Farmer's perceptions on climate change impacts in different rice production systems in Morogoro Tanzania

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Abstract- This study was done to assess farmers' perceptions on climate change impacts in different rice production systems in Morogoro Tanzania. In specific the study analyzed farmers socio-economic characteristics in different rice production systems in Morogoro Tanzania and also examined farmers perceptions on climate change impacts in different rice production systems in Morogoro Tanzania. Both secondary and primary data using a structured questionnaires and focus group discussion were collected from Morogoro rural and Mvomero Districts in Morogoro Region, Tanzania. The study employed cross sectional research design by which data were collected at one point in time. However the sample size involved was 150 respondents. The analyses were done using descriptive statistics to analyze farmers socio-economic characteristics and Likert scale was used to assess respondents' perceptions on the climate change impacts in different rice production systems. The results indicate that socio-economic factors such as age, education level, household size and main activities of the household affect the climate change adaptation and coping strategies perception of rice farmers. Moreover small number of respondents believed that the climate change is threat to future food security, and also majority of farmers perceived that climate change might lead to crop failure, unpredicted seasons, drought and floods. The study suggested that there is a need for upscalling of awarewness, education and capacity building on good agricultural practices which will assist farmers to cope with climatic changes.

Index Terms- Farmers' perception, climate change, rice production system

I. INTRODUCTION

Among the modern global challenge is Climate change, climate change has been recognized as a foremost human and environmental crisis of the 21st century. Particularly in Africa and other developing regions of the world, climate change is a hazard to economic growth, long-term prosperity, as well as the survival of already vulnerable populations. Consequences of this include persistence of economic, social and environmental vulnerabilities particularly for the economic and livelihood sectors (IPCC, 2007; ISS, 2010). The consistency of variability of rainfall is a substantial constraint to the sustainability of rain-fed farming systems in least developing nation particularly sub-Saharan Africa (SSA) (Moyo et al., 2012; Unganai, 2000). Due to the fact that, most of SSA countries are heavily depending on rain-fed agriculture system a number of factors now tend to affect the sector such as rapid population growth which influence the changes in resource uses to accommodate the increasing population, this lead to destruction in the water catchment, environment at large and speed the rate of climate change effect (Moyo et al., 2012; Martin *et al*., 2000). The impacts of climate change in Africa are large and wide ranging, affecting many parts of people's everyday lives. Many climate change impacts studies predict negative impacts of climate change more specific on agricultural production and food security in large parts of sub-Saharan Africa (SSA) (FAO,2008 as cited by ISS,2010).Among important issue in agricultural adaptation to climate change is the way in which farmers apprise their expectations or perceptions of the climate in response to unusual weather patterns (Gbetibouo,2009). However perception refers to the process concerned with the acquisition and interpretation of information from one's environment (Maddox, 1995).Maddison (2006) described that adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them. Most researchers argue that environmental perceptions are among the key elements which influence adoption of adaption strategies. Nevertheless perceptions may be categorized based on context and location specific due to heterogeneity of factors that influence them such as culture, education, gender, age, resources, endowments, and institutional factors (Rashid et al., 2014).

Slegers (2008) as cited by Moyo et al., (2012) also indicated that experience is an important factor that shapes individuals' perceptions, in terms of seasonality, by which with bad experiences of the seasons which the climate was not supportive for agriculture production such as drought seasons conveying memories and being responsible for how farmers may tend to describe different season types. Even though there are several studies on climate changes in agriculture, and crop sub sector in particular (Mbillinyi et al., 2010; Herath et al., 2011; Nhemachena et al., 2010; Rowhan et al., 2011) still little is known regarding the farmers' perceptions on economic impacts of climate change under different emission scenarios, costs and benefits of adaptations in different smallholder rice production systems in Tanzania. These include the rain-fed upland rice, the lowland water harvesting-based and the irrigated systems.

