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Brown Gwambene

Lecturer/ Researcher, Department of Geography, Faculty of Social Sciences and Entrepreneurship, Marian University College, P.O. Box 47, Bagamoyo, Tanzania

E-mail: gwambene@gmail.com

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SMALLHOLDER FARMER'S PERSPECTIVE TO RESILIENCE: ADAPTATION CHALLENGE IN INCREASING CROP PRODUCTION IN THE SOUTHERN HIGHLANDS OF TANZANIA

Brown Gwambene*[1]
**E-mail: gwambene@gmail.com*

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ABSTRACT
Building resilience and adaptation measures among the smallholder farmers are constrained by low capacity to sustain the viable measures. This is expressed by farmers' ability to prepare and adjust to the resulting stress at household levels. This paper aims to assess the adaptation challenges among the smallholder farmers for improving resilience to the impacts of climate variability. The study used a combined method that involves both qualitative and quantitative sources of data that include key informant interview, focus group discussion and household questionnaire. The data were organized, processed and analyzed by using trend and content analysis of qualitative data whereas the Statistical Package for Social Science (SPSS) and Microsoft Excel software were deployed for quantitative data. The result revealed that smallholder farmers use both the local traditional and conventional measures for increasing resilience and reducing vulnerability to the impact of climate variability. Nevertheless, land, climate and conditioning factors hindered or promoted adaptation measures. Since the instance, changes in agricultural practices accelerate impact on production and land productivity. Thus, to increase resilience, substantial improvement in policy and practice for smallholder farmers is important. This needs to enhance resilience of smallholder farmers against changing environmental conditions and providing the enabling environment for increasing adaptive capacity.

1. Introduction

Climate change and variability already affected agriculture and projections show it's likely to have further impacts on the potential agriculture regions (URT, 2015; Mbilinyi et al., 20162). The farmer has a real problem in making a decision. The risks are extremely high (Mbilinyi et al., 20162; Chona, 1989) that is why many people fear investment in farming. The farming has been undervalued, underestimated, discouraged and underachieving and it will continue to be so unless there is leadership (URT, 2015; Chona, 1989). Given the limited opportunities for increasing yields by applying modem technology, farmers are attempting to increase production by extending the area under cultivation (Gwambene, 2011). In the forest zone expansion leads to shorter fallow periods and declining soil fertility, deforestation of upland watersheds also causes erosion, drought, and flooding,

[1] Dr. Brown Gwambene, Lecturer/ Researcher, Department of Geography, Faculty of Social Sciences and Entrepreneurship, Marian University College, P.O. Box 47, Bagamoyo, Tanzania

which further reduce the productive potential (Gwambene, 2011; Kalungu et al., 2013; World Bank, 2013). These changes will especially affect more smallholder farmers, due to their dependence on agriculture for their livelihoods which are sensitive to changes and have limited alternatives or no other means of earning their living (Oxfam, 2012).

The African agricultural production systems are typically resource constrained, organizationally complex, and ecologically vulnerable, their sustainability can only be ascertained through their effective management (World Bank, 2013). Added to this is the fact that the small farmer lacks the essential long-term resources investment to acquire various farm equipment and machinery, as well as the short-term fiscal resources to meet cash input purchases. All these have accumulated in serious under-investment in the sector and in the persistence of obsolete and primitive technology and consequently led to the failure to production (Chona, 1989; Oxfam, 2012).

Climate change could have positive impacts on some of the area, regions that results in increasing crop production and land productivity. However, without proper adaptation and mitigation measures, it is unlikely for smallholder farmers to realize the benefits of climate change and variability (Gwambene, 2011; Oxfam, 2012). Climate change poses more challenges among the smallholders farming communities who depend on climate-sensitive for their production. Also, climate change is likely to adversely affect agricultural production in smallholder farmers. Therefore, adaptation and mitigation measures are urgently needed to increase resilience among smallholder farmers and improve food security and household livelihood (Gwambene and Majule, 2010).

