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Full Length Research Paper

Gender and perception on climate change in Bahi and Kondoa Districts, Dodoma Region, Tanzania

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Perception precedes measures to adapt to climate change effects. However, little is known on how men and women dealing with agriculture in rural Tanzania perceive climate change. The study to analyze perception on climate change by gender was done in Bahi and Kondoa Districts Dodoma Region, Tanzania. Meteorological data were also used. Primary data obtained from 78 key informants, 12 focus groups and a sample of 360 respondents. Analysis involved descriptive statistics for quantitative data and content analysis for qualitative data. Findings revealed that 82.7% of men and 76.7% of women perceived the change in rainfall; 98.3% of men and 97.2% of women the change in temperature; 97.2% of men and 95.6% of women the change in strong wind; and all men (100%) and 98.9% of women the change in drought; acknowledging that rainfall variation, temperature, strong wind and drought had increased. It is concluded that majority of men and women perceived the changes in climate. The information obtained can be used as a base in formulating appropriate interventions to manage climate change problems in agriculture sector. The study recommends people of Dodoma, Tanzania and the LDCs to use available knowledge systems to develop appropriate interventions to manage climate change problems.

Key words: Climate change, perception, men and women, agriculture.

INTRODUCTION

Climate change is apparent and its effects including variation in temperature and rainfall, drought, floods, heat waves, hurricanes and typhoons are already felt across the world affecting countries differently. The effects of climate change are unevenly distributed among different income groups, occupations and between men and women. The poor (of whom 70% are women), primarily in developing countries, are more vulnerable and thus more affected by climate change. The adverse effects of climate are stronger in Africa where prolonged floods and severe drought are common; and more severe in Sub-Saharan Africa especially in semi-arid areas (Cline, 2007; Inter-governmental Panel on Climate Change (IPCC), 2007; United Nation Population Fund (UNFPA), 2009; Haque et al., 2012). East African countries including Tanzania are already among the most food insecure in the world and climate change is expected to aggravate falling harvests (Devereux and Edward, 2004).

Tanzania is experiencing greater weather extremes including increases in temperature and changes in rainfall patterns. Such effects have increased drought, floods, land resources degradation as well as health problems. The intensity of droughts, floods and changes to growing seasons have significant effects on agricultural productivity, water supply, food security and human welfare (Yanda et al., 2006; United Republic of Tanzania (URT), 2007). For example, the drought that occurred in 2005/06 and the El Niño in 1997/98, highlight the country's vulnerability to current climatic hazards (Ehrhart and Twena, 2006). Although every individual will be affected by climate change in Tanzania, small-holder

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farmers in rural areas especially women are likely to be more affected by climate change because of their low adaptive capacity, extreme poverty and dependence on rain-fed agriculture, activity more sensitive to climate change. Moreover, inequalities existing between men and women partly due to statutory and/or customary laws that often restrict women's property and land rights; constrain women from accessing important resources for example, land and credit, undermining further their adaptive capacity (International Fund for Agricultural Development (IFAD), 2008; Osman-Elasha, 2008; Brody et al., 2008). The fact that women are likely to be more affected by climate change is also supported by climate change literature (Lambrou and Piana, 2006; UNFPA, 2009; United Nations Development Programme (UNDP), 2009). The literature insist studies focusing on gender and climate change to be conducted at community level in various sectors including agriculture, in order to gather disaggregated data that will show the way men and women perceive, are affected and thus responding to climate change effects.

Perception is a process by which individuals receive information or stimuli from the environment and transform it into psychological awareness, in order to learn about the environment and respond to what is perceived (Bridgeman and Tseng, 2011). How individuals perceive risk is influenced in part by the type of hazard to which they are exposed and the perceived severity and frequency of that exposure (Slegers, 2008; Frank et al., 2011). Perception is important in climate change because it is one of the elements that influence adaptation process. It is after perceiving the changes in climate that individuals can undertake required measures to adapt to or reduce climate change effects (Maddison, 2006). Knowing the importance of perception, climate change perception studies have been conducted in developed countries mainly to explore mitigation options (Semenza et al., 2008; Mertz et al., 2009; Debono et al., 2010; Hansen et al., 2012). In developing countries studies on perception have been conducted in relation to adaptation options (Gbetibouo, 2009; Dhaka et al., 2010; Mengistu, 2010; Nzeadibe et al., 2011; Maharjan et al., 2011). Moreover, most of the studies on climate change conducted in Tanzania have focused on vulnerability, impact and adaptation strategies (Paavola, 2008; Lema and Majule, 2009; Mongi et al., 2010). The findings from these studies revealed that climate had changed and was the source of various adverse effects. However, the findings were not disaggregated by gender to indicate the way men and women perceived/were affected and thus responding to the negative effects of climate change. Studies on climate change perceptions and gender at the community level that could make disaggregated data available in Tanzania are scarce. Lack of disaggregated data has meant that climate change policy makers dealing with climate change in Tanzania for example, the National Adaptation Program of Action (NAPA), cannot come up with effective policies or adaptation options (URT, 2007). According to UNFPA (2009) and UNDP (2009), for the policy that is intended to address any aspect of climate change to be effective, the differences between men, women, boys and girls must be taken into account during policy formulation. Gender blind policies may exacerbate the problems associated with climate change by widening inequalities between the sexes. Thus, to attain effective and successful adaptation, the needs of men and women should be integrated in climate change policies including adaptation plans. This can be achieved if disaggregated information on the way men and women perceive climate change will be gathered.

Using Dodoma Region as a case study, the region is located in a semi-arid area, an area prone to drought. But the nature of drought felt in the region in the 1990s is not only due to its location. The situation has been exaggerated by climate change. However, it was not clear if men and women had perceived and related experienced drought in the 1990s with climate change. Information on how men and women perceived and described the concept of climate change was lacking. This paper therefore, presents results of the study on perception of respondents on climate change done in Bahi and Kondoa Districts of Dodoma Region in order to fill part of the information gap. The rest of the paper is structured as follows: the next section covers methodology including study area, research design and the way data were collected and analyzed; results and discussions; and finally conclusion and recommendations.