This study aimed; i) To analyze farmers socio-economic characteristics in different rice production systems in Morogoro, Tanzania. ii) To assess farmers perceptions on climate change impacts in different rice production systems in Morogoro, Tanzania. The study aim to contribute in sharing the understanding and knowledge farmers perception toward climate change on rice farms, this will help policy makers and various projects aimed at generating adaptive strategies on climatic

changes specifically on how to approach these societies having prior knowledge on their perception.

II. METHODOLOGY

This study was conducted in Morogoro rural and Mvomero Districts in Morogoro Region, Tanzania, using a cross sectional approach by collecting data at one episode of time. A cross sectional household survey was carried out using a standard structured questionnaire and both qualitative and quantitative methods of data collection and analysis. Moreover, Primary data using focus group discussion with key informants were held. The questionnaire assessed farmers' perception of changes in rainfall, temperature and extreme weather events in the last 20-30 years and effects of climate change on crop production , rural – urban migration in the last 20-30 years , adaptation options used to mitigate the impact of climate change and demographic and Social- economic characteristics of the respondents.

Purposive sampling technique was used to obtain the study districts and villages. The main criteria for selection were the different agro-ecological zones and smallholder rice farmers. These agro- ecological zones were Rainfed , Rain water Harvesting and Irrigation. Morogoro rural and Mvomero Districts were purposively selected for the study. A total of three villages were purposively selected, that is, one village from Morogoro rural District which is Kiroka and two villages from Mvomero District which Mgongola and Mkindo area practicing Rainfed , Rain water Harvesting and Irrigation system respectively.

In each village, sampling frame was used to select a random sample of 50 smallholder farmers from the village household register. For the sampled household, the head or his representative was interviewed. Therefore, the study covered 150 respondents in total.

The study adopted descriptive analysis method in analyzing farmers' socio-economic characteristics in different rice production systems in Morogoro Tanzania. In assessment of farmers' perception on climate change impacts, Likert scale was used to assess and present findings of respondents' perceptions on the climate change impacts in different rice production systems. For each perception measuring statement respondents were asked to state whether they agree, strongly agree, disagree, strong disagree or were neutral (Undecided). In analysing the responses, agree and strong agree responses were combined into one category to indicate strongly agree while disagree and strong disagree were combined to indicate strongly disagree and neutral were treated as don't know (undecided). For qualitative data collection, focus group discussions and key informant interviews were used.

However focus group discussions were done in the three villages. The group participants and key informants were chosen with the intent of balancing social aspects such as gender, age and geographical dispersion in the target areas. During the discussion, a checklist with guiding questions was used. The information gathered included farmers perception on climate change impacts, adaptation strategies used in the community by farmers, challenges faced when adapting, costs and benefits of adaptation, production practices used by rice producers and climatic trends for the past few years. Focus group discussion was useful as it allowed freedom of expression and maximum participation in respect to knowledge, experience, opinions and feelings.

III. RESULTS AND DISCUSSION

Demographic and Social-Economic Characteristics of the Respondents

The socio-economic profile of the respondents examined were age, marital status, household size, education of the respondent, main activities of the respondents, perception on climate as follows:

Age of the respondents

The distribution of the respondents according to age was presented in (Table 1). The age of the respondent indicated that experience had an influence on agricultural production and adaptation options. A large proportion of respondents were 32-51 years old, followed by over 51 years old and few respondents were in the age below 32 years old. This implied that rainfed area had large group (58%) of active people aged between 32-51 years followed by irrigated (56%) and rainwater harvesting area (44%). Therefore, results of this study revealed that, many of the households' heads were in the age group of active people and could take actions on adaptation measures on the climate change.

Education level

The distribution of respondents by education level indicated that most of the respondents in irrigated area had primary education (78%) and beyond secondary education (4%) compared to non-irrigated areas (Mgongola and Kiroka). Rainfed area had high level of illiteracy (28%) compared to other villages. In addition, rainfed and rainwater harvesting areas had equal number of respondents with secondary education (6%) compared with respondents from irrigated (4%) Based on these findings, one could infer that farmers with high level of education marginally had more knowledge and information on good agricultural practices, coping and adaptation strategies and, those farmers with tertiary education were able to synthesize information much better than those who had less formal education or illiterate. This indicated that farmers' education and skills were important factors in production activities; adaptation of strategies (options) against adverse effects of climate change.

