Perceptions on resilience to climate change variability among farmers in Meatu and Iramba districts, Tanzania

James A. Nyangas[1], Emanuel E. Chingonikaya[2], Justin K. Urassa[3] and Jonathan S. Mbwambo[4]

[1]Department of Education, Sokoine University of Agriculture (SUA), Tanzania
[2]Department of Development Studies, Sokoine University of Agriculture (SUA), Tanzania
[3]Department of Policy Planning and Management, Sokoine University of Agriculture (SUA), Tanzania
[4]Ministry of Education, Science and Technology, Tanzania

Abstract: Though knowledge on climate change has increased over time, previous studies showed that knowledge on farmers' perception on resilience to climate change and its variability was lacking. This study examined farmers' perceptions on resilience to climate change and its variability in Meatu and Iramba districts, Tanzania. A cross-sectional research design was used whereby, information was collected from 183 randomly selected households using a questionnaire. In addition, key informant interviews and focus group discussions were used to collect data. Statistical Package for Social Sciences (SPSS) was used to analyse quantitative data. In addition qualitative data were analyzed by using content analysis. Over 73% of household heads perceived to be highly resilient. Among the socio-economic factors for perceived household resilience, household head's income levels (χ^2=30.16; df=6; p=0.000), marital status (χ^2=27.78; df=2; p=0.000) and land ownership (p=0.000) were statistically significant. Based on the results it can be concluded that most important socio-economic factors of perceived household resilience were, income levels, marital status and land ownership of the household heads. This study therefore, recommended that there is need for provision of training which would enable household members to engage on various non-farm economic activities, provision of access to agricultural extension to the households.

Key Words – *Climate change variability, Farmers, Iramba, Meatu, Perception, Resilience*

I.   INTRODUCTION

1.1   Background

The concept of resilience has multi dimensional approaches which are underpinned in psychology and well-being (Buikstra *et al.,* 2010), socio - ecological systems (Gunderson and Holling, 2002) and disaster management (Norris *et al.,* 2008). In the socio-ecological systems (SES) theory of resilience, ecological and social systems are inextricably linked and that their long term health is dependent upon change, including periods of growth, collapse and reorganization (Walker *et al.,* 2006). SES theory also allows resilience by adaptation in which unsustainable or socially unjust practices tend to persist (Jarneck and Olsson, 2008). Essentially, resilience is built on what is known to be how individuals and communities who are faced with risks manage their resources and livelihoods (Adger *et al.,* 2009). Resilience is also about potential for flexibility to reduce vulnerability and allow specific functions to persist (Pelling, 2011). Cutter *et al.,* (2008) identify studies attributing resilience and related metrics to ecological systems (biodiversity), social systems (social networks), economic systems (wealth generation), institutional systems (participation), infrastructure systems (design standards) and community competence (risk perception).

Perception on resilience to climate change variability is key in determining how households persist the shocks of climate change variability and continue to function (Ellis, 1993). Understanding perceptions on resilience to climate change is fundamental to both climate science and policy issues because it defines the local and global socio-political contexts within which policy makers and scientists operate (Crona *et al.,* 2013).The study of perception on resilience to climate change variability helps to lead to a better understanding of local perceptions which reflect real world and tangible concerns (Crate and Nuttall, 2009). Generally, perception of resilience to climate change variability by farmers and households can either extremely risk aversive, or in other cases, highly optimised in dealing with high climate variability and other risks (Francis, 2000). In addition, people's perception on resilience to climate change can show how good they are as natural observers of their

local environment thus appreciation for their knowledge which is interwoven in their cultural and ecological contexts, and how the same can provide important models and unique understanding of resilience to climate change and variability (Salick *et al.,* 2009). Climate change variability is one of the main challenges humankind will have to face for many years to come (Mendelssohn *et al.,* 2003). The impacts of climate change vary in spatial difference, as soil types, topography and other factors vary across the regions (ODI, 2009). Globally, climate change is projected to increase the frequency and severity of extreme weather events such droughts and floods (Oxfam, 2006). The African continent has been highlighted as particularly vulnerable to climate change (IPCC, 2007). Studies conducted in Tanzania, have indicated that climate change variability is happening drastically with significant impacts on agriculture which is the main source of livelihood in rural areas (Agrawal *et al.,* 2003). In Tanzania climate change variability poses a serious risk to not only poverty reduction efforts but it also threatens to undo the development achievements registered over the decades (URT, 2007). Also, it was noted that over the last two to three decades climate change and variability have become overriding development challenges, especially in the western and central semi-arid areas of Tanzania (Kangalawe and Lyimo, 2013). Climate change and variability directly affect the agricultural production, as agriculture is inherently sensitive to climatic conditions and is one of the most vulnerable sectors to the risks and impact of global climate change (Parry *et al.,* 1999). Farmers have always lived in changing environments where uncertainty and disturbances are inevitable. In agriculture, farming households face dynamics and disturbances in their farms, induced by climatic shocks (Milestad and Darnhofer, 2003). As climate continues to change, households are under increased stress and shocks due to the impact of the climate change variability on farm sustainability (Folke *et al.,* 2003). When faced with climatic risks, households prioritize elements of production, consumption, and ecological systems in which they are. Also, when faced with the prospect of difficult climatic conditions for agriculture, farmers have the option to either mitigate or exit farming production.

Norgaard (2009) noted that even though knowledge on climate change has increased overtime, existing literature indicates that the public lacks information and knowledge on resilience to climate change variability, and this lack of information and knowledge is a barrier to social action and sustainability. In adherence to this, ESRF and FANRPAN (2010) initiated national dialogue series on building climate change resilience in Africa's agricultural research programmes. Successful resilience requires information and understanding of future change, knowledge around adaptation options, the ability to assess them, and the capacity to implement the most suitable interventions (ACCRA, 2010). Shayo (2006) has shown that some societies, including semi arid areas of Tanzania are already coping with the effects of climate change variability in agriculture. Iramba and Meatu districts are among rural districts in semi arid areas of Tanzania, dominated by smallholder farmers and agro-pastoralist (Otysina and Asenga, 1993).