METHODOLOGY

Study area

The study was conducted in three villages of Bahi District, Dodoma Region, namely Nagulobahi, Chipanga B and Msisi; and three villages of Kondoa District that is Puhi, Isusumya and Kurio. Administratively Bahi District has four divisions, 21 wards and 56 villages whereas Kondoa District has eight divisions, 35 wards and 160 villages. Both Districts are situated in semi-arid areas and have a dry savannah type of climate which is characterized by long dry season, unimodal and erratic rainfall that falls between November/December and April. Bahi District has an annual average rainfall of about 500 to 700 mm and annual average temperature of about 22.6°C. Kondoa District has an annual average rainfall of about 500 to 800 mm and an annual temperature of about 21°C. The economies of Bahi and Kondoa Districts depend on agriculture (crops and livestock production). The main crops grown in Bahi District are pearl millet, sorghum, paddy and ground nuts; and for Kondoa District the main crops are maize, finger millet, oil seeds, pearl millet and sorghum (URT, 2003) (Appendix 1).

Research design and methods of data collection

A cross-sectional research design was used in this study. Sampling techniques involve purposive sampling, stratified random sampling and simple random sampling. Purposive sampling was used to select two districts, three divisions from each district, one ward from

each division and one village from each ward; basing on the availability of the evidence of climate change, accessibility and limited or no research especially on climate change had been conducted in the particular area. A sampling unit was a household from which a man or a woman was chosen; and a sampling frame was the farmers dealing with agriculture (crop farming and livestock keeping).

To obtain a representative sample according to Bailey (1994), the sampling frame was stratified into two strata of men and women and from each stratum simple random sampling was used to select 30 men and 30 women. The sampling frame was 4498 farmers, the two strata 2139 men and 2359 women; the sample proportions were 48% of men and 52% of women that resulted into a sub-sample of 173 men and 187 women respectively. Dividing each sub-sample by six villages the results were 29 men and 31 women respectively. However, from the two strata a simple random sampling technique was employed to select 30 men and 30 women per village in order to facilitate statistical analysis especially where comparison between men and women per village was necessary during discussion. This is based on Bailey (1994) that a sample or sub-sample of 30 respondents is a bare minimum for a study in which statistical data analysis is to be done, regardless of the population size. Besides, the key informants including ward and village leaders, crops and livestock extension workers, religious leaders, members of village government committees, head teachers and elderly farmers (two men and two women) were selected purposively. The selection was based on the position, knowledge and opinions/views of the individuals on climate change, history of the study area and other important required information.

Both primary and secondary data were collected. Primary data involved qualitative and quantitative data. Methods to collect qualitative data involved key informant interviews and focus group discussions; and a structured questionnaire was used to collect quantitative data. To collect qualitative data, a checklist of items for in-depth interviews with key informants was used to gather information from 78 key informants; and a focus group interview guide was used in discussion to gather information from 12 focus groups (one group of men and one of women from each village). To collect quantitative data, a structured questionnaire was administered to a sample of 360 respondents (30 men and 30 women from each village) to verify and quantify some of the findings from qualitative data. Among the questions administered were Likert items of five responses (strongly agree, agree, undecided, disagree and strongly disagree) prepared for four climate change indicators – an increase in rainfall variation, temperature, strong wind and drought (Appendix 2 and 3). The sources of secondary data were various reports relevant to the study, the web and Tanzania Meteorological Agency (TMA) Dar es salaam where data of seasonal rainfall, mean minimum and maximum temperature and mean wind speed were obtained.

Data analysis

Analysis of qualitative data involved content analysis in which the data were broken down into smallest meaningful units of information and/or themes and summarized to supplement important information with respect to the objectives of the study. Quantitative data analysis was based mainly on descriptive statistics including frequencies, means, percentages and cross-tabulations. An inferential analysis was done using the chi-square test at $p < 0.05$ level of significant to determine the association between perception of climate change and demographic/socio-economic variables. Perception on climate change was measured through indices of four climate change indicators. In order to form indices: (i) Likert statements were reverse-coded to obtain dimensionality. (ii) Reliability analysis was performed for each climate change indicator; and statements that counted Cronbach's alpha value of 0.7 and above were the only ones included in further analysis to develop indices. The reliability analysis is based on a calculation of the correlation among statements using Cronbach's alpha. The value of alpha of 0.7 and above is accepted in social science as indicating a reliable scale (Marshall and Marshall, 2007; Swai, 2006). (iii) Strongly agree and agree responses were transformed into 1; strongly disagree and disagree into **0** to form scale of the index of 0 – 1; and undecided responses were regarded as missing. (iv) Scores for each respondent were then summed and divided by the number of statements for each climate change indicator. (v) The scale was further transformed into two categories of 'not perceiving' for respondents that scored 0.5 and below and 'perceiving' for respondent that score 0.6 and above. This procedure of forming index was also used by Magayane (1995) when studying adaptive effort of farmers to soil erosion and land productivity decline in Uluguru Mountain Tanzania.

To analyze meteorological data, MS Excel was used to perform simple regression analysis for rainfall, temperature and wind data. The dependent variable [Y(j)] was the physical factor (rainfall, mean minimum temperature, mean maximum temperature and mean wind speed) and independent variables (x) were the number of seasons/years (for example, 1970/71 to 2009/10 for rainfall). From the analysis the XY scatter plot with regression line, regression equations together with the R–square (R^2) values were established. To determine significance of the trends, f-test was used to test significance of R^2.

RESULTS

Description of the concept of climate change by sex

The first question requested respondents to give one description on climate change in order to understand the way climate change was described in the study area. The findings revealed that 23.3% of men described the concept of climate change as a situation occurred when crops and livestock were in a good condition, while about 23% of women described climate change as a situation which occurred when the food was available or not available in the household. Besides, more men (16.7%) described the concept of climate change as the variation in temperature (coolness/hotness), while more women (17.8%) described the concept of climate change as the change in the amount of rainfall (Table 1). Results revealed that men and women described the concept of climate change differently. Men were more concerned with the condition of crops while in the field and the good condition for livestock, but women were more concerned with the availability of food in the household. Although the good condition for crops mentioned by men was an indicator of harvesting enough food, most of the crop yield could be sold after harvesting; an action that could reduce the available amount of food and subject the household to hunger or food shortage.