Household size

Irrigated area had higher percentage of the household size, 5-7 members, (48%) compared to rainfed area (42%) and rainwater harvesting area (38%) locations (Table 1). Results from this study indicated that large household size might have positive impact in the improvement of the productivity especially if members fully participate in farming activities. These findings indicated that households with large farm size were more likely to engage in agricultural production, take advantage of high production in agriculture and are more likely to adapt to climate change.

Main activities of the head of the household

Majority of the respondents in rainwater harvesting areas (72%) were engaged in crop production and, other activities (28%) such as causal labour and livestock keeping. Most of the respondents in rainfed areas (44%) engaged in crop and livestock production compared to irrigated (16%) and rainwater harvesting (12%). The majority of the people in irrigated area (18%) earned

their living from crop production and business followed by rainwater harvesting (16%) and rainfed category (10%). This suggested that, crop production was the major activity in the study area followed by livestock keeping while off farming activities and engagement of work for wages were taken as coping strategies to supplement income and against climate change impact in the study area.

Table 1: Distribution of respondents by social and economic characteristics

	Kiroka (Rainfed)		Mgongola (RWH)		Mkindo (Irrigated)	
Variables	Frequency	%	Frequency	%	Frequency	%
Sex						
Male	25	50	32	64	35	70
Female	25	50	18	36	15	30
Total	50	100	50	100	50	100
Age						
< 32	9	18	12	24	12	24
32 – 51	29	58	22	44	28	56
Above 51	12	24	16	32	10	20
Total	50	100	50	100	50	100
Education level						
No formal education	14	28	11	22	7	14
Primary	33	66	36	72	39	78
Secondary	3	6	3	6	2	4
Beyond Secondary	0	0	0	0	2	4
Total	50	100	50	100	50	100
Household Size						
< 2	6	12	12	24	7	14
3 – 4	18	36	17	34	14	28
5 – 7	21	42	17	34	24	48
8 – 10	3	6	4	8	4	8
11 and above	2	4	0	0	1	2
Total	50	100	50	100	50	100
Household Activities						
Crop production	21	42	36	72	33	66
Crop and Livestock	22	44	6	12	8	16
Crop and Business	5	10	8	16	9	18
Others (Livestock and causal labor)	2	4	14	28	0	0
Total	50	100	50	100	50	100

Source: Field Survey (2013).

The Perception of Farmers about Climate Change Impact

Threat from climate change

The perceptions regarding threats from climate change impacts differed among farmers (fig. 3). The study found that climate change was perceived to have more impact on agriculture than on other sectors, as agriculture depended much on rainfall compared to other sectors. A few respondents (about 2%) perceived climate change impacts in the health sector and fuel wood availability. While (10%) of the respondents in rainfed system perceived that there were no threats from climate change in any of the livelihood sectors. This was due to lack of knowledge and awareness on the impacts caused by the climate in those sectors.