However, recent studies have shown that due to climate change variability, farmers in Iramba and Meatu districts have frequently experienced crop failure and provision of food aid by the government for the people to overcome hunger (Kabote *et al.,* 2013). This suggests that farmers in Iramba and Meatu Districts are still susceptible to climate change variability. Holling (1973) asserted that due to the dynamic nature of climate change variability not all climatic threats or disasters can be averted. In order to sustain the agricultural production and livelihood farmers need the ability to cope with, adapt to and shape change (Folke et al., 2003). Farmers also need resilience to climate change variability to be able to maintain their farms and livelihoods (Kummer *et al.,* 2012). Therefore, the general objective of this study was to examine farmers' perception on resilience to climate change variability in Iramba and Meatu Districts. Specifically, the study was intended to examine farmers' perception on resilience to climate change variability; to determine proportions of household resilience; and to determine indicators of resilience among farmers in Iramba and Meatu Districts.

1.2   Theoretical Framework

Theoretically, the study was guided by sustainable livelihood framework (SLF) as in Fig 1. The SLF defines five key categories (human, natural, financial, social and physical) that can effectively encompass the indicators of resilience (DFID, 2000). The framework depicts stakeholders as operating in a context of vulnerability, within which they have access to certain assets. Assets gain weight and value through the prevailing social, institutional and organizational environment (policies, institutions and processes). This context decisively shapes the livelihood strategies that are open to people in pursuit of their self-defined beneficial livelihood outcomes (Kollmair *et al*., 2002).The following are the elements of Sustainable Livelihoods Framework:

First, the vulnerability context frames the external environment in which people exist. Critical trends as well as shocks and seasonality, over which people have limited or no control, have a great influence on people's livelihoods and on the wider availability of assets (DFID, 2000).

Second, there are the livelihood assets. SLF identifies five types of livelihood assets or capitals upon which livelihoods are built, namely human capital, social capital, natural capital, physical capital and financial capital.

Thirdly, there are policies, institutions and processes. The importance of policies, institutions and processes cannot be overemphasized in the SLF, because they operate at all levels, from the household to the international arena, and in all spheres, from the most private to the most public. They effectively determine access (to various types of capital, to livelihood strategies and to decision-making bodies and source of influence), terms of exchange between different types of capitals, and returns to any given livelihood strategy (DFID, 2000).

Fourth, livelihood strategies comprise the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals. Different members of a household might live and work at different places, temporarily or permanent. Livelihood strategies are directly dependent on asset status, policies, institutions and processes. Hence, poor people compete and that the livelihood strategy of one household might have an impact (positive or negative) on the livelihood strategy of another household (DFID, 2000). Fifth, livelihood outcomes are the achievements or outputs of livelihood strategies, such as more income, increased well-being, reduce vulnerability, improved food security and a more sustainable use of natural resources (DFID, 2000).
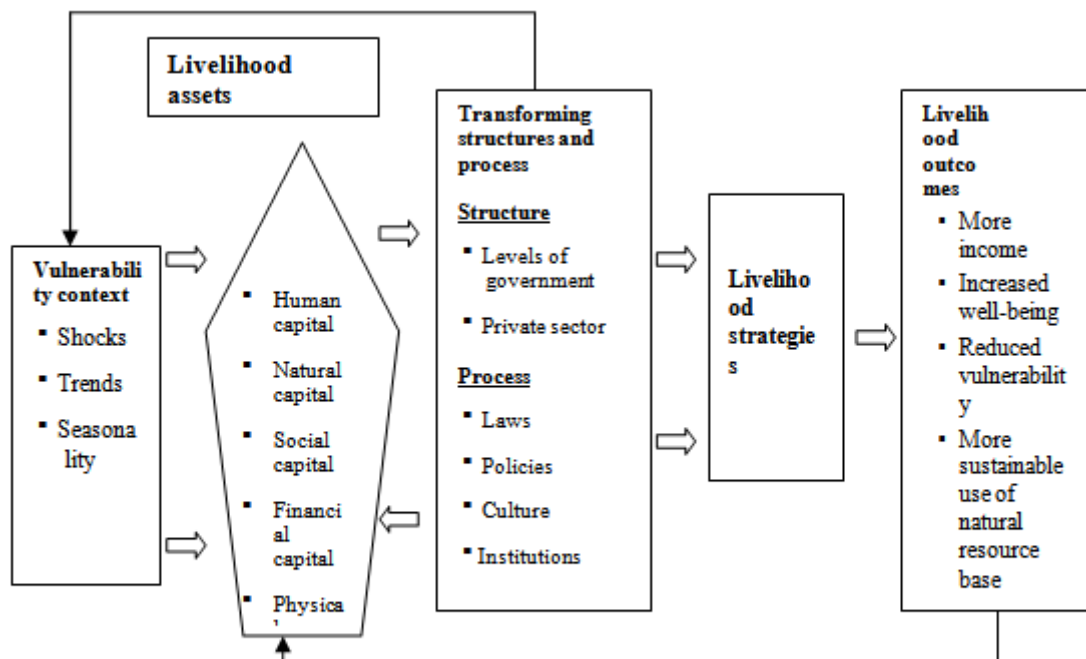

Figure 1:   Sustainable livelihood framework (DFID, 2000)

1.3   Conceptual Framework

There are numerous conceptual models, frameworks, and assessment techniques that have been developed to understand vulnerability and resilience both theoretically and from point of application (Cutter, *et al.*, 2008). According to IPCC (2007), vulnerability can be explained by exposure, sensitivity and adaptive capacity. Exposure to climate change is change in temperature and rainfall pattern in the area over the years and also occurrence of natural hazards. With increase in exposure, i.e., increase in the change in temperature and rainfall and also increase in the occurrence of natural hazards the people will be more vulnerable to climate change, especially farmers as their livelihood depends on it. Sensitivity increases the effect of exposure on the people and will have more negative impact on them. Sensitivity will include the factors like casualties and damaged caused by the natural hazards as well as human and environmental factors that makes them more susceptible to the natural hazards and climate variability. The combined effect of exposure and sensitivity will increase the vulnerability while adaptive capacity will decrease it. Ford *et al.,* (2006) suggest while defining adaptive capacity based on resource and risk management decision is influenced by human system like social, economic, experience and so on. Adaptive capacity includes the factors like buffering capacity, self-organization and capacity of learning and adaptation which will improve their capacity of adaptation. The