Major changes in climate between 1970s and 1990s

Respondents were also required to identify/choose one major change in climate that had occurred between 1970s and 1990s in the study area. The findings revealed

Table 1. Description of the concept of climate change by sex.

Description	Men (n = 180)		Women (n = 180)	
	n	%	n	%
Men and women description of the concept of climate change				
Good condition for crops and livestock	42	23.3	14	7.8
Food availability/food shortage/hunger	40	22.2	42	23.3
Variation in temperature (coolness and hotness)	30	16.7	22	12.2
Whirlwind and strong wind that blows away rainfall clouds	24	13.3	25	13.9
Changes in rainfall amount	20	11.1	32	17.8
Drought/dry spell	17	9.5	20	11.1
Presence/absence of diseases and deaths for people	6	3.3	23	12.8
I do not know	1	0.6	2	1.1
Total	180	100.0	180	100.0

Source: Survey data (2011).

Table 2. Major changes in climate between 1970s and 1990s.

Description	Men (n = 180)		Women (n = 180)	
	n	%	n	%
Major changes in climate between 1970s and 1990s				
Drought has increased	51	28.4	47	26.1
Temperature has increased	34	18.9	39	21.7
Rainfall variation has increased	30	16.6	31	17.2
Rainfall amount has decreased	20	11.1	19	10.5
Strong wind has increased during rainy season and whirl	19	10.5	21	11.7
Others.....	26	14.4	23	12.8
Total	180	100.0	180	100.0

Source: Survey data (2011).

that: drought, temperature, rainfall variation and strong wind had increased and rainfall decreased in the 1990s compared to the 1970s. The change in drought was ranked high by both men and women (that is 28.4% of men and 26.1% of women) (Table 2).

It was also revealed during key informant interviews and focus group discussions that in the study area bad years had increased and good years (years in which there were sufficient and well distributed rainfall) decreased in the 1990s compared to the 1970s. The discussants (both men and women) described a bad year as the year when rainfall, water and pastures were inadequate; when crops failed or when they got very low crop yield and when drought/dry spell and insect pests damaged crops. Men discussants described a bad year as the year when there was floods and strong wind in December blowing away rainfall clouds; and when improved seeds and honey were inadequate. Conversely, the ratio of bad and good years was 3:2, meaning three women described a bad year as the year when there was food shortage/hunger, when market for crops was inadequate, when crops fetched very low price; when they had no money to buy food; and when they were forced to spend most of their time selling labour in order to buy food. Women further explained a bad year as the year when they were forced to replant more than twice; when rainfall was irregularly distributed; and when there was inadequate green vegetables in the study area. According to the discussants, in the 1970s the ratio between good and bad years was 1:5 that is, one bad year followed by five consecutively good years. But in the 1990s in all surveyed villages good years were few and difficult to remember. The ratio between good and bad years for the most surveyed villages was 1:3 and in other villages 1:5, that is one good year followed by three or five consecutively bad years, except in Puhi village where relatively good years followed by two consecutively bad years. The discussants argued that there was no good year hundred percent but the years regarded as good had deficiencies; and that, in most seasons farmers were forced to buy food in November throughout March, hopping to start harvesting in April. It was also revealed that the ratio of bad years started to increase in 1984 for Bahi District and in 1990 for Kondoa District.

Table 3. The main causes of climate change by sex.

Description	Men (n = 180)		Women (n = 180)	
	n	%	n	%
Main reasons for the changes of climate				
Deforestation	89	49.5	92	51.1
Increase in population	47	26.1	59	32.8
Keeping large number of cattle per area	33	18.3	10	5.6
God's plan	4	2.2	11	6.1
Increase of carbon dioxide in the atmosphere	4	2.2	0	0.0
I do not know	3	1.7	8	4.4
Total	180	100.0	180	100.0

Source: Survey data (2011).

The main causes of climate change by sex

When respondents were asked to give one main reason for the changes in climate, deforestation was ranked high by both men and women (49.5% of men and 51.1% of women) (Table 3). Other causes mentioned were increased population and livestock keepers keeping large number of cattle per unit area.

The causes were interconnected because, as the village population increased demand for farms, building material including poles, firewood and grazing area also increased. Deforestation was aggravated by the demand of farmers to increase income, the situation that caused more of them to be engaged in charcoal and firewood businesses due to climate change. Furthermore, only four men associated the changes in climate with an increase in carbon dioxide in the atmosphere.

Perception on climate change by sex

After the reliability testing, Likert items for climate change indicators – the change in rainfall had eight items and Cronbach's alpha value of 0.845; the change in drought 20 items and alpha value of 0.738; the change in temperature eight items and alpha value of 0.726 and the change in strong wind eight items and alpha value of 0.734 (Appendix 2 and 3). Those items were used to form indices to measure perception. It is depicted in Table 4 that 87.2% of men and 76.7% of women perceived the change in rainfall; 98.3% of men and 97.2% of women perceived the change in temperature; 97.2% of men and 95.6% of women perceived the change in strong wind; and all men (100.0%) and 98.9% of women perceived the change in drought.

Respondents who perceived the change in rainfall accepted that the amount of rainfall had decreased; rainfall was less predictable and more unevenly distributed. Respondents who perceived the change in temperature accepted that the temperature had increased and was the main cause of increased hotness especially during dry season, the number of warm days to increase during cold season and uncomfortable nights especially during dry season. Similarly, respondents who perceived the change in strong wind accepted that strong wind during rain season and whirl wind during dry season had increased; and respondents who perceived the change in drought accepted that drought (including the number of days of dry spell) had increased and was the main cause of water sources and water amount to decrease; wetland areas to shrink; crop yield, food amount and pastures to decrease; and frequencies of occurrence of crop pests and livestock diseases to increase in the 1990s compared to the 1970s.