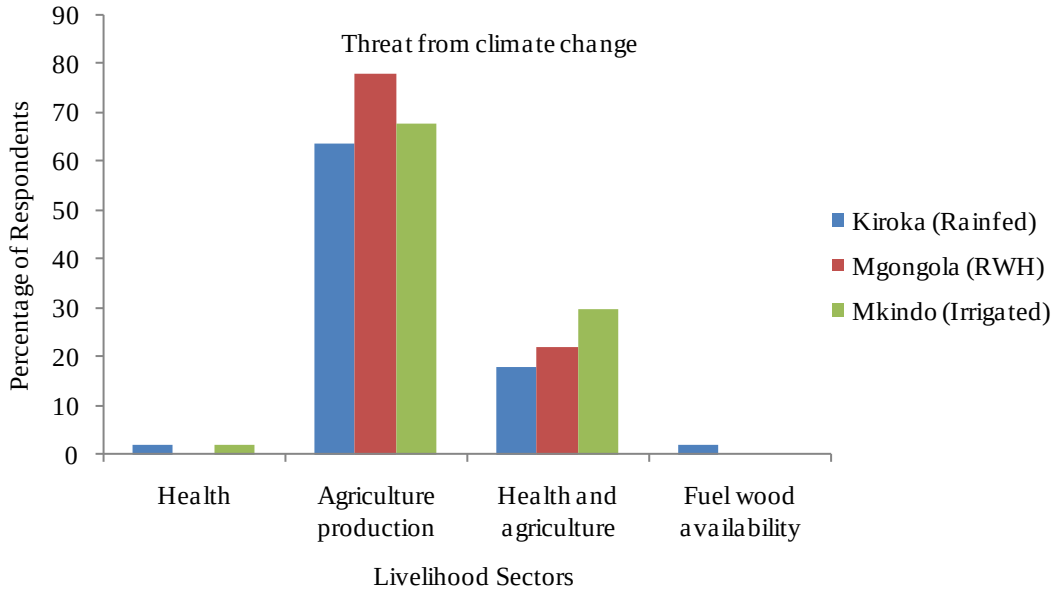

Figure 1: Farmers perception on threat from climate change

Perceived impacts of climate change on rice production

The majority of the respondents (98%) across the rice production systems perceived climate change to have impacted negatively on rice production (Fig. 4). Climate change impacts all the production systems with differing magnitude of impacts on yields that cannot be explicitly conceived in mere perception of farmers. Under a changing climate, with no adaptation, rainfed areas and RWH experienced low yields of 0.72 tons per hectare, which was below the average national rice production in comparison with other systems. For example, RWH and irrigated systems had production level of 1.24 and 4.51 tons per hectare, respectively, under a changing climate. Therefore, farmers were aware of the adverse effects of climate change on rice production.

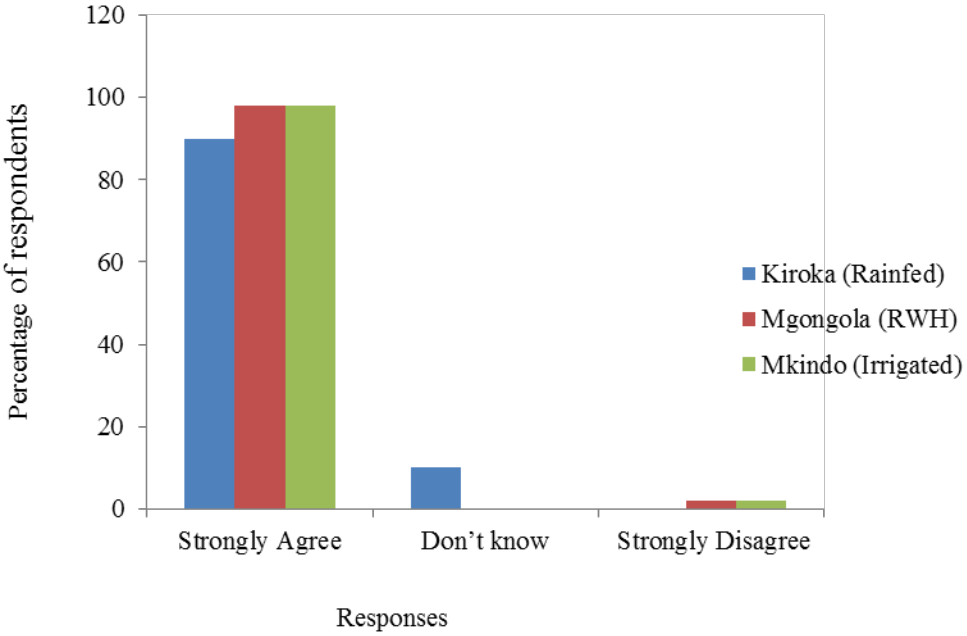

Figure 2: Perception of climate change impact on rice production

Rainfall-related production risks

Results from the FGDs conducted in Rainfed, RWH and irrigated areas indicated that there were changes in rainfall patterns for the past thirty years. For example in the past 30 years (1980's) *Masika* rain season regularly started from March to June; the dry season started from July to August; and *Vuli* from September or mid-October. In Kiroka where rainfed rice production is practiced, for the past 30 years *Masika* regularly started from February to June; the dry season from June to July; while *Vuli* started from August to September. Due to heavy

rainfall in year 1999, irrigated areas experienced floods which had big impacts on their livelihoods (Daninga, 2011).