buffering capacity includes the variables like demography, wealth, infrastructure, and livelihood options, while self-organization will include institute and information. The capacity of learning means the management and openness for learning which will be given by their perception to climate change. The conceptual framework is indicated in Fig 2.
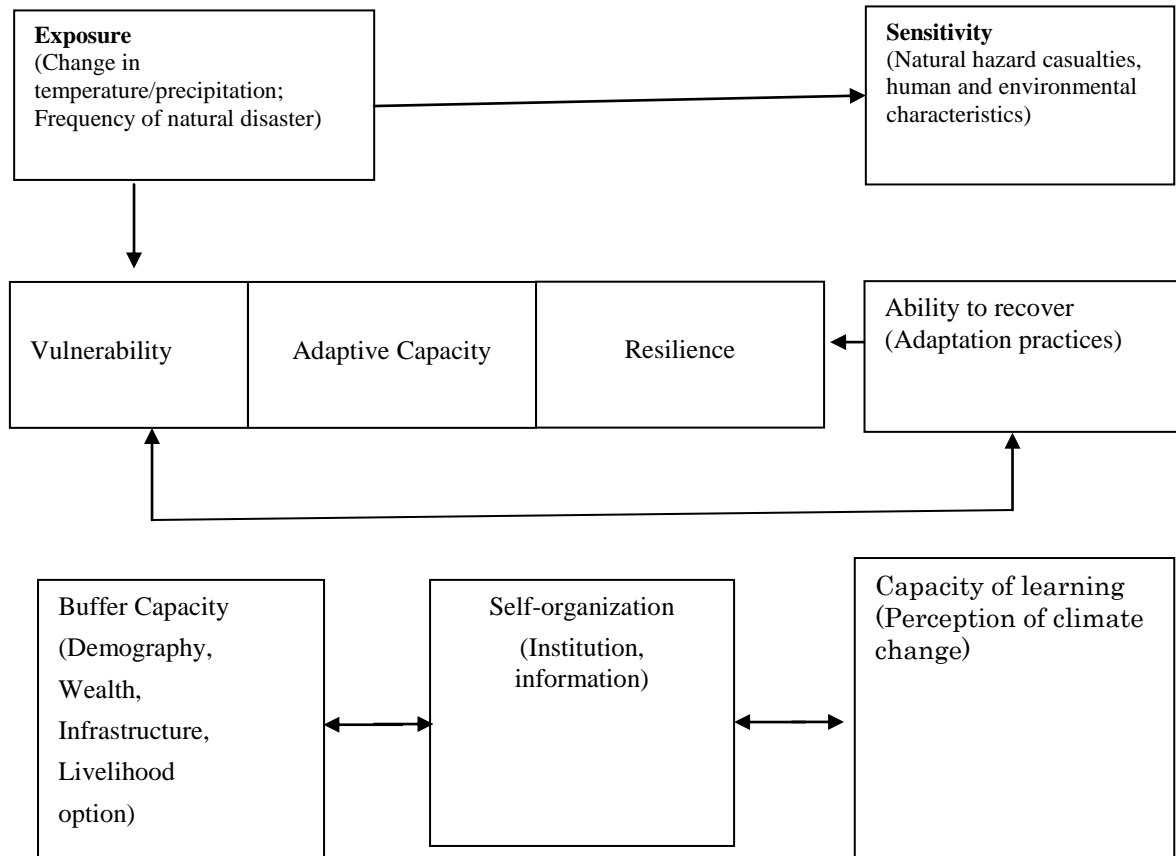
Figure 2: Conceptual framework for households' resilience to climate change   (Adopted from Lal, 2014)

II.   METHODOLOGY

2.1   Description of the study area
        The study was conducted in Iramba and Meatu Districts in Tanzania. Study areas were selected based on their significant levels of climate change variability, which allowed the examinations of farmers' resilience to climate change. The population of Iramba was 405 132 while that of Meatu was 405 177 (NBS, 2012). Meatu District is found in Simiyu Region. The district covers 8 871 Sq. km (URT, 1996) and the altitude of between 1 000 and 1 500 m above sea level, with detached hills and grassy savannah woodlands. Iramba is one of the districts in Singida Region. The climate of Iramba and Meatu is semi arid with seven to eight months of dry season, lasting from late April to early November. The mean annual rainfall ranges from 600mm to 800mm and the rainfall is erratic and unreliable in terms of both amount and timing (URT, 2005). Iramba has a highly erratic, unpredictable rainfall between October and May, with two minor seasonal peaks in December and March to April (Otysina and Asenga, 1993). Precipitation, which occurs in brief storms, is lost through quick surface runoff and high evapo-transpiration rates. Dry-season precipitation extends between May and November with less than 50mm per year, whereas, monthly evaporation rate exceeds the monthly rainfall almost every month (Ministry of Tourism, Natural Resources and Environment, 1995). The temperatures in the districts range from about $15^{o}C$ in July to $30\ ^{o}C$ during October. Temperatures vary according to altitude. Furthermore temperature difference between day and night may be vary with high hot afternoons going up to $35\ ^{o}C$ and chilly

nights down to 10 ^{o}C.The districts are characterized by two superficial geological deposits. These are the alluvium, comprising sandy, soil and clay. The second despots are cainozoic consisting of cemented sand, literate and sandstone. Additional the Iramba District is characterized of bush or thicket and bushland vegetation (URT, 2005). While, Meatu District is mostly shrubs and thorny trees scattered or clustered in some areas revealing a characteristic of a semi-arid zone. Most parts in the southern zone of the district have bare soils especially during dry seasons compared to the northern zone. There are a number of seasonal rivers in the district. River Simiyu, is the biggest river that used to flow throughout the year, but is now drying up.

Food crops grown in the districts include maize, sorghum, paddy, sweet potatoes, cassava, pulses and groundnuts. However, in Meatu, a majority of the district's population grew cotton, which was the main cash crop. The livestock that were raised by farmers include cattle, goats, local chicken, donkeys and sheep (URT, 2005).

2.2 Research design

A cross-sectional research design was adopted in the study on which the manuscript is based. This design allows data to be collected at a single point in time (Levin, 2006). The design can also be used in descriptive studies and in determination of relationships between variables (Varkevisser *et al.,* 2003). The design was considered favourable to the nature of this study as despite the weakness of being static/snapshot, a cross sectional design can still be used for climate change adaptation and resilience studies (Allinovi, 2008).

2.3 Sampling procedure and sample size

Multistage sampling was adopted for this study. First, purposive sampling was used to select the regions, districts, wards and villages due to occurrence of extreme weather events due to climate change, such as floods and droughts. Second, it involved random sampling to obtain the household heads among the households. The sampling frame for this study involved the list of all households participating in agricultural production in the selected villages in Iramba and Meatu Districts. The sample was drawn from three villages, namely Kidaru, Mwashata and Mwamanimba (Appendix 1). One village was chosen from Iramba District and two villages from Meatu District. A total of 183 households were randomly drawn from the population from the three villages to form the sample size. Bailey (1994) and Saunders *et al.,* (2007) suggests that a sub sample of 30 household heads is a bare minimum for studies which statistical data analysis is to be done regardless of population. See sample allocation is in Table 1.