The chi-square test showed significant association between perception of respondents on the change in rainfall and sex ($\chi 2 = 11.588$; $p \leq 0.05$); perception of respondents on the change in strong wind and their villages/location ($\chi 2 = 42.792$; $p \leq 0.01$); and perception of respondents on the change in drought and marital status ($\chi 2 = 73.536$; $p \leq 0.001$) and ethnic groups ($\chi 2 = 193.098$; $p \leq 0.001$); indicating that perception of respondents on climate change varied by sex, location/village of respondent, ethnic groups and marital status. However, the chi-square test showed no significant association between perception of respondents on the change in temperature and sex (or other socio-economic/demographic variables); the result that suggests an equal chance for respondents from Bahi and Kondoa districts to perceive the change in temperature.

The evidence of climate change from meteorological data

The trend of rainfall anomaly of Bahi District for the growing season of November to April for the past 39 seasons (1970/71 to 2009/10) revealed that rainfall was decreasing gradually but the change was insignificant, that is $R^2 = 0.0461$, ($p = 0.1831$). However, from 1980/81 season rainfall started to decrease significantly, that is $R^2 = 0.205$, ($p \leq 0.05$) (Figure 1a).

Table 4. Perception of respondents on climate change by sex.

Scale categories for perception	Men (n = 180)		Women (n = 180)	
	n	%	n	%
Perception on the change in rainfall				
Perceiving	157	87.2	138	76.7
Not perceiving	23	12.8	42	23.3
Perception on the change in temperature				
Perceiving	177	98.3	175	97.2
Not perceiving	3	1.7	5	2.8
Perception on the change in strong wind				
Perceiving	175	97.2	172	95.6
Not perceiving	5	2.8	8	4.4
Perception on the change in drought				
Perceiving	180	100.0	178	98.9
Not perceiving	0	0.0	2	1.1

Source: Survey data (2011).

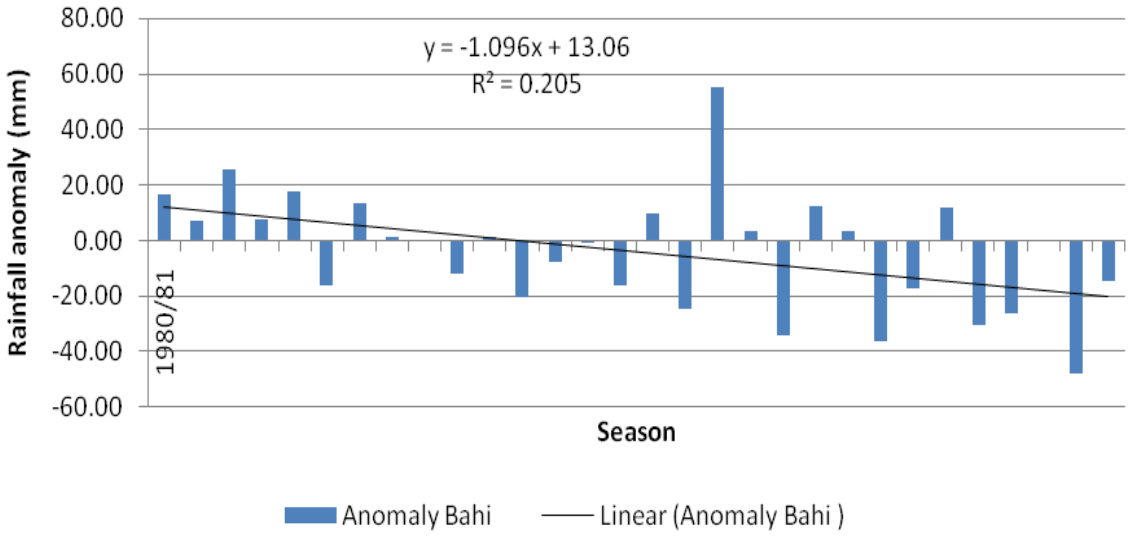

Figure 1a: The trend of rainfall anomaly for Bahi district 1980/81 – 2009/10 seasons
Source: TMA data (2011) (Some season are not shown).

Likewise, the trend of rainfall anomaly of Kondoa District for the growing season of November to April for the past 39 seasons (1970/71 to 2009/10) revealed that rainfall was increasing with a decreasing rate but insignificantly from 1970/71, that is R^2 = 0.0107, (p = 0.5255). But, from 1984/85 rainfall started to decrease although the change was statistically insignificant, that is R^2 = 0.022, (p = 0.4628) (Figure 1b).

It is shown in Figure 2a that, trends of the mean minimum and mean maximum temperature anomalies for Dodoma region for the past 40 years (1970 to 2010) showed significant increase in both mean minimum and mean maximum temperature, that is R^2 = 0.404, ($p \leq 0.001$) (Figure 2a) and R^2 = 0.125, ($p \leq 0.05$) (Figure 2b) respectively. The observation also revealed that the mean minimum temperature was increasing more rapidly compared to the mean maximum temperature.

Equally, the trend of the mean wind speed anomaly of Dodoma region for the past 32 years (1977 to 2009) showed a significant increase in wind speed, that is R^2 = 0.276, ($p \leq 0.01$) (Figure 3).

