in the study area. Socio-economic data were collected through qualitative methods using participatory research methods including focus group discussions (FGD), discussion with key informants and household surveys in two selected villages.

The use of qualitative methods is among the evolving approaches in climate change studies, including perceptions, impacts, vulnerability, and adaptation (Gwambene, 2007; Majule et al., 2009). The various participatory rural appraisal (PRA) techniques used are the same used by Kangalawe et al. (2005). Before field work, a detailed literature review was undertaken on similar kind of work relevant to semi arid conditions. Table 1 presents the sampling size distribution employed in this study.

To understand the impacts of climate change and variability on community livelihoods, a sustainable livelihoods framework was used. The sustainable livelihoods framework (Frankenberger, 2000) presents the main factors that affect people's livelihoods, and typical relationships between these. Vulnerability of crops to climate change was considered within the framework in terms of trends, and seasonality affecting productivity.

This was explored particularly with respect to climate change and variability e.g. (drought, increasing incidence of crop pests and diseases) and associated impacts in terms of % loss of major crops over the last 20 years. In this case, average crop yield in bags per acre (each with 100 kg) over the last 20 and the last 5 years ago obtained through household surveys to a sample of 99 households

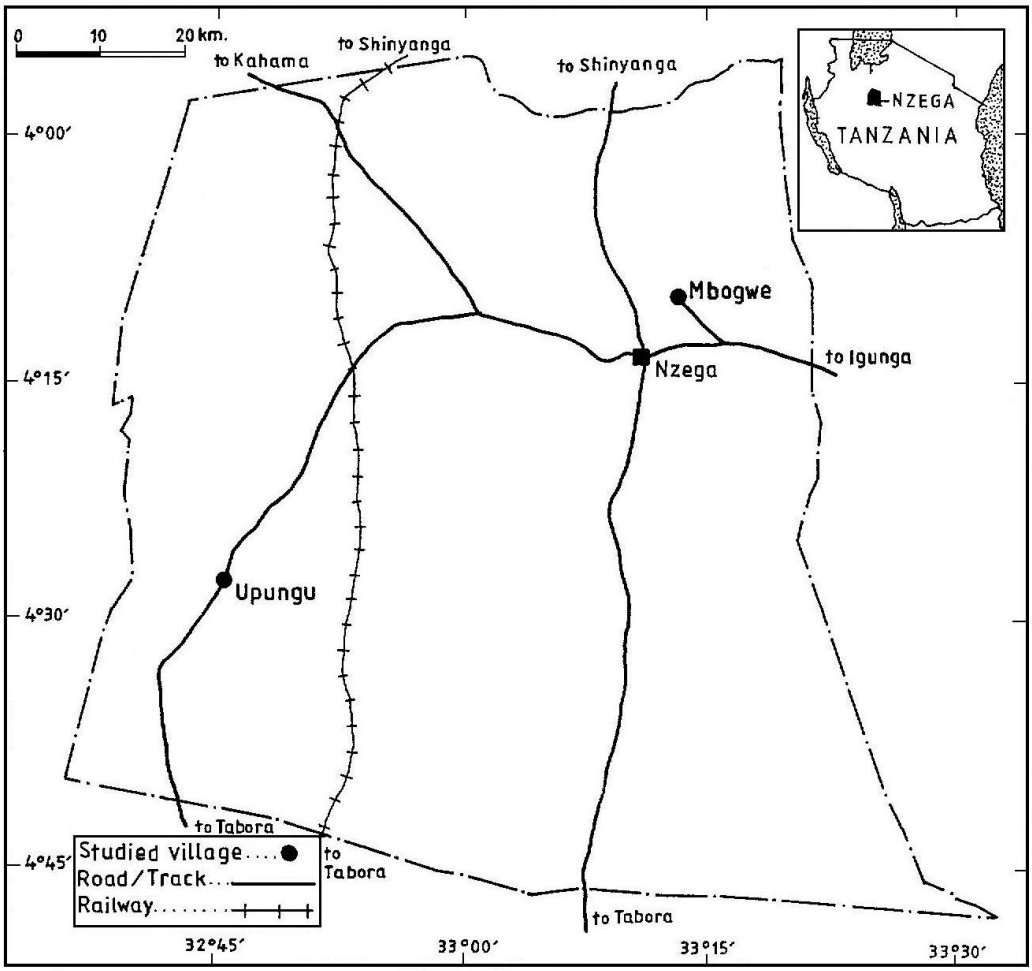

Figure 1. Location of study area in Nzega, Tanzania showing sample villages.

were analyzed and compared. In this case household members were requested to provide estimates of crop yields in relation pest incidences attributed by climate change. Household data was analyzed using appropriate statistical softwares commonly known as SPSS and results were presented in the form of Tables, Figures and descriptive statistics.