Table 1: Sample Allocation

Name of selected district	Name of selected village	Number of households	Sampled households (15%)
Iramba	Kidaru	444	67
Meatu	Mwashata	462	69
	Mwamanimba	315	47
Total		**1221**	**183**

2.4 Data types and sources

Both, primary and secondary data were collected for this study. The primary data were obtained through surveys, while secondary data such as number of households were obtained from population census.

2.5 Data collection methods and instruments

This study employed both, qualitative and quantitative methods to collect data on the farmers' perception on resilience to climate change variability. A structured questionnaire was used to obtain quantitative data, whereby face to face interviews with household heads were conducted. The questionnaire comprised of general questions about the household heads and their household characteristics. It also explored household heads' perceptions on resilience to climate change variability and rating respondent's levels of agreement about the concept of resilience using a Likert scale. The Likert statements reflected the general perception of farmers in Iramba and Meatu Districts about resilience to climate change variability, whereby the household heads were asked to state whether they strongly disagreed, disagreed, undecided, agreed or strongly agreed with each of the eight statements. Focus Group Discussions were used to capture qualitative data, in which checklist were used to guide the discussions. In each village, one focus groups composing of seven to 10 people were conducted. Therefore three focus group discussions were held. The FGDs covered a range of issues such as the concept of resilience to climate change, identification of resilient and non-resilient households and mapping the indicators

of resilience among households. Information from the qualitative data helped to supplement the quantitative data, collected through the structured questionnaires in the household survey. Key informant interviews were also used to collect qualitative data that captured specific changes and information, whereby elders and leaders in each village narrated historical information on climate change variability, resilience and agricultural production in the study area.

2.6   Measurement of farmers' perceptions on resilience

The study used a self-assessment approach to measure resilience. Self-assessment or self-perception approach is one of the common approaches used to study resilience, in which household heads are asked to assess themselves whether they were resilient or not (Tulane University, 2012). This kind of approach included a truly participatory process that involved various stakeholders in defining resilience, helping identify key thematic areas that describe resilience dimensions, and developing key indicators (Tulane University, 2012). A self assessment based on understanding resilience from a community perspective on how participants defined and prioritized the characteristics of resilience or, in other words, those households that were able to cope with a shock or stress without external assistance. This considered what the existing resilient households looked like, and how they got to be resilient. Importantly, the approach was aimed at learning from the positive experience by identifying resilient households as a starting point and examining how they were able to cope with climate induced shocks.

2.7   Data analysis

In this study resilience of the household heads was sought by using Likert attitudinal scale. The Likert scale that was constructed had eight statements which carried the negative and positive statements about resilience. Five points Likert scale was combined into three points Likert scale disagree, neutral and agree. It was coded as, 3- agree, 2-undecided and 1- disagree against reach statement. Those statements which were negative were recorded as 1- agree, 2-undecided and 3- disagree. Information on resilience was analysed using the summated scale approach where total score ranged from 8 to 24. It was further categorized as 8 to 15 low, 16 medium while 17 to 24 high due to reasons that the medium score on the Likert is 2, which for 8 statements give the total score of 16. The sixteenth point was given a medium because, the total scores of 16 point is equivalent to total score of all 8 statements receiving 3 point (undecided-mid value).

III.   RESULTS AND DISCUSSION
3.1   Relationship between Perception of the Household Resilience to Climate change and Socio-economic Characteristics

3.1.1   *Occupation*

The results in Table 2 show that more than half (66.7%) of household heads involved on crop production had a high perceived household resilience than livestock keepers (33.3%). However, these results were not statistically significantly (χ^2 =3.15; df =2; p=0.206). These findings are contrary to Davis and Nori (2008) who held that the adaptive capacity of livestock keepers is what has made them so resilient throughout history and enabled them to sustainably exploit their natural environment. Though the results were not statistically significant, during FGD, participants in Kidaru village revealed that during drought though both crop producers and pastoralists are affected, as drought brings hunger and lack of pastures, the livestock keepers sell their animals and get some money to buy food and support their households. As such, the participants perceived crop producers to be less resilient than livestock keeper because once drought happens they have nothing to sell and support their households.This perception of resilience among farming households implies that, traditional adaptation strategies to climate change variability in Africa considers livestock as an adaptive measure which can lead to resilience among farmers who have adopted it as a means of diversifying their livelihoods, preserving assets and harnessing marginal resources (WISP, 2010). Maintaining such a diversity of herd has a number of advantages, including, resilience to climate change. A diverse herd is also an adaptation to a diverse ecology in which vegetation can be highly varied in both space and time. For instance, Bosso (2006) attributes resilience in livestock to local adaptation, citing an example of the N'Dama cattle and the West African dwarf goats, both of which have been bred in the tsetse infested zones (sub-humid and humid zones) of West and Central Africa where trypanosomiasis is prevalent. According to Bosso (2006), these breeds have a proven ability to survive, reproduce and remain productive without recourse to drugs. Keeping these indigenous, trypano-tolerant livestock is not only an approach to control disease and reducing the risk of inducing drug resistance in trypanosome strains, but it has also been reported that trypano-tolerant cattle, especially the N'Dama breed show superior heat tolerance than Zebu cattle (WISP, 2008). These breeds metabolize water with

greater economy, making them better adapted to the hot and water-stressed regions of Africa, conferring obvious advantages in the face of climate change, which contribute to resilience among livestock keepers (WISP, 2008).

3.1.2 *Household head's age*

Table 2 shows that in the study area, age was perceived as one of the important variables in the perception on resilience to climate change. However, results shows that there was no significant association between age groups and resilience to climate change (χ^2 =14.16; df=6; p=0.028). Various age groups had different categories of perceived resilience. Those who were between 31 and 40 years old had about 77% of high resilience category, which was greater than those at the age groups above them. While those at the age between 41 and 50 had the overall (34.4%) high category of perceived resilience greater than others. Those at age between 51 and 60 and those above 60 years had their high resilience category of about 19 each. It is likely that, in the study area resilience was decreasing as age increased.