It is evident from the analysis of meteorological data that rainfall had decreased in Bahi District. However, in Kondoa District the change in rainfall was not statistically

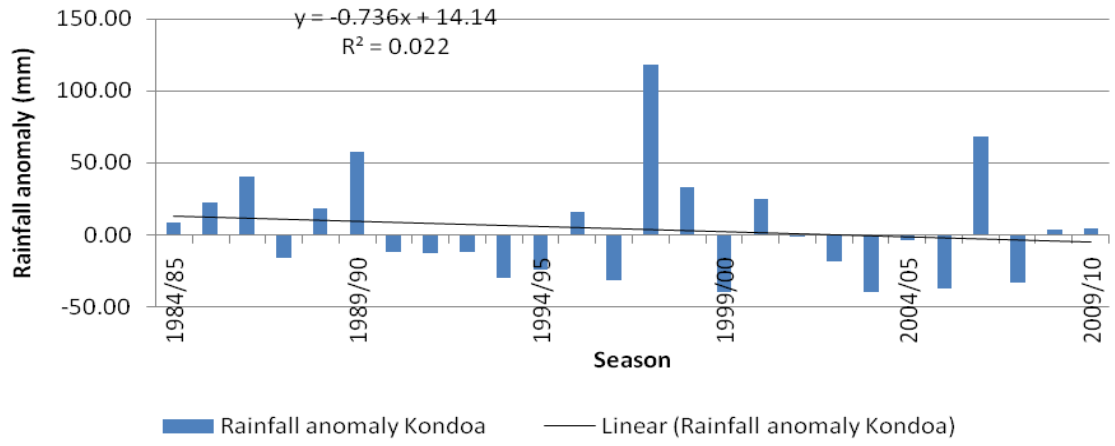

Figure 1b. The trend of rainfall anomaly for Kondoa district 1984/85 – 2009/10 seasons. Source: TMA data (2011).

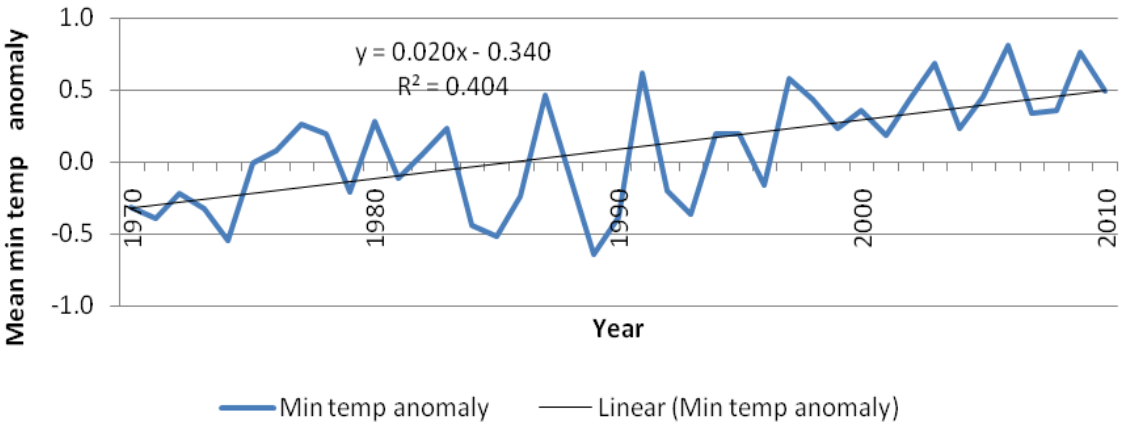

Figure 2a. The trend of Dodoma region mean minimum temperature anomaly 1970 – 2010. Source: TMA data (2011).

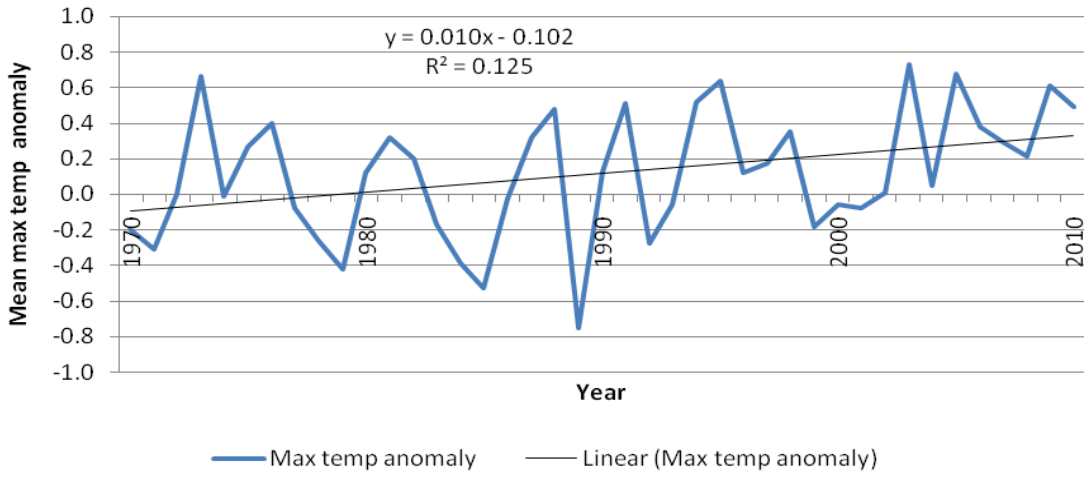

Figure 2b. The trend of Dodoma region mean maximum temperature anomaly 1970-2010. Source: TMA data (2011).

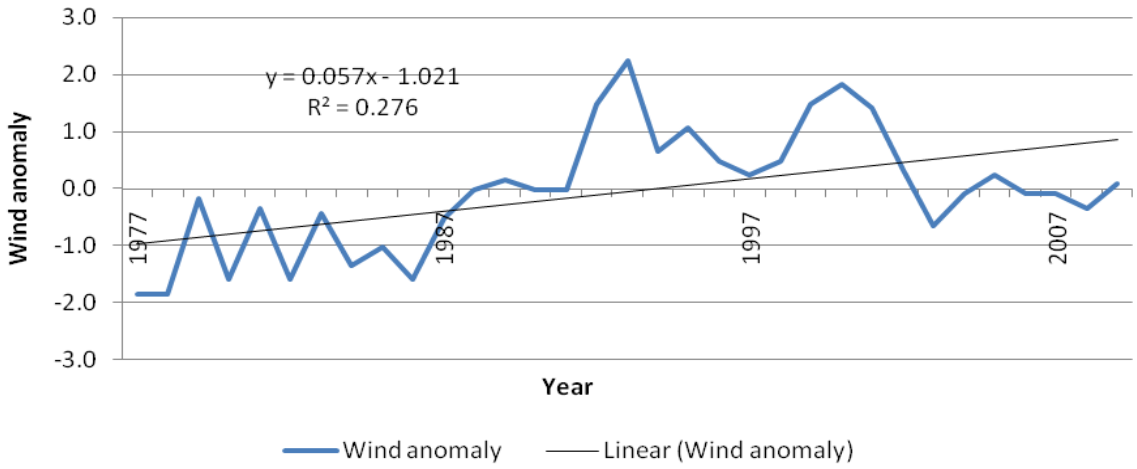

Figure 3. The trend of mean wind speed anomaly of Dodoma region for 1977 – 2009. Source: TMA data (2011).