RESULTS AND DISCUSSION

Characteristics of the study area

Upungu village is located in Puge Ward, in Puge Division, Nzega District, Tabora Region located at 59 kilometers south of Nzega town on the main road to Tabora town. Upungu village is composed of five sub-villages namely Upungu East, Upungu West, Ntungulu, Ugawe and Kisumo. The village was established in 1974 under the villagilization (*Ujamaa*) program. Historically Nzega district is the six districts of Tabora region and it covers an area of 7,319 square kilometers, located between 32°30'-33°30' longitudes east of Greenwich and Latitude 3°45'-500' south of the equator. The district is located in semi arid areas of Tanzania where drought and poor soil conditions are limiting factors for agriculture development (De Pauw, 1984). A number of climate and environmental studies conducted in the area describe the area to be among the most vulnerable areas to climate change in Tanzania (Mongi et al., 2010; Kaijage, 2012; Muzo, 2012). Figure 1 presents the location of study area in Tanzania and specific villages used as a case study. the name "Upungu" is reported to have originated from the observed decrease in rainfall in the area (*Mvua kupungua*) which led to a food shortage (*Upungufu wa chakula*). This could BE a reflection of initial perception by communities on climate change and associated impacts.

On the other hand, Mbogwe village is located in

Table 2. Origin of community members in study villages.

Major reason	Upungu village		Mbogwe village	
	Frequency	%	Frequency	%
Born in the village	22	45.8	30	58.8
Born outside the village but within the district	12	25.0	16	31.4
Born outside the district but within the region	07	14.6	03	05.9
Born outside the region	07	14.6	02	03.9
Total	48	100.0	51	100.0

Table 3. Major reasons for in migration into study villages by %.

Major reason	Upungu village	Mbogwe village
Search for agricultural land	50.0	50.0
Search for business opportunities	33.3	96.2
Following relatives	71.0	90.0
Escaping unfavorable climatic conditions	57.3	50.0
Looking for employment	62.5	33.3

Mbogwe Ward, in Nyasa Division and is located 14 km east of Nzega town off the main road to the Dar es Salaam region. Mbogwe village is composed of ten sub-villages namely *Mbogwe kusini* (south), *Mbogwe kati* (middle), *Mwitinde*, *Mwakabilu, Kalangae*, *Budutu, Mwanubila, Mwangongo, Shapela* and *Bugegemela*. The village was established in 1929. The name "Mbogwe" is reported to have originated first from "*Mbogo*" (buffalo) who used to come and drink water in the Kilimi dam located within the village area. To date, the has dried off and buffalo are no longer coming due to environmental change and drying of the dam.

The socio economic profile of study villages

Ethnicity

A number of parameters constituting to this were studied and findings indicate that Upungu village is composed of three main ethnic groups namely Nyamwezi (66.7%), Sukuma (16.7%) and Tutsi (4.2) from Rwanda. Other minor tribes include Nyaturu, Chagga, Hehe and Kimbu and all together constitute 6.3% in total. There were 801 households in the village with a total population of 5,978 composed of 2,900 males and 3,078 females. On the other hand, 52 % in Mbogwe village were Nyamwezi while 44.2% and 3.8% were Tutsi from neighbouring country (Rwanda). Such a diversity of ethnic has enabled a range of livelihoods activities to exist in the study villages.

Family sizes and origins of community members

At community level, findings reveal that the number of family sizes varies in both villages as follows; i) those with between 1 and 3 members constitutes 31.3 and 25% in Upungu and Mbogwe villages respectively. Those with family sizes having four up to 6 members constituted 39.5 and 46.1% in Upungu and Mbogwe villages respectively. Those with more than six members were 29.2 and 28.9% in Upungu and Mbogwe villages respectively. Results suggest that the majority of the people in study areas had family sizes ranging from 4 to 6 members. On the other hand, family sizes in both villages follows the same pattern since families having more than 6 members are almost the same in both villages. The finding represents a typical African household size to support labor requirement based on subsistence farming as reported by Muzo (2012) and Kaijage (2012) in Nzega district.

With regards to origin of people in the study villages, some tribes have moved into the villages for different reasons (Table 2). Findings show that most of the community members (nearly 50%) were born within their villages and other migrated to the villages from different places due to several reasons. Discussion with key informants in Upungu revealed that those who migrated in the village came for the purpose of searching agricultural land and also for seeking employment to livestock keepers' especially grazing livestock.

However based on household survey, a number of reasons for migrating into the two villages emerged and are presented in Table 3. The reasons are generally common to both villages with few exceptions due to the location of a place and also existing opportunities. For example, 50% of respondents in both villages moved into the village for agricultural purposes while a significant large number of people moved into the Mbogwe village for business reasons. This is because Mbogwe village is

Table 4. Major livelihood activities in Mbogwe village.

Relevance	Major economic activities					
	Crop cultivation	Agro-pastoralism	Wage employment	Casual labour	Petty business	Crop trading
Very important	84.8	19.0	0.00	60.0	35.7	50.0
Important	15.2	52.4	6.30	20.00	28.6	50.0
Less Important	0.0	28.6	93.7	20.00	35.7	00.0
Total %	100.0	100.0	100.0	100.0	100.0	100.0

Table 5. Major livelihood activities in Upungu village.

Relevance	Major economic activities					
	Crop cultivation	Agro-pastoralism	Wage employment	Casual labour	Petty business	Crop trading
Very important	95.9	31.6	50.0	09.1	09.1	33.3
Important	04.1	63.2	50.0	54.5	36.4	66.7
Less Important	00.0	05.3	00.0	36.4	54.5	0.00
Total %	100.0	100.0	100.0	100.0	100.0	100.0

Table 6. Productivity of different crops over years in Upungu village.