Furthermore, respondents reported that in recent years the *Vuli* and *Masika* rains were not predictable in Irrigated and RWH areas. *Masika* usually lasted from February to July while *Vuli*, with relatively low amount of rainfall, lasted from September to December. These seasons' patterns led to change in the crop pattern and for example, the main crops grown currently were rice and maize. In Kiroka where rainfed rice production is practiced, currently *Masika* lasted from February to April; the dry season from May to September; while *Vuli* lasted from October to December and the main crops grown were banana, maize, sorghum, cassava and rice. Therefore, the changing pattern of rainfall regime resulted into a number of production risks that farmers had to bear over time.

Flooding

Results in Table 5 show that about and over three quarters (74% and 88%) of the respondent farmers in RWH and irrigated areas concurred with the argument that due to the change in rainfall pattern, the incidences of floods had increased in their areas. The incidences of floods were relatively less perceived by farmers in a rain-fed farming system.

Table 5: Perceptions on flooding risk

Responses	Kiroka (Rainfed)		Mgongola (RWH)		Mkindo (Irrigated)	
	n	%	n	%	n	%
Strongly Agree	33	66	37	74	44	88
Don't know	5	10	0	0	0	0
Strongly Disagree	12	24	13	26	6	12

The lowland irrigated and RWH crop land landscapes are prone to flooding with high intensive rains. For example, in year 1999, floods occurred in Mgongola and led to the destruction of houses and farms. In rain-fed uplands, the hilly land scapes facilitated drainage of excessive rain currents down the slopes, hence reduced the threat of flooding.

Crop failure

The results in Table 6 indicate that majority of respondents (88%-100%) across the rice production systems perceived that rainfall related risk due to climate change and variability caused crop failures.

Table 6: Perception on crop failures risk

Responses	Kiroka (Rainfed)		Mgongola (RWH)		Mkindo (Irrigated)	
	n	%	n	%	n	%
Strongly Agree	44	88	50	100	45	90
Don't know	5	10	0	0	1	2
Strongly Disagree	1	2	0	0	4	8

These observations corresponded with the findings from the study reported by IFPRI (2007) that, farmers perceived that drought, heavy rainfall and floods were the major causes of crop failure. This implied that rainfall fluctuation also affected crop production much in the study area.

Drought risk

Drought aggravated by climate change and variability has led to impacts in crop production. These impacts include reduced and failed crop yields, increased crop pest infestation and diseases. Results in Fig. 5 show that most of the respondent farmers (> 90%) agreed that drought had adversely impact their rice production. According to Daninga (2011) the high frequency of drought was a result of numerous economic activities. This culminated into the destruction of the environment and adversely affected rainfall formation cycle hence minimizing chances of having rainfall in the area. For example, it was observed that due to increased population pressure forests had been encroached by farmers in search of agricultural land and firewood collection.