Despite the fact that the results had no significant association between age and resilience, during FGD some participants perceived that young people have energy that they can use to overcome the impacts of climate disaster such as rebuilding their houses and cultivating farms destroyed by either wind or heavy rain falls, as such, they constitute one of the most resilient groups of the farming society. Similarly, YPARD (2011) insisted on the necessity of youth for a climate resilient development as it holds that there is need to allow the youth to actively participate in addressing climate change problems, not as victims but, more importantly, as solution providers. It is in this context that the African youth should be recognized (not only on paper) as an age group with a lot of potential in addressing the climate change problem which spans within and across generations. YPARD (2011) also argued that representatives in climate change discussions to "acclimatize the youth, towards a climate resilient development." Thus, besides the enormous challenges that the youth face, they can meaningfully contribute towards a climate resilient development, provided an enabling environment is created. While this perception holds general truth in household resilience in the study area, one elderly woman was not contented as she was contrasting:

"… Households composed of old couples are more resilient than those consisting of young couples. Old couples are more tolerant and have much experience of the area than the young. The young couples are not well settled and are so mobile. During climate hazards and shocks young people have high tendency of abandoning their farms and migrate to escape the hardships. They return later when weather improves…" (Farmers FGD in Meatu).The above argument of a woman implies that older adults bring with them a lifetime of experience and this can be applied in difficulties that come up later in life (Blane *et al.,* 2011). For example, older adults often cope better with the loss of a spouse than younger adults because late adulthood is the expected time for such a loss to occur, with friends often in similar situations. In comparison, younger people may find themselves isolated and lacking in coping resources.

3.1.3 *Household head's income level*

Table 2 shows that there was a significant association (χ^2=30.16; df=6; p=0.000) between household head's income levels and perceived household resilience. Income level of the household head was generally assumed to be an important determinant of the perceived household resilience. The results shows that about 88.1% of those with incomes above TAS 2 500 000 who constitute of only 23% of all respondents perceived to have high resilience to climate change. While those below TAS 1 000 000 despite the fact that they constitute 57.9 of all respondents had about 68% of high resilience. With increase in the income level farming households will have more access to information, inputs and resources for adopting new adaptation practices and hence household become resilient. Further, as expected any increase in the income of farmers will increase the probability of farmers perceiving resilient to climate change (Semenza *et al.,* 2008). Such results can also be linked to an empirical investigation of socio-economic resilience to natural disasters in a tropical cyclone-prone coastal community in Bangladesh; whereby Akter and Mallick (2013) indicated that household with low income had low resilience due to the negative effect of the cyclone to the local community. Further, the results show that, during focus group discussion some participants in Kidaru village noted, during hazards all households were shocked, however, it was noted that households with good economic status tended to bounce back quicker than the poor.

3.1.4 *Household head's sex*

In the study area sex of the household head was identified as one of the key socio- economic factors associated with perceived resilience. Table 2 shows that female constituted about 76.9% of high resilience category. This is little higher than male (71.2%) despite the fact that males formed about 64.5% of the

respondents. However, the association between household head's sex and the perceived resilience was not statistically significantly (χ^2=0.72; df=2; p=0.695). Although the results were not statistically significant, during FGD females participants were perceived to be less resilient to climate change than their male counterparts. This is mainly due to the fact that females are responsible for household chores like fetching the drinking water especially in rural areas of Tanzania. So, if there is water scarcity due to changing climate they need to travel far and will be less resilience. Thus, the increase in the time taken to reach the drinking water source, the probability of perceiving household being less resilience increases.

3.1.5 *Household head's marital status*
In the study area, the results (Table 2) have shown that marital status of the household's head was significant in the perceived household resilience, in which married couple had about 79% of high resilience category. The association between married and single household heads was statistically significant (χ^2=27.78; df=2; p=0.000). Some participants also added that married women, especially those with children were more resilient that the single and those without children. One elderly woman noted:

"… because of the family and responsibility of taking care of the children, a wife, for instance, cannot abandon her children and migrate to other areas. She has to find all means possible, even by seeking off farm jobs or selling household items to sustain the children…" (Farmers FGD in Meatu).

The above results also imply that when climate change worsens so does gender inequality, in which case, women and girls are more susceptible to the impacts of climate change. This offers opportunities to tap into women's traditional roles as careers of natural resources and link them with paid employment (Skinner, 2011). Also, in the study area, during the focus group discussion those who were single were not perceived to be resilient among participants in Meatu. One participant reasoned, "…once they [male and single] get shocks they tend to feel free to escape and abandon farming…"

3.1.6 *Household size*
In the study area, various household sizes were identified. The results (Table 2) show that more than half (71%) of households with more than 6 people were perceived to have high household resilience. Similarly, more than half (71.3%) of households with 1 to 3 household members were perceived to have high resilience. Further, the results show that there was no association between household size and perceived household resilience (χ^2=0.53; df=4; p=0.971). This is contrary to the findings by Cassidy and Barnes (2012) who considered household as the unit of consumption and production; therefore in terms of human capital, the number of adults in the household represents labour availability which increases the household resilience. It is also important to note that the significance of human capital on resilience does not only rely on quantity but also the quality of capital reflected by various factors including education level of the household head and the dependence ratio of the household members.

3.1.7 *Households' land ownership*
In the study area land ownership was perceived as one of key indicators of resilience among farming households. The larger the size of land owned by a household the higher is the proportion it perceived to be resilience. Table 2 shows that more than half (90.9%) of those who own above 4 acres of land perceived to have high household resilience. Further, the results show that there was significant association between household land ownership and perceived household resilience (χ^2=22.35; df=2; p=0.000). Such results were also supported by some participants during FGD who expressed:

"… among us, those with land are more resilient because the land or part of it can be sold and get income to support the households and buy some farm implements or restore properties lost during a climate disaster..." (Farmers FGD in Meatu).
These results are also in line with the argument that with increase in the possession of assets like landholding, there will be higher adoption probability of adaptation practices as they will have better access to resources (Gbetibouo, 2009; Below *et al.,* 2012) and hence it increase their household resilience to climate change.