Production pattern	Different crop types						
	Maize	Sorghum	Rice	Sweet potato	Groundnuts	Sunflower	Cassava
Increasing	13.1	25.0	08.3	07.7	03.1	20.0	00.0
Decreasing	65.2	50.0	75.0	53.8	75.0	20.0	61.1
Fluctuating	21.7	25.5	16.7	38.5	21.9	60.0	38.9
Total	100	100	100	100	100	100	100

very close to Nzega town which has large opportunity for making different small scale business.

Upungu village has large opportunity to invest in agriculture due to well developed vegetation cover including miombo woodlands and fertile soils which attracts agricultural activities to take place. The findings are not surprising because other studies have also indicated that in order to cope and adapt to climate change impacts, some community members have tended to move to suitable areas (Kangalawe et al., 2005).

Major economic activities and their relevance to adaption

The major socio-economic activities include agriculture and livestock keeping and small business activities. Major food crops produced are: maize, rice, groundnuts, bambaranuts, sweet potatoes, cassava, sorghum and vegetables (onions, tomatoes and spinach). Most of these crops and vegetable grown are local and were reported to be vulnerable to climate change impacts. Cash crops being produced are sunflower, tobacco, and cotton. Livestock kept include cattle, goats, sheep, pigs, chicken, ducks and donkeys as draught animals.

Non farm activities in the village include charcoal production, carpentry, bicycle repair, food vending, production of local brew and other small scale businesses such as running shops, selling of crops, provision of transport services (by use of motorcycles and bicycles), entertainment (by offering TV shows) and casual labor (Tables 4 and 5).

Vulnerability of common crops to climate change

Household interviews in Upungu village results showed that farmers have been experiencing fluctuating productivity of crops and mostly a declining trend in crop production (Table 6). Community's perceptions on productivity of different crops over the years are that this state of affairs has been caused by climate change and variability which lead to the breakup of pests and diseases attacking different crops.

Table 7. Perceptions on the productivity of different crops over years in Mbogwe village.

Production pattern	Different crop types						
	Maize	Sorghum	Rice	Sweetpotato	Groundnuts	Sunflower	Cassava
Increasing	10.4	40.0	00.0	04.8	00.0	25.0	00.0
Decreasing	79.2	38.0	80.8	66.7	75.0	50.0	83.3
Fluctuating	10.4	22.0	19.2	28.6	25.0	25.0	16.7
Total	100	100	100	100	100	100	100

Table 8. Impacts of crop pests on yields of different crops (kg/acre) Upungu village.

Type of crop	Average yield before pests*	Average yield with pests**	Loss incurred	% Loss
Maize	1131	435	696	62
Rice	2033	683	1350	66
Cassava	1525	725	800	52
Cotton	n/a	n/a	n/a	n/a
Groundnuts	1356	488	869	64
Sweet potato	1325	500	825	62

Source: Field data (2011).

Table 9. Impacts of crop pests on yields of different crops (kg/acre) Mbogwe village.

Type of crop	Average yield without pests	Average yield after pests	Loss incurred	% Loss
Maize	809	436	373	46
Rice	2336	647	1689	72
Cassava	480	155	325	68
Cotton	479	97	382	80
Groundnuts	763	313	450	59
Sweet potato	675	258	418	62

The findings for Mbogwe village are quite similar to those for Upungu village (Table 7). The analysis based on 100% of the house hold interviewed in this case showed that most vulnerable crops are maize and rice which require moisture availabitiy during their growth circle. Less vulnerable crops include sorghum and sunflower.

Impacts of pest on major crops

Climate change and variability have been reported to affect different cash and food crops in Tanzania (Lema and Majule, 2009). Studies conducted by Majule et al. (2009) in semi arid areas showed that major loss in crop production is associated to prolonged drought, attack by pests and diseases and also damage caused by flood. Household interviews in this study also revealed that recently increase pests and crop diseases has contributed significantly to a decrease in crop productivity in Nzega district. Table 8 presents rough estimates of crop loss in kg/acre and also the % loss due to crop pests for different crops. The impact of pest is assessed and discussed; it was easy to remember and mention a particular pest as compared to diseases.

In general (Table 9) but with an exception of maize yields in Mbogwe village, pest incidences result in a loss of more than half of the yields (i.e above 50%). Highest loss is on rice probably due to drought indicating increasing dry spells in both villages (see Mongi et al., 2010). Cotton crop is very sensitive to pest and thus a high loss in Mbogwe village.

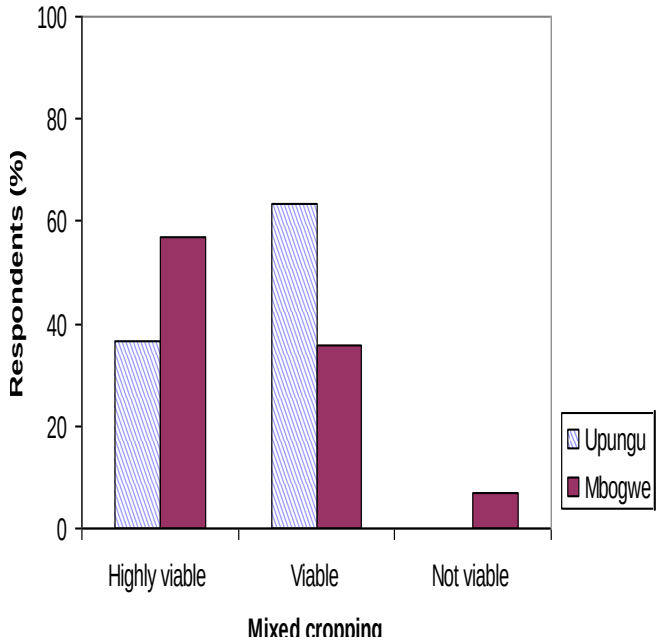

Figure 2. Viability of mixed cropping.