significant, indicating that the area could have been affected more by the variation in rainfall onset or rainfall distribution than the change in rainfall amount. It is also clear that the mean minimum and mean maximum temperature; and the mean wind speed for Dodoma Region had increased significantly. Findings from the analysis of meteorological data have matched well with responses of respondents who perceived the change in rainfall, temperature, wind and drought, admitting that rainfall variation, temperature, strong wind and drought had increased and rainfall amount decreased in the 1990s compared to the 1970s; also findings from the focus group discussions which revealed that bad years had increased since 1984 for Bahi District and 1990 for Kondoa District.

Perception on the future climate change by sex

Respondents were requested to indicate their anticipation concerning climate change in the future five to ten years; their responses indicate that 30.5% of men and 23.7% of women's responses anticipated the state of climate change to continue deteriorating in the future. Moreover, 29.6% of men and 29.7% of women's responses anticipated the amount of rainfall to continue decreasing; 32.1% of men and 24.1% of women's responses indicate reduction of livestock in number because of starvation; 19.0% of men and 13.3% of women's responses indicate continuous decrease in crop yield; and 10.4% of men and 10.3% of women's responses indicate continuous increase in hunger and/or food shortage. In the case of family relationship and/or bond, 27.3% of men responses expected family conflict and divorce rate to increase; men to migrate or abandon their families (11.7% of women's responses); and almost the same percentage of men (17.1%) and women's (16.0%) responses anticipated children to migrate to other villages and/or towns including Dodoma and Dar es salaam to fight for their future. Only 4.3% of men and 3.2% of women's responses anticipated family relation to improve or become better.

DISCUSSION

Both men and women have perceived the changes in climate and have predicted that climate will continue to change in the future. They have clear perception on the change in rainfall, temperature, strong wind and drought. Rainfall is more erratic, more unpredictable and continues to decrease in amount; and also temperature and strong wind have increased. Changes in rainfall, temperature and strong wind were the main causes of drought and increase in bad years in the 1990s compared to the 1970s. Responses of respondents were supported by trends of anomalies of meteorological data which showed that rainfall had decreased in Bahi and Kondoa districts and both minimum and maximum mean temperature; also mean wind speed of Dodoma Region had increased. The same observations are reported in various climate change literature including United Nations Framework Convention on Climate Change (UNFCCC) (2007), IPCC (2007), Ishaya and Abaje (2008), Mongi et al. (2010) and Nature (2011), showing/predicting an increase in temperature, drought (especially in semi-arid areas) and a decrease in precipitation in parts of Tanzania and other areas of Africa.

Besides, the study was conducted in the villages where research especially on climate change was inadequate and the education level was low (mainly primary school education level). But using available knowledge system respondents managed to perceive and identify climate change indicators in the study area. This is in addition to the fact that the area is in a semi-arid where drought is prominent, but they managed to differentiate the condi-

tion they were experiencing in the 1990s from the situation they had experienced in the 1970s. In the 1970s the bad years were few and one bad year could be followed by more than four consecutively good years, before experiencing another bad year (Mwanga, 2002). The farmers used coping strategies (short term adaptation practices) to cope with the harsh environment conditions, hoping the situation would improve after a year or two. But in the 1990s bad years have increased because of climate change; the situation that requires farmers to be motivated to implement long term adaptation practices (Chaudhary and Aryal, 2009; Hartter et al., 2012; Haque et al., 2012).

Likewise, respondents perceived and described climate change differently depending on sex, location/village, ethnic groups and marital status. Perception of respondents on the change in rainfall varied by sex, the difference that could probably be explained by the existing different socially constructed roles and responsibilities between men and women (Brody et al., 2008; Agwu and Okhimamhe, 2009; UNFPA, 2009; UNDP, 2009). For example, women were subjected to various hardships including starving during food shortage or hunger; and collected water from far sources to fulfil their roles. Equally, men especially livestock keepers were forced to move livestock far away during dry season, sometime when it was very hot, to search for water and pastures. The challenges that both men and women experienced when struggling to fulfil their roles were among the causes of variation in perceiving the change in rainfall (Slegers, 2008; Speranza, 2010).

In addition, perception of respondents on the change in strong wind varied by location/village of respondents. The differences in perception could be explained by the diversity of topography and other features existing in the specific location including type of vegetation, as climate change literature indicates that effects of climate change are location specific (IPCC, 2007). For example, the Bahi District is in low altitude, it is dry and has experienced extensive deforestation compared to Kondoa District which is in high altitude, wet and is observing environmental management practices including tree planting and other measures to control soil erosion (Chamshama and Nduwayezu, 2002; Mongi et al., 2010).

Moreover, perception of respondents on the change in drought varied by ethnic groups and also marital status of respondents. Ethnic groups situate in specific location. For example, the Rangi reside mainly in Kondoa District which is wet compared to the Bahi District where the Gogo reside. Likewise, perception of respondents on the change in drought was reported to vary by marital status, a variable that has diverse groups including the married some of who are polygamists; and the single including separated, divorced, widows and widowers. Differences in the level of wealth/adaptive capacity and family size can be among the main sources of variation in perceiving drought among the married and single groups (Meena and Sharif, 2008). In the study area for example, most married men and women especially the polygamists had big family sizes, big farms and a big number of livestock. When severe drought occurred most of their crops were damaged and livestock died, events that caused them to experience big losses compared to the single groups (Slegers, 2008; Speranza, 2010). While perception of respondents on climate change in the study area varied by sex, location, ethnic groups and marital status, other studies have shown that farmer's experience, availability of free extension advice, formal education, social interactions and access to information had also influence on perception (Maddison, 2006; Gbetibouo, 2009; Hartter et al., 2012). This indicates how elements influencing perception on climate change can vary from one location to another.