3.1.8 *Household head's attachment to social networks*
In the study area, household head's attachment to social networks was identified as one of the key indicators of the perceived resilience. Table 2 shows that more than half (80.5%) of those in social networks perceived high household resilience. Furthermore, the results show that there was no significant association

between attachment to socio networks and perception on household resilience (χ^2=4.46; df=2; p=0.107). Though the results were not significant, during the FGD participants in Iramba District perceived themselves to be resilient and pointed out that their resilience was attributed to strong social networks and bonds that provided supports to the members. They mentioned "Kenkakenka" as one of the famous network systems. One of the elderly men said:

"… Kenkakenka is a traditional network, which was initially established to help carrying sick people to hospital. Nowadays, it has evolved into an informal network system that not only helps sick people but also helps member households in the village access loans and other social support during shocks and hardship, such as bad weather and climate disasters…" (Farmers FGD in Iramba).

The above argument is plausible because, while a social networking was not significant in the study area, elsewhere Bergkamp *et al.,* (2003) acknowledges that in order to build resilience social capital has a high significant role in organizing and changing societies. Social capital is generally considered to consist of the combination of trust, norms and networks that facilitate coordination and cooperation for mutual benefit (Bergkamp *et al.,* 2003). Also, on the socio-ecological theory, Walker *et al.,* (2006) point out that, social and ecological systems are inextricably linked and that their long term health is dependent upon change, including periods of growth, collapse and reorganization.

Further to the above findings, Jarneck and Olsson (2008) suggest that social capital allows resilience by adaptation where unsustainable or socially unjust practices persist. In all these cases, households tend to be more resilient where social networks are strong. Unlike other villages, the existence of Kenkakenka in Kidaru revealed the community's strong social capital. Generally, social networks can be strengthened and established through various forms including improving healthcare, schools, or communal water supplies, which provide essential services and can be a meeting point for action. They can also be established through production, manufacturing or trading cooperatives. These may contribute to social capital by creating solidarity among stakeholders, enabling collaborative action in communities that may have little experience with such approaches. Other methods include community managed village banks where people have access to credit and building a sense of solidarity (Jarneck and Olsson, 2008). Therefore, strengthening and maintaining social capital is essential if resilience is to be achieved.

Table 2: Socio-economic Determinants of the Perceived Household Resilience to Climate change (n=183)

Indicator	Category	Low		Medium		High		Total		χ^2	df	p
		n	%	N	%	n	%	n	%			
Occupation	Livestock keeping	8	13.1	11	18	42	68.9	61	33.3	3.15	2	0.206
	Crop production	19	15.6	11	9	92	75.4	122	66.7			
Age	31 – 40	7	13.5	5	9.6	40	76.9	52	28.4	14.16	6	0.028
	41 – 50	11	17.5	5	7.9	47	74.6	63	34.4			
	51 – 60	2	5.9	10	29.4	22	64.7	34	18.6			
	More than 60	7	20.6	2	5.9	25	73.5	34	18.6			
Income (TAS)	<1,000,000.00	24	22.6	10	9.4	72	67.9	106	57.9	30.16	6	0.000
	1 000 001.00 - 1 500 000.00	1	8.3	6	50	5	41.7	12	6.6			
	1500 001.00 - 2 500 000.00	1	4.3	2	8.7	20	87	23	12.6			
	>2 500 000.00	1	2.4	4	9.5	37	88.1	42	23			
Sex	Male	19	16.1	15	12.7	84	71.2	118	64.5	0.72	2	0.695
	Female	8	12.3	7	10.8	50	76.9	65	35.5			
Marital status	Single	16	42.1	4	10.5	18	47.4	38	20.8	27.78	2	0.000
	Married	11	7.6	18	12.4	116	80	145	79.2			
Household size	1 – 3	13	16.3	10	12.5	57	71.3	80	43.7	0.53	4	0.971
	4 – 6	4	11.4	4	11.4	27	77.1	35	19.1			
	>6	10	14.7	8	11.8	50	73.5	68	37.2			

Land ownership	1 – 2 acre	26	23.4	15	13.5	70	63.1	111	60.7	22.35	4	0.000
	3 – 4 acre	0	0	2	33.3	4	66.7	6	3.3			
	>4 acre	1	1.5	5	7.6	60	90.9	66	36.1			
Network	Yes	10	12.2	6	7.3	66	80.5	82	44.8	4.46	2	0.107
	No	17	16.8	16	15.8	68	67.3	101	55.2			

3.2   Farmers' perceptions on the household resilience

In the study area, about three quarter (73%) of household heads indicated a high perceived resilience. Among households, Meatu District constituted of about 63% of high perceived resilient households category, while Iramba District had only 36.6% of high perceived resilient households category. However, the results indicated that the difference between perceived resilient households categories between Meatu and Iramba Districts was not statistically significant ($\chi^2 = 1.541$; df=2; p=0.546). Results are shown in Table 3.

Table 3: Proportions of Household Resilience to Climate Variability (n=183)

Household resilience category	Iramba (67)		Meatu(116)		Total		χ^2	Df	p
	N	%	N	%	n	%			
Low	12	44.4	15	55.6	27	14.8	1.54	2	0.546
Medium	6	27.3	16	72.7	22	12			
High	49	36.6	85	63.4	134	73.2			

Perceived households' resilience was also assessed by how long the households took to bounce back after the disasters. Various bounce back durations were divided in the study area, such as shortly after disaster, long after disaster, too long after disaster and much too long after disaster. About 31% of the population stated that they normally take a time to get back to normal after the disaster, while only 4.9% of the study population took much too long to get back to normal after a disaster/shock. The results further show that there was no significant association between the time of bouncing back after climate change between the district (P= 0.535). Results are presented in Table 4.

Table 4: Proportions of Bounce back Duration after Climate disaster (n=183)

Time taken to bounce back	Iramba	Meatu	Overall	p
Shortly after disaster	26.9	33.6	31.1	0.535
Long after disaster	50.7	44.0	46.4	
Too long after disaster	14.9	19.0	17.5	
Much too long after disaster	7.5	3.4	4.9	

Resilience is influenced by many factors which also shape its understanding in spatial difference. For instance, Ranjan and Athalye (2008) point out that several factors influencing resilience among farmers, include: behavioural factors, which dominated the decision to adopt the method; economic factors, such as the price of natural resources exploitation, which do not capture the true opportunity costs of these resources; and the range of available technological options which is crucial to resilience, as marginal improvements in technology do not lead to adoption.