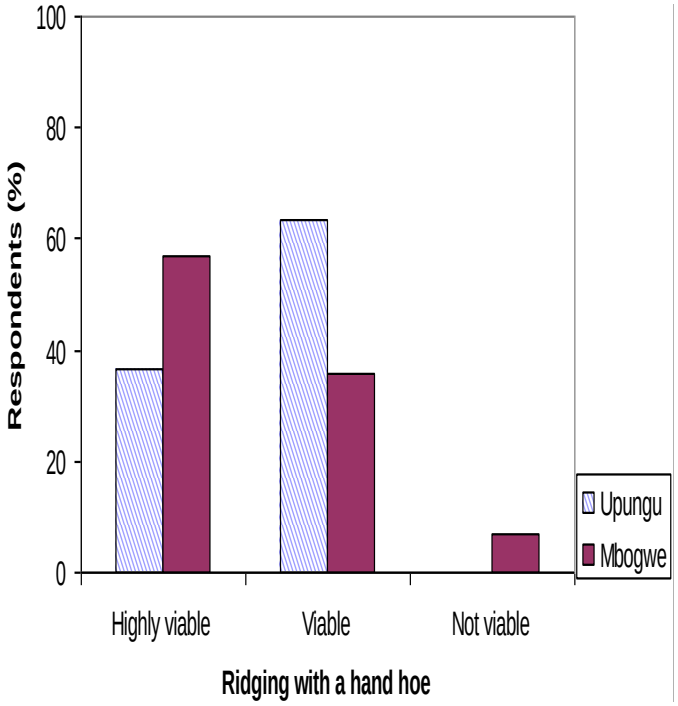

Figure 3. Viability of ridging.

Climate change adaptation and sustainability of strategies

Mixed cropping

Mixed cropping involves growing different types of crops on the same piece of land either on the same plot or different plots yet on the same piece of land. This is done in order to evade the risk loss of all crops to harsh climate change and variability impacts. The results from interviews conducted in Upungu and Mbogwe villages were that over 38 and 58% of respondents respectively said that mixed cropping was highly viable as an adaptation strategy in cases of climate change and variability impacts.

About 62 and 38% of respondents of the same villages respectively said that mixed cropping was a viable strategy for adaptation to climate change and variability impacts and 10% of respondents from Mbogwe village had the opinion that mixed cropping was not a viable strategy for adaptation to climate change impacts as indicated in Figure 2.

Ridging with a hand hoe

Ridging with a hand hoe is done by using cheap farming implements. Moreover ridges have a higher water retention capacity than flat cultivation which is ideal for areas with low rainfall records. During the interview, 38 and 59% of Upungu and Mbogwe villages respectively feel that ridging with a hand hoe is highly viable strategy for adaptation to climate change impacts as indicated in Figure 3 by over 61 and 38% of respondents in Mbogwe and Upungu villages respectively.

Small scale irrigation

Irrigation farming provides an opportunity for growing crops all-year round even when there is a drought or failure of the rains. About 50 and 59% of Upungu and Mbogwe village residents respectively pointed out that small scale irrigation is a highly viable strategy for adaptation to climate change and variability impacts, while about 40 and 18% of Upungu and Mbogwe residents respectively were of the opinion that small scale irrigation was a viable strategy for adaptation to climate change and variability impacts. However, 10 and 30% of Upungu and Mbogwe residents said that small scale irrigation was not a viable strategy for adaptation to climate change and variability impacts.

Crop rotation

Crop rotation which involves change of crops planted on same piece of land for in successive years can serve as