Smallholder farmers are already attempting, but struggling to adapt to the changing environment. Consequently, they are not well supported in their struggle (Obasanjo, 1989; Oxfam, 2012; Mbilinyi et al., 2016). Smallholder farmers are already affected by the changing environment, yet have to invest their limited resources in adaptation measures. Also, the adaptation measures require an increased workload among smallholder farmers with limited technology (World Bank, 2013; Oxfam, 2012). The adaptation strategies must address the needs of smallholder farmers at the local level across the Agra-ecological gradients, diverse ecosystems and create realistic opportunities. This paper focus on the experiences of smallholder farmers and another stakeholder in agricultural production in the southern highland of Tanzania. A long-term commitment and awareness of the challenges are crucial in the success and improvement in agricultural production and food security. Whereas, acceptable options available for action from decision makers and responsive to the specific situation need to have a wide range of stakeholders.

2. Materials and methods

The study used a combined method that involves both qualitative and quantitative sources of data for triangulation and employed different tools and methods to collect and validate information. The key informant interview and focus group discussion were used to obtain the qualitative data while the quantitative data were mainly through household surveys. Extensive participatory methods and tools that focus on collecting information on smallholder farmer's perspective, resilience and adaptation challenges in crop production were employed. Both reviewing of existing literature and survey methods were used in gathering information. The survey, focus group discussions, household survey and key informant interviews collected both socioeconomic and biophysical information. Whereas the literature reviews (secondary sources) focused on collecting data from different sources including the internet, survey reports and institutional documents.

Questionnaire and guiding checklist for FGD and interview guide for target group were designed and used for data collection. Open and close-ended questions were used at household with the purpose of unveiling the system of knowledge and structuring of ideas essential to the respondent's own view of the studied problem. A combination of closed and open-ended questions in a questionnaire used with close-ended questions put at the beginning of the survey tool, then allow for more expansive answers once the respondent has some background on the issue. Also, some unstructured interviews carried out to complement the quantitative data. Specifically, key informant interviews and focus group discussions carried out as part of qualitative data collection.

Information collected from different data sources, including focus group discussions, household survey, Key informant interviews and observation were organized, processed, compiled, and analyzed through qualitative and quantitative methods. The content and trend analysis were used in analyzing qualitative data, whereas quantitative data was analyzed by using Statistical Package for Social Sciences (SPSS) and Microsoft Excel software. The analyzed information formed the basis for discussions and interpretations focusing on the specific requirements.

3. Results and Discussions

3.1 Perception on adaptation measures

Climate change threatened the ability of smallholder farmers to properly adapt, particularly those who depend on rain-fed agriculture, to sustain tangible amounts of agricultural production. To improve and sustain the crop production would require surmountable effort on ameliorating adaptive capacity of smallholder farmers, improving effectiveness of extension delivery and coverage. Subsequently, identify the socioeconomic context to set priorities with farmers and taming agricultural technology generation and transfer. The perceived improvement in agricultural production was due to the use of improved varieties, use of fertilizers through a voucher system, and increase in extension services education on agronomy practices.

The smallholder farmers play a central role in the agricultural production process. They use the knowledge, which they have acquired through the process of inter-generational transfer of farming skills, based on trial and error methods. Such experience helped them in coping and adapting to the impact of environmental change and climate variability. The viability of this measure is indicated by Skewness =1.328 with Std. Error.374 and Kurtosis 1.060 with Std. Error.733 (indigenous n = 40) and Skewness =1.473 with Std. Error.319 and Kurtosis 1.326 with Std. Error.628 (n = 56 conversions). Table 1 below indicated the viability of adaptation measures to food shortage.

Table 1 Viability of adaptation measures to food shortage

The viability of adaptation measures	N	Mean	Std. Deviation	Kurtosis	Std. Error
Use climate resistant crop varieties	40	1.63	.868	1.060	.733
Expansion of agricultural activities