The study focused on gender and obtained disaggregated data, the information required in order to formulate effective climate change interventions/adaptation options (Lambrou and Piana, 2006; UNFPA, 2009). The disaggregated data obtained from this study are useful information for the researchers/scientists, agriculture and livestock sectors and Tanzania NAPA. The information can be used as a base by the NAPA when formulating adaptation options. Moreover, since the main actors in rural areas are the individuals dealing with agriculture, adaptation options developed by the NAPA can be incorporated in districts' one year rolling plans or in the recent instituted five year plan instead of the NAPA to work alone. Equally, feedback meetings with stalk-holders (District Agricultural and Livestock Officers and District Development Officers) and sensitization and/or awareness creation seminars on the causes and threats associated with climate change to the grass-roots can give climate change appropriate weight during participatory development problems identification. This will enable climate change adaptation needs to appear in District Agricultural Development Plans (DADPs) in order to be considered for funding.

CONCLUSION AND RECOMMENDATIONS

Both men and women have perceived climate change and have clear perception on the change in rainfall, temperature, strong wind and drought. They managed to anticipate future threats of climate change arguing that climate change will continue to worsen. As rainfall amount will decline, crop and livestock yield/productivity will continue to decrease and family bond/relations will deteriorate. The field based findings corresponded well with trends of anomalies of meteorological data that showed a decrease in rainfall amount for the Bahi and Kondoa districts; an increase in minimum and maximum mean temperature; and mean wind speed for Dodoma Region. Findings also agreed with climate change literature and findings of other scientists that showed/

predicted an increase in temperature, drought (especially in semi-arid areas) and a decrease in precipitation in parts of Tanzania and other areas of Africa. The findings have addressed an important knowledge gap and provided significant information to policy makers. The information obtained can be used as a base when formulating interventions/adaptation options to manage climate change problems in agriculture and livestock sectors. In addition, the trends of anomalies of meteorological data can be used to learn and/or monitor climate change. The study recommends the Least Developed Countries (LDCs) to use available knowledge systems to develop appropriate interventions to manage climate change problems; and use trends of anomalies of meteorological data to learn and/or monitor climate change.

Respondents perceived climate change differently depending on sex, location/village, ethnic groups and marital status. The underlying causes of the variation could probably be due to the existing differences in roles and responsibility between men and women; diversity of topography and other features existing in specific locations; and differences in the level of wealth/adaptive capacity and family size. This implies that location/ethnic groups and marital status are also important variables in understanding climate change perception. This suggests more location specific studies on climate change and gender, married and single individuals; and youths at the community level in agriculture and other important sectors in Tanzania in order to gather more / enough location specific areas of specific information.

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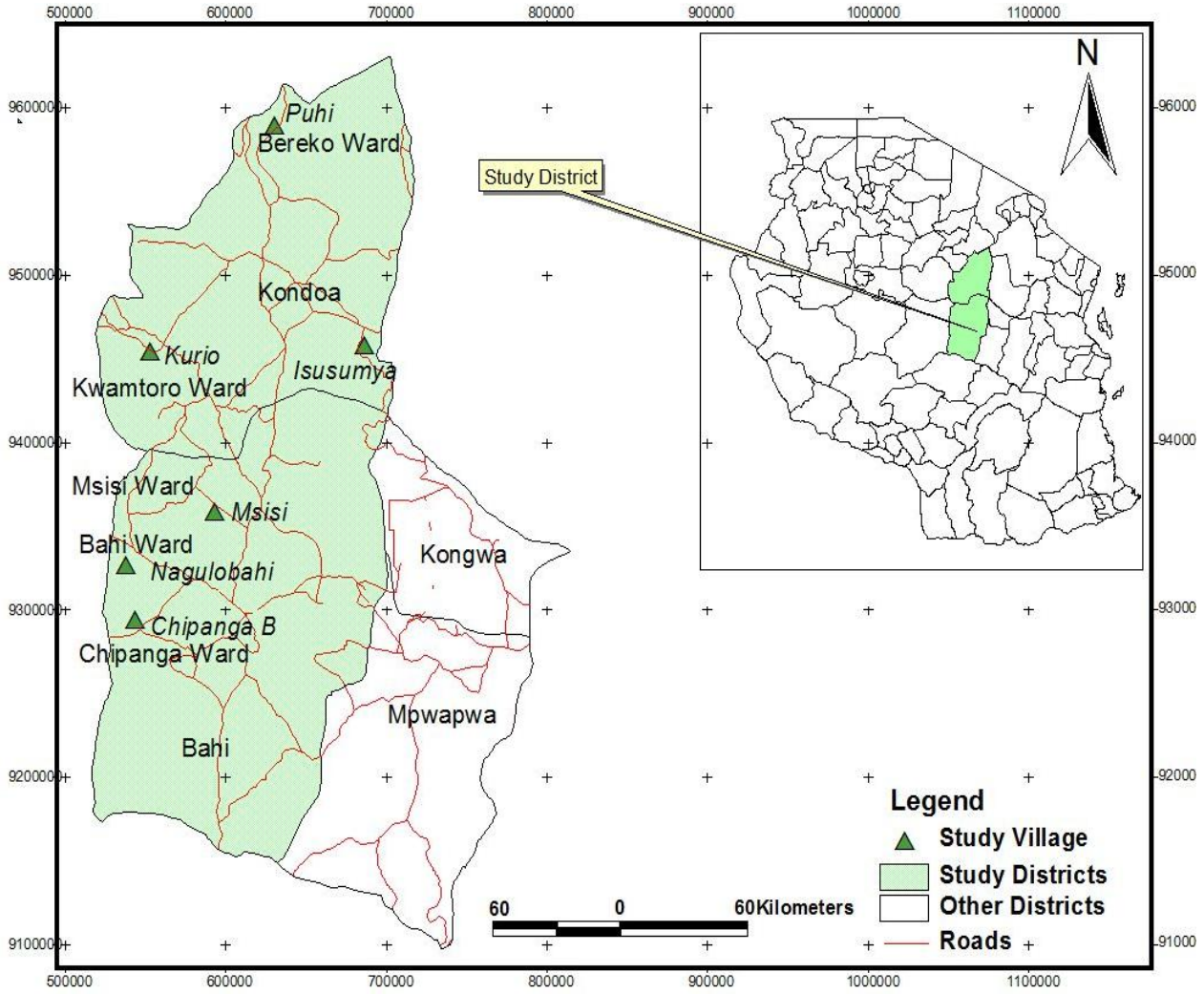
APPENDIX