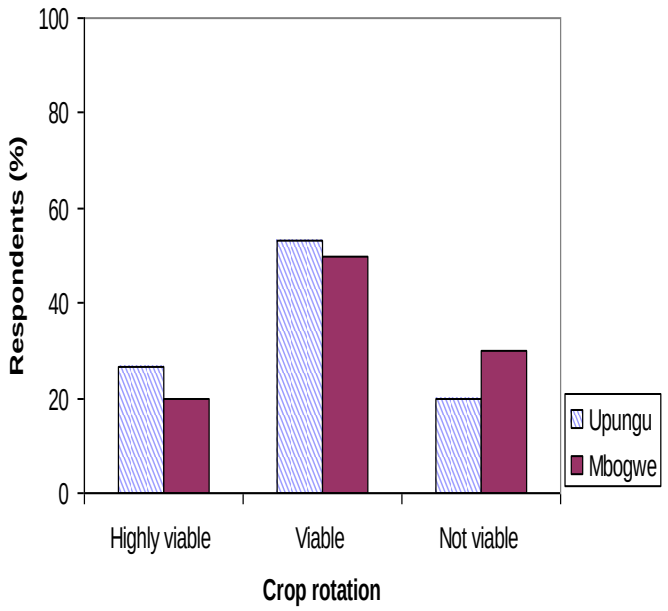

Figure 4. Viability of crop rotation

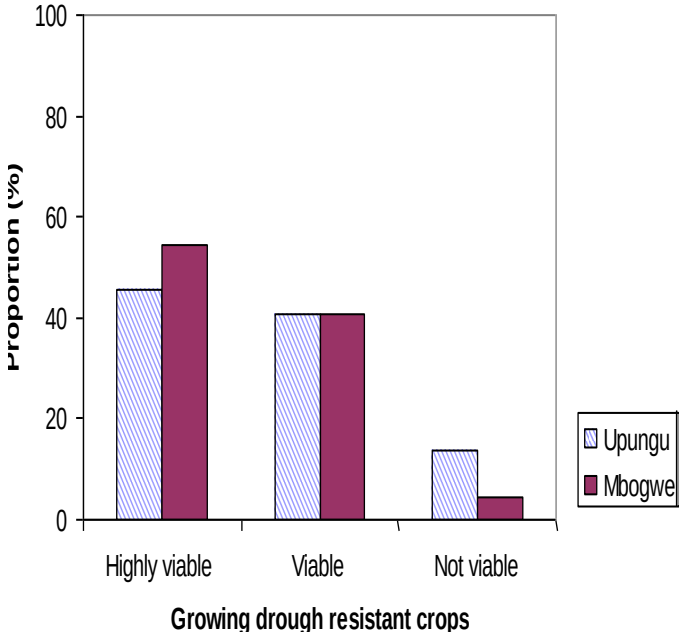

Figure 5. Viability drought resistant crops

a strategy for adaptation to climate change and variability impacts. About 23 and 20% of communities in Upungu and Mbogwe village respectively see crop rotation as a highly viable strategy for adaptation to climate change and variability impacts, while 55 and 50% see crop rotation as a viable strategy for adaptation to climate change and variability impacts as shown in Figure 4. At the same time, 19 and 30% of residents of the same village respectively do not regard crop rotation as a viable strategy to climate change and variability impacts. Crop rotation has also been reported to be a potential cropping practice in semi humid areas of southern highland Tanzania and other parts of east Africa (Majule and Mwalyosi, 2005; Maitima et al., 2009).

Adoption of drought resistant crops

This is also among potential adaptation option and farmers in those areas needs to grow drought resistant crops. The findings show that 43 and about 54% of Upungu and Mbogwe respondents respectively regard growing drought resistant crops as a highly viable strategy for adaptation to climate change and variability, while about 41% of respondents from each of Upungu and Mbogwe villages regard growing drought resistant crops as just a viable strategy for adaptation to climate change and variability (Figure 5). About 10 and 4% of Upungyu and Mbogwe village's residents respectively said growing drought resistant crops is not a viable strategy for adaptation to climate change and variability impacts.

Early planting and early maturing crops

The majority of respondents (more than 50%) were of the opinion that early planting is a higly viable strategy for enhancing adapatition of small farmers in study villages and this was further supported by approximately 40% of respondents who sees that practice to be viable (Figure 6). This suggests intervention with regard to early planting to be in place in collaboration with the meteorological deparment in Tanzania to inform communities on onset of rain. Figure 7 also clearly shows that planting early maturing crops or plants is a vaiable solution to farmers to escape a dry spell as reported by Mongi et al. (2010) in the region.

Dependence on wild food and non wood forest products

During years of serious food shortage or famine, people do not have a wide range of types of food to eat. Anything that is not poisonous but can sustain their lives will be consumed or eaten. During the interviews, about 21 and 10% of Upungu and Mbogwe residents respectively said that eating wild food is a viable strategy for adaptation to climate change and variability impacts (Figure 8). The same figure also shows that 62 and 43%

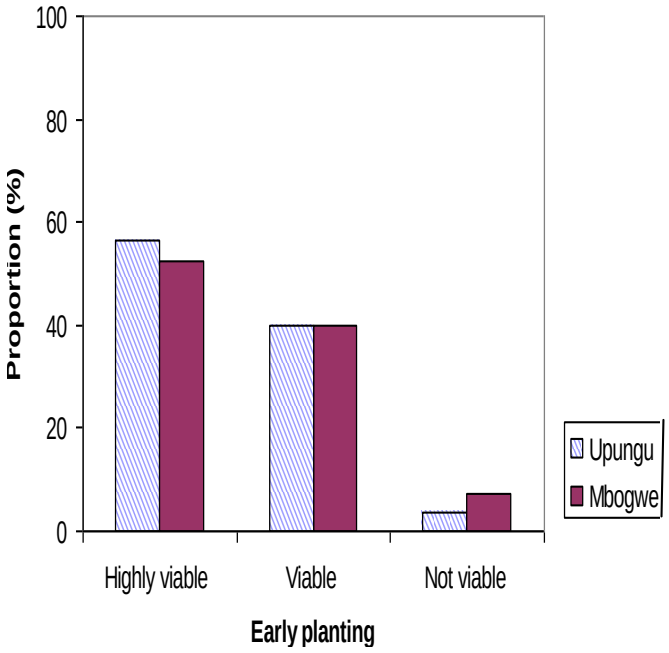

Figure 6. Viability of early planting.