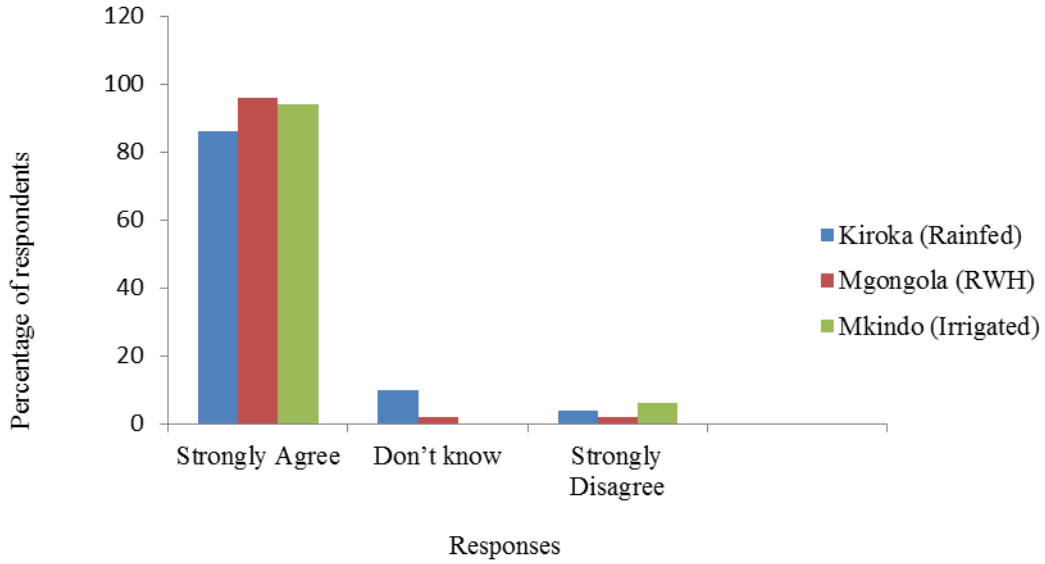

Figure 3: Farmers perception on drought risk

IV. CONCLUSION, RECOMMENDATION AND POLICY IMPLICATION

The study concluded that, socio-economic factors affect the perception of rice farmers in that areas studied. Among these are age of the respondent which is proxy for experience and this shows that it had an influence on agricultural production and adaptation options. Households' heads found in the study were in the age group of active people implies they are able to take actions on adaptation measures on the climate change. It was clearly observed that farmers with high level of education marginally had more knowledge and information on good agricultural practices, coping and adaptation strategies on climate change. However households with large farm size were more likely to engage in agricultural production and are more likely to adapt to climate change. Among the main activities, crop production was the major activity in the study area followed other off farm activities which were taken as coping strategies to supplement income and against climate change impact.

Small number of respondents believed that the climate change is threat; this was due to lack of knowledge and awareness on the impacts caused by the climate in those sectors. Majority of rice farmers across the rice production systems perceived climate change to have impacted negatively on rice production. Respondents perceived that in recent years the rains seasons were not predictable in Irrigated and RWH areas but also; floods were relatively less perceived by farmers in a rain-fed farming system the rice production systems perceived that rainfall related risk due to climate change and variability caused crop failures. Moreover drought had adversely impact on the rice production system in the study area.

This suggest that more education and awareness or capacity building programs on good agricultural practices which will enhance increase in productivity in line with climate change should be up-scaled to rich many farmers as results show that the perception of the threat that may be caused by climate change is still very low. This indicates the awareness of impact of climate change is not known to farmers.

Government as the policy and law making Institution has to play most influential part to ensure climatic mitigation and adaptation at all levels. It is the main responsibility of the government to prepare a planned and proactive strategy to secure good functioning of the social, economic and agricultural system. The respected authorities also need to check the significance of the necessity of farmers' expectations of new supports from time to time to take appropriate steps and support the affected farmers. Moreover, Government institutions need to put more efforts into providing farmers with accurate weather forecasts as most farmers have no confidence in the weather forecasts received. This will enable farmers to fully exploit seasonal rainfall distribution so as to improve and stabilize crop yields.

In addition to that small-holder farmers need to be supported by different institutions and Government in the adaptation process like efficient usage of water resources in agriculture due to the fact that rain has becoming more erratic and with delayed onsets of rainfall there is need for the government through scientist and policy makers to facilitate the development and dissemination of agricultural technologies such Irrigation schemes and the usage of integrated pest management as this will help in forecasting extreme climatic events like floods, disease and pest outbreaks in Tanzania.

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DECLARATION OF INTEREST

The author of this paper declare no any conflict of interest with any part.

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