IV.   CONCLUSIONS AND RECOMMENDATIONS

Based on the study findings it can be concluded that household heads perceived resilience as a tendency of a person or household to bounce back after the shocks or disasters. Perceived resilient households were identified as those which resisted shocks and disasters caused by climate variability. It can also be concluded that, the majority of household heads perceived to be resilient, in which the higher proportion of household heads have positively expressed the adaptive capacity of resilience with characteristics such as ability to bounce back, ability to cope and adapt to climate variability and capacity to manage risks as a results of climate variability. Lastly, it is concluded that the most important socio-economic factors of perceived household resilience such as, household head's income levels, household head's marital status and household land ownership were statistically significant in relation to a perceived household resilience. This study therefore, recommended that there is need for joint efforts among various stakeholders to improve household income through provision of training which would enable household members to engage into various non-farm economic activities. Rural development partners should ensure access to agricultural extension to both male and

female headed households. Lastly, it is recommended that the government and nongovernmental organization efforts should empower youth to have the vision of owning land.

V. ACKNOWLEDGEMENT

REFERENCES

[1]   E. Buikstra, H. Ross, C. A. King, P. G. Baker, D. Hegney, K. McLachlan, and C. Rogers-Clark, The components of resilience: perceptions of an Australian rural community, *Journal of Community Psychology, 38,* 2010, 975 – 991.

[2]   L.H. Gunderson, and C.S. Holling, *Panarchy: understanding transformations in human and natural systems* (Washington, D.C, USA: Island Press, 2002).

[3]   F. Norris, S. Stevens, K. Wyche, and R. Pfefferbaum, Community Resilience as Metaphor, Theory, Set of Capacities and Strategy for Disaster Readiness, *American Journal of Community Psychology 41,* 2008, 127-150.

[4]   B. Walker, D. Salt, and W. Reid, *Resilience Thinking: Sustaining People and Ecosystems in a Changing World* (Washington, D.C. USA: Island Press, 2006).

[5]   A. Jarneck and L. Olsson, Adaptation and the Poor: Development, Resilience and Transition, *Climate Policy, 8 (2),* 2008,170 – 82.

[6]   W.N.Adger, Social and Ecological Resilience: Are They Related? *Progress in Human Geography, 24(3),* 2009, 347–64.

[7]   M. Pelling, *Adaptation to climate change: from resilience to transformation* (New York,USA: Routledge, 2011).

[8]   S. L Cutter, L.Barnes, M.Berry, C. Burton, E. Evans, E. Tate, and J. Webb, A Place –based Model for Understanding Community Resilience to Natural Disasters, *Global Environmental Change, 18,* 2008, 598-606.

[9]   F. Ellis, *Peasant economics: farm households and agrarian development* (Cambridge, UK: Cambridge University Press, 1993).

[10]   B. Crona, A. Witich, A. Brewis, and M. Gartin, Perceptions of climate change: Linking local and global perceptions through a cultural knowledge approach, *Climate Change 119 (2),* 2013, 519 – 531.

[11]   S. Crate, and M. Nuttall, *Anthropology and climate change: from encounters to actions* (Walnut Creek, USA: Left Coast Press, 2009).

[12]   E. Francis, *Making a living: changing livelihoods in rural Africa* (London, UK: Rutledge, 2000).

[13]   J. Salick, Z. Fangb, and A. Byg, Eastern Himalayan alpine plant ecology, Tibetan ethnobotany, and climate change, *Global Environmental Change, 19(2),* 2009, 147–155.

[14]   R. Mendelssohn, A. Dinar, and A. Dalfelt, *Climate change impacts on African agriculture* (Mimeo, School of Forestry Environmental Studies, Yale University, 2003).

[15]   ODI, Pastoralism and climate change: Enabling adaptive capacity, Research report and studies, 2009. Retrieved from *[http://www.odi.org.uk].* Retrieved on 06/02/2012.

[16]   Oxfam, Causing hunger: An overview of the food crisis in Africa, Briefing Paper 2006. Retrieved from *[http://www.oxfam.org/sites/www.oxfam.org], R*etrieved on 22/04/2012.

[17]   IPCC, *Climate Change 2007: impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change* (Cambridge, UK: Cambridge university press, 2007).

[18]   S. Agrawal, T. Ota, A. U. Ahmed, J. Smith, and M. Van Aalst, *Development and climate change in Bangladesh: focus on coastal flooding and the sunderbans* (Paris, France: Organization for Economic Co-operation and Developent, 2003).

[19]   URT, *National adaptation programme of action* (Dar es Salaam, Tanzania: The Vice President's Office, 2007).

[20]   R. Kangalawe, and J. Lyimo, Climate Change, Adaptive Strategies and Rural Livelihoods in Semi arid Tanzania, *Natural Resource 4(3),* 2013, 266-278.

[21]   M. L. Parry, C. Fischer, M. Livermore, C. Rosenzweig, and A. Iglesias, Climate change and world food security: a new assessment, *Global environmental change 9,* 1999, 551 – 567.

[22]   R. Milestad, and I. Darnhofer, Building farm resilience: the prospects and challenges of organic farming, *Journal of Sustainable Agriculture 22 (3),* 2003, 81-97.

[23]   C. Folke, J. Colding, and F. Berkes, Synthesis: building resilience and adaptive capacity in social-ecological systems, in C. Folke, J. Colding, and F. Berkes (Eds.), *Navigating Social-ecological Systems: Building Resilience for Complexity and Change* (Cambridge, UK: Cambridge University Press, 2003) 352-387.

[24]   C. M. Shayo, Adaptation planning and implementation: Agriculture and food security, *Proc. UNFCCC African Regional Workshop on Adaptation,* Accra, Ghana. 2006, 110-116.

[25]   R. Otysina, and D. Asenga, *Tanzania ICRAF Agro Forestry Research Project: Annual Progress Report 1992/93* (Shinyanga, Tanzania: ICRAF, 1993).

[26]   K. M. Norgaard, Cognitive and behavioural challenges in responding to climate change: Background Paper to the 2010 World Bank Policy Research Working Paper Series, 2009. Retrieved from *[http://www.ssm.com/].* Retrieved on 15/07/2015.

[27]   ESRF and FANRPAN, A National Dialogue on Building Climate Change Resilience in Africa's Agriculture, Workshop Report, (2010). Retrieved from *[http://www.fanrpan.org/documents/report_nov2010.pdf].* Retrieved on 25/07/2015.

[28]   Africa Climate Change Resilience Alliance, Consultation Document (The ACCRA Local Adaptive Capacity Framework, 2010). Retrieved from *http://www.community.eldis.org/ACCRA_adaptive capacity_framework_consultation_version_oct 2010.pdf/.* Retrieved on 22/07/2015.