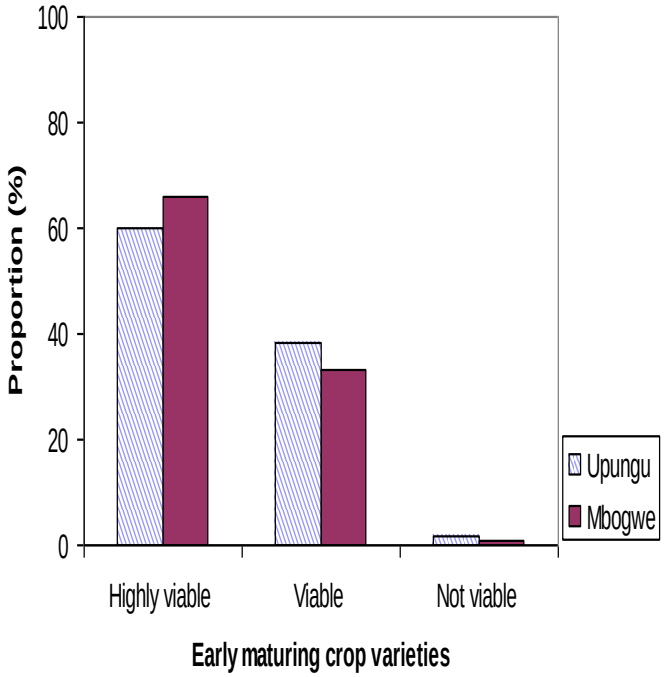

Figure 7. Early maturing crops

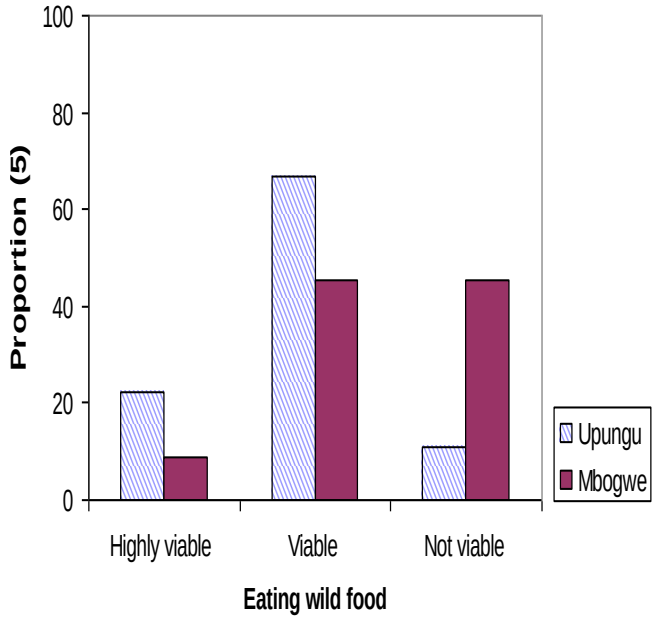

Figure 8. Viability of eating wild food.

of the respondents from Upungu and Mbogwe respectively were of the opinion that eating wild food is just a viable strategy for adaptation to climate change and variability impacts. More over 10 and 43% of Upungu and Mbogwe residents respectively said eating wild food is not a viable strategy for adaptation to climate change and variability.

Forests are major sources of timber and non-timber products. Non-timber products include edible fruits, tubers, mushrooms, etc which can be eaten during serious food shortage periods (Majule et al., 2009). Forests provide raw materials, maintain biodiversity, protect land water resources and play a role in climate change mitigation.

Use of forest products was investigated in both Upungu and Mbogwe villages with reference to viability as a strategy for adaptation to climate change and variability. Findings have shown that 8 and 80% of village residents in Upungu and Mbogwe respectively (Figure 9) said that use of forest products is a highly viable strategy for adaptation to climate change and variability impact, while about 50 and 20% of residents respectively of the same villages said that use of forest products is a viable strategy for adaptation to climate change and variability impacts.

Climate change adaptation linkages

Rural-Urban, Urban-Rural and Rural-Rural linkages observed in Upungu village involve an intricate interactions of social, economic, and political nature.

Rural-urban linkage

The movement of people from the rural areas to surround-

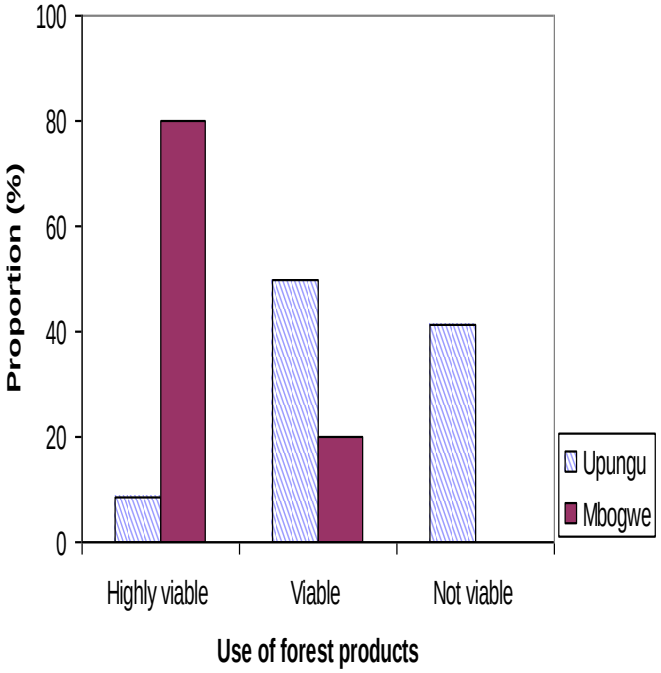

Figure 9. Use wild forest products.