Appendix 1. A map of Dodoma Region Tanzania showing study area.

Appendix 2. Item-total statistics of a change in rainfall, temperature and wind.

Climate change domain	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
The change in rainfall				
Rainfall amount in 1990s has decreased compared to 1970s	12.2528	19.532	0.593	0.825
Rainfall amount in 1990s has increased compared to 1970s	12.2500	19.074	0.643	0.819
Compared to 1970s in 1990s it has been difficult to predict rainfall onset	12.4083	20.632	0.534	0.832
Compared to 1970s in 1990s it is easy to predict rainfall onset	12.3667	20.606	0.524	0.834
Rainfall shortage is insignificant in 1990s	12.2333	19.104	0.642	0.819
Rainfall shortage is significant in 1990s	12.2500	19.074	0.643	0.819
Rainfall amount in 1990s is more irregular distributed	12.4083	20.632	0.534	0.832
Rainfall amount in 1990s is less irregular distributed	12.3556	20.642	0.519	0.834
The change in temperature				
Compared to the 1970s temperature in the 1990s has increased	11.6722	9.530	0.416	0.699
Compared to the 1970s temperature in the 1990s has decreased	11.6778	9.422	0.453	0.692
Compared to the 1970s the number of warm days during cold season in 1990s has increased	11.6833	9.181	0.479	0.686
Compared to the 1970s the number of warm days during cold season in 1990s has decreased	11.6806	8.953	0.510	0.679
It has been too hot during dry season in the 1990s compared to 1970s	11.7056	9.885	0.356	0.711
It has been too cool during dry season in the 1990s compared to 1970s	11.6722	9.341	0.479	0.687
Increase in temperature in the 1990s has caused uncomfortable nights in the 1990s compared to the 1970s	11.7000	9.837	0.309	0.721
Increase in temperature in the 1990s has caused comfortable nights compared to the 1970s	11.6778	9.589	0.352	0.713
The change in wind				
Frequency of heavy winds during rain season in 1990s has increased compared to 1970s	11.8333	12.947	0.371	0.718
Frequency of heavy winds during rain season in 1990s has decreased compared to 1970s	11.8194	12.867	0.389	0.715
Compared to the 1970s frequency of whirlwind in 1990s has increased	11.8111	12.672	0.375	0.718
Compared to the 1970s frequency of whirlwind in 1990s has decreased	11.8139	12.670	0.375	0.718
Whirlwind is the major cause of environment and water pollution in the 1990s when compared to the 1970s	11.8250	11.811	0.536	0.684
Whirlwind is the minor cause of environment and water pollution in the 1990s when compared to the 1970s	11.8167	11.844	0.529	0.686
Strong wind destroys crops regularly in the 1990s when compared to the 1970s	11.9056	12.855	0.433	0.707
Strong wind destroys crops rarely in the 1990s when compared to the 1970s	11.8889	12.879	0.412	0.710

Appendix 3. Item-total statistics of the change in drought.

Climate change domain	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
Compared to the 1970s frequency of drought in 1990s has increased	31.6250	29.522	0.301	0.728
Compared to the 1970s frequency of drought in 1990s has decreased	31.6083	29.481	0.304	0.728
The number of days of dry spell in 1990s has increased compared to 1970s	31.8222	30.637	0.206	0.735
The number of days of dry spell in 1990s has decreased compared to 1970s	31.8194	30.549	0.219	0.734
Drought is significant in the 1990s	31.7417	29.752	0.350	0.725
Drought is insignificant in the 1990s	31.7417	29.802	0.332	0.726
Compared to the 1970s in the 1990s water amount has decreased due to drought	31.7556	29.962	0.282	0.729
Compared to the 1970s in the 1990s water amount has increased regardless of drought	31.7611	29.820	0.301	0.728
Compared to the 1970s wetland area in 1990s has decreased due to drought	31.7722	30.020	0.303	0.728
Compared to the 1970s wetland area in 1990s has increased regardless of drought	31.7694	30.183	0.287	0.729
Compared to the 1970s water sources in 1990s have decreased due to drought	31.7222	29.789	0.250	0.733
Compared to the 1970s water sources in 1990s have increased regardless of drought	31.7194	29.812	0.247	0.733
Compared to the 1970s insect pest attack to crops in 1990s has increased	31.7833	30.410	0.231	0.733
Compared to the 1970s insect pest attack to crops in 1990s has decreased	31.7917	30.310	0.244	0.732
Frequency of diseases attack to livestock in the 1990s has increased compared to 1970s	31.7556	29.132	0.322	0.726
Frequency of diseases attack to livestock in the 1990s has decreased compared to 1970s	31.7639	29.139	0.320	0.726
The amount of crop yield in 1990s has decreased compared to 1970s due to drought	31.8139	29.461	0.347	0.724
The amount of crop yield in 1990s has increased compared to 1970s regardless of drought	31.8056	29.516	0.337	0.725
Compared to the 1970s the amount of pastures in 1990s has decreased due to drought	31.7833	28.660	0.412	0.718
Compared to the 1970s the amount of pastures in 1990s has increased regardless of drought	31.7722	28.683	0.411	0.718