[29]   S.J. Kabote, D. Mamiro, G. Synnevåg, J. K. Urassa, A. Z. Mattee, J. S. Mbwambo, C. I. Nombo, L. M. Masolwa, and E. E. Chingonikaya, Inter-annual Anomaly and Seasonal Variability of Rainfall and Temperature in Selected Semi-arid Areas of Tanzania, *Journal of Continuing Education and Extension, 4(2),* 2013, 295-317.

[30]   C. S. Holling, Resilience and stability of ecosystems, *Annual Review of Ecological System, 4 (1),* 1973, 23-45.

[31]   S. Kummer, R. Milestad, F. Leitgeb, and C. R. Vogl, Building Resilience through Farmers' Experiments in Organic Agriculture: Examples from Eastern Austria, *Sustainable Agriculture Research, 1(2),* 2012, 308-321.

[32]   DFID, *Sustainable Livelihoods Guidance Sheets* (London, U.K: DFID, 2000).
[33]   M. Kollmair, and S. Gamper, *The Sustainable Livelihood Approach: Input Paper for the Integrated Training Course of NCCR North-South. Development Study Group*. (Zurich: University of Zurich, 2002).
[34]   J. D. Ford, B. Smit, J. Wandel, and J. MacDonald, Vulnerability to climate change in Igloolik, Nunavut: what we can learn from the past and present, *Polar Record* 42 (221), 2006, 127-138.
[35]   S.S. Lal, S. *Climate Change Resilience and Vulnerability of Farmers in Nepal* (Nepal. Hiroshima University, 2014).
[36]   National Bureau of Statistics (NBS), 2012, Agriculture Sample Census Survey 2007/2008. Retrieved from *http://www.nbs.go.tz.* Retrieved on 03/04/2013.
[37]   URT, *Shinyanga regional social economic profile: planning commission* (Dar-es-Salaam, Tanzania: Regional Commissioners Office, 1996).
[38]   URT, *Singida region rocio-economic profile, second edition* (Dar es salaam, Tanzania: National Bureau of Statistics, 2005).
[39]   Ministry of Tourism, Natural resources and environment, *Hashi phase II programme report 1996/97* (Dar-es- salaam, Tanzania: Government Printer, 1995).
[40]   K. A. Levin, Study design III: Cross-sectional studies. Evidence-Based, *Dentistry 7,* 2006, 24–25.
[41]   C. M. Varkevisser, I. Pathmanathan, and A. Brownlee, *Designing and conducting health system research projects, Vol 1: Proposal development and fieldwork* (Amsterdam. KIT Publishers, 2003).
[42]   L. Allinovi, E. Mane, and D. Romano, *Towards the Measurement of Household Resilience to Food Insecurity: Applying a Model to Palestinian Household Data. In: Deriving Food Security Information from National Household Budget Surveys. Experiences, Achievement, Challenges,* Edited by Sibrian, R. (Rome, Italy: FAO, 2008).
[43]   D. K. Bailey, *Methods of social science research 4th edition* (New York, USA: The Free Press, 1994).
[44]   M. Saunders, P. Lewis, and D. Thornhill, *Research methods for business students, 4th edition* (London, UK: Pearson Education Prentice Hall, 2007).
[45]   Tulane University, *Haiti humanitarian assistance evaluation: from a resilience perspective* (Haiti, Tulane University's Disaster Resilience Leadership Academy, 2012).
[46]   J. Davis and M. Nori, Managing and mitigating climate change through pastoralism. Climate Change, and Livelihoods, *Policy Matters, 16,* 2008,   127-141.
[47]   World Initiative for Sustainable Pastoralism (WISP), *Building climate change resilience for African livestock in Sub-saharan Africa* (Nairobi, Kenya: The International Union for Conservation of Nature, Eastern and Southern Africa Regional Office, 2010).
[48]   N. A. Bosso, *Genetic improvement of livestock in tsetse infected areas in West Africa* (The Netherlands: Wageningen University, 2006).
[49]   World Initiative for Sustainable Pastoralism (WISP), Forgotten Services Diminished Goods: Understanding the Agro ecosystem of Pastoralism. WISP Policy Note No 8. (2008). Retrieved from *[http://cmsdata.iucn.org].* Retrieved on 21/07/2014.
[50]   Young Professionals' Platform for Agricultural Research for Development (YPARD), A youth perspective on climate change opportunities and challenges for climate resilient development. *Proc. on Africa Adapt Symposium,* Addis Ababa, Ethiopia, 2011, 201-213.
[51]   D. Blane, R. Wiggins, S. Montgomery, Z. Hildon, and G. Netuveli, *Resilience at older ages: the importance of social relations and implications for policy* (London, UK: International Centre for Life Course Studies, 2011).
[52]   J. C. Semenza, D. E. Hall, D. J. Wilson, D. B. Bontempo, D. J. Sailor, and L. A. George, Public Perception of Climate change: Voluntary mitigation and barriers to Behaviour change, *American Journal of Preventive Medicine 35(5),* 2008, 479 – 457.
[53]   S. Akter, and B. Mallick, The poverty-vulnerability resilience nexus: Evidence from Bangladesh, *Ecological Economics 96*, 2013, 114-124.
[54]   E. Skinner, *Gender and climate change: overview report* (Brighton, UK: Institute of Development Studies, 2011).
[55]   L. Cassidy, and G. D. Barnes, Understanding household connectivity and resilience in marginal rural communities through social network analysis in the village of Habu, Botswana, *Ecology and Society 17 (4),* 2012, 11 - 22.
[56]   G. Gbetibouo, and C. Ringler, *Mapping South African farming sector vulnerability to climate change and variability: A sub national assessment* (Washington, DC USA: International Food Policy Research Institute, 2009).
[57]   B. T., Below, K.D. Mutabazi, D. Kirschke, C. Franke, S. Sieber, R. Siebertc, and K. Tscherning, Can farmers' adaptation to climate change be explained by socioeconomic household-level variables? *Global Environmental Change, 22(1),* 2012, 1- 32.
[58]   G. Bergkamp, B. Orlando, and I. Burton, *Change: adaptation of water resources management to climate change* (Cambridge, UK: International Union for Conservation of Nature and natural Resources, 2003).
[59]   R. Ranjan and S. Athalye, Drought Resilience in Agriculture: The Role of Technological Options, Land Use Dynamics and Risk Perception, *Natural Resource Modeling. Featured Article*, 22(3), 2009, 437-462.

Appendix 1: Map of Tanzania Showing Study Villages