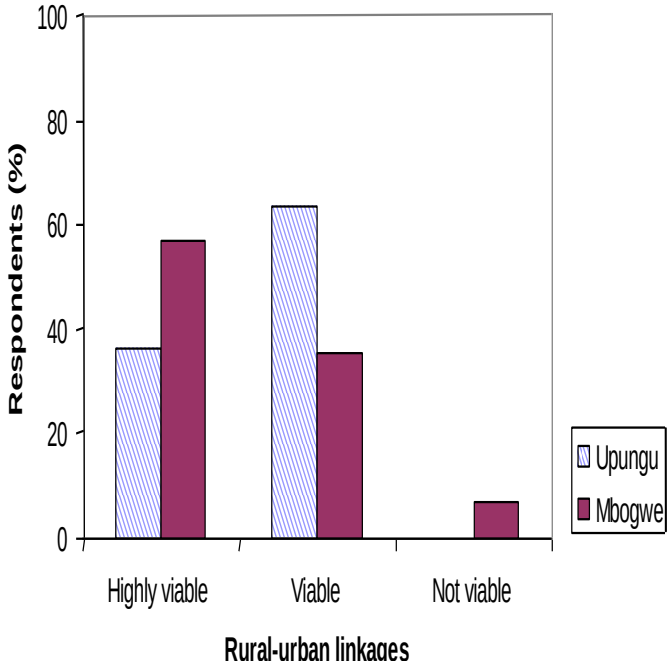

Figure 10. Viability of rural-urban linkage on adaptation.

ing town in search of employment and social services as well as social amenities can serve as a strategy for adaptation to climate change and variability impacts. Rural-urban linkages are regarded as a strategy for adaptation to climate change and variability.

About 39 and 68% of Upungu and Mbogwe village residents respectively concur that rural-urban linkages are highly viable as an adaptation strategy to climate change and variability impacts, while about 62 and 48% of residents respectively from the same village regard rural-urban linkages to be viable as adaptation strategies for climate change and variability impacts. From Mbogwe villages, less than 5% does not regard rural-urban linkages as adaptation strategies for climate change and variability impacts.

The rural-urban linkages involves: people moving from the rural areas to surrounding town in search of employment and social services as well as social amenities especially the youth; i) taking agricultural and livestock products (food and cash crops, chickens, goats, etc) and forest products (charcoal and firewood) to town for sale and ii) purchasing their requirements which are not available in their rural areas; conducting banking activities.

This study has established that such linkage provides an opportunity for strengthening involved parties or communities to adapt to impacts associated with climate change. Figure 10 presents responses from communities on the viability of such linkage on adaptation.

The movement of people from the rural areas to surrounding town in search of employment and social services as well as social amenities can serve as a strategy for adaptation to climate change and variability impacts. Rural-urban linkages are regarded as a strategy for adaptation to climate change and variability.

About 39 and 68% of Upungu and Mbogwe village residents respectively concur that rural urban linkages are highly viable as an adaptation strategy to Climate change and variability impacts, while about 62 and 48% of residents respectively from the same village regard rural-urban linkages as adaptation strategies for climate change and variability impacts. From Mbogwe villages, less than 5% does not regard rural-urban linkages as adaptation strategies for climate change and variability impacts.

Nearly 60% of respondents in Mbogwe village indicated that such linkage is highly viable and this was due to; i) selling of different products to nearby Nzega town; ii) transport to people to and from Nzega town as well as; iii) selling of different products from the village and also buying different products from urban area. On the other hand, in Upungu village such s linkage was also considered to be viable with more than 60% of respondents indicating so.

The urban-rural linkages

Based on FGD, the Urban-Rural linkages involve selling to rural communities industrial products which in the ma-

jority of cases are produced in towns such as agricultural inputs (inorganic fertilisers, pesticides, insecticides and implements), clothes, domestic utensils and drugs, etc); purchasing of products produced in the rural areas; offering social services (education, health services, extension services, etc) to rural communities; transmission of information (newspapers, radio and Televisions); financial remittance to relatives living in the rural areas and payments of salaries to workers in the rural areas.

The rural-rural linkages

Following discussions with key informants and FGD, the Rural - Rural linkages involve people moving from one place to another in search of pasture for their livestock; search of arable land for cultivation of crops; moving from densely settled area to sparsely populated areas; joining relatives living in other rural areas, marriages, etc.

There is great influx of particularly youth from rural areas to urban areas seeking for employments, casual labour and selling their rural produced products to urban markets. This movement is mainly seasonal. However, there are people moving into the community mainly for visiting relatives, establishing new economic activities, purchasing of agricultural and forest products. This movement is mainly seasonal and done mostly by business people (of different age groups). Percentage wise, nearly 5% of the population are those who are moving in and approximately 10% moving out of the village community.

Conclusions

Climate change and associated impacts is among factors controlling migration of people as they try to adapt. Impact of climate change are real and negatively affects crop yields in various magnitude rice and maize being the most vulnerable crops to drought and increased crop pests. Crops like sorghum and sunflower are less vulnerable in the area. A number of adaptation strategies does exists but are still weak.

Different linkages that exists tend to support adaptation in terms of information and products flows from urban-rural-urban or rural-rural. We recommend best adaptation practices such as growing more drought, pest and disease crop types and varieties to be grown in the area be promoted using innovation approaches in the area through existing District Agricultural Development Plans (DADPS) set up in the country.

Rural-urban, urban-rural and rural-rural linkages needs to be strengthen in the study area in order to ensure that information and products flow from and to both ends on time.

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REFERENCES

Adger WN, Arnell NW, Tompkins E L (2005). Successful adaptation to climate change across scales. Glob. Environ. Change 15:77-86.

De Pauw (1984). Soils, physiography and agro ecological zones of Tanzania. A Final Consultant Report submitted to the Ministry of Agriculture and Cooperative, United Republic of Tanzania.

Frankenberger TR (2000). A brief overview of sustainable livelihoods approaches, in: Proceeding from the Forum on Operationalizing Sustainable Livelihoods Approaches. Pontignano (Siena) 7-11 March 2000.http://www.fao.org/docrep/003/X9371e/x9371e22.htm#P0_0

Gwambene B (2007). Climate Change and Variability Adaptation Strategies and its Implication on Land Resources in Rungwe District, Tanzania. MSc. Dissertation, Dar es Salaam University Press

Hulme M (2001). Climatic Perspectives on Sahelian Desiccation: 1973-1998. Glob. Environ. Change 11:19-29.

IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for Policymakers. IPCC AR4.

Kaijage HR (2012) Impact of Climate Change on Groundwater Dynamics in Nzega District, Tanzania: Triangulation of Indigenous Knowledge and Empirical Method Scenario Analytical Approach. M.Sc Dissertation, University of Dar es Salaam, Dar es Salaam, Tanzania.

Kalinga-Chirwa R, Ngongondo C, Kalanda-Joshua M, Kazembe L, Pemba D, Kululanga E (2011). Linking rainfall and irrigation to clinically reported malaria cases in some villages in Chikhwawa District, Malawi. J. Phys. Chem. Earth 36(14–15):887–894.

Kangalawe RM, Majule AE, Shishira EK (2005). An Analysis of Land Use Dynamics and Land Degradation Process In the Great Rift Valley, Central Tanzania: A Case of Iramba District. Book Published by OSSREA. ISBN 1 904855 628

Lema MA, Majule AE (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi arid areas of Tanzania: The case of Manyoni District in Singida Region, Tanzania. Afr. J. Environ. Sci. Technol. 3 8):206-218.

Liwenga ET (2003). Food Insecurity and Coping Strategies in Semiarid Areas: The Case of Mvumi in Central Tanzania. Dissertation No. 11. Stockholm Studies in Human Geography, Department of Human Geography, Stockholm University.

Maitima JM, Mugatha SM, Reid RS, Gachimbi LN, Majule AE, Lyaruu H, Pomeroy D, Muthai S, Mugisha S (2009). The linkages between land use change, land degradation and biodiversity across East Africa. Afr. J. Environ Sci. Technol. 3(10):310-325.

Majule AE, Liwenga ET, Kangalawe RM, Yanda PZ (2009). Natural Resource Contribution to Community Livelihoods. Experience from Selected case Studies in Tanzania. Dar es Salaam University Press LTD. ISBN: 978-9976-60-486-6.

Majule AE, Mwalyosi RBB (2005). Enhancing Agricultural Productivity through Sustainable Irrigation. A case of Vinyungu Farming System in selected Zones of Southern Highland, Tanzania. A chapter in a Book Social and Environmental Impacts of Irrigation farming in Tanzania: Selected Cases: Edited by H.Sosovele, J. Boesen and F. Maganga. Dar es Salaam University Press. ISBN 9976 60 431 9.

McCarthy JJ, Canziani OF, Leary NA, Dokken DJ, White KS (2001).

Climate Change 2001: Impacts, Adaptaion and Vulnerabilty. Cambrige University, Uk.
Mongi H, Majule AE, Lyimo JG (2010). Vulnerability Assessment of Rainfed Agriculture to Climate Change and Variability in Semi-arid Tanzania. Tanzania. Afr. J. Environ. Sci. Technol. 4(6):371-381.
Muzo N (2012). Climate Change and its Impacts on Agricultural Land use Practices in Selected Viilages of Nzega District, Tanzania. MSc. Dissertation. MSc. Dissertation, Dar es Salaam University Press.
Nelson V, Stathers T (2009) Resilience, Power, Culture and Climate and New Research Directions: A case Study from Semi-Arid Tanzania. Gend. Dev. J. 17(4):81-94.
Paavola J, Adger TW (2005). Analysis of Fair Adaptation to Climate Change. Ecol. Econ. 56 (2006): 594-609.
Watson RT, Zinyowera MC, Moss RH (Eds.). (1996). *Climate Change 1995.* Impacts, Adaptations and Mitigation of Climate Change: Scientific-technical Analyses. Contribution of Working Group ll to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. pp. 879.
World Bank (2005). Global Monitoring Report available at http://siteresources.worldbank.org/GLOBALMONITORINGEXT/Resources/complete.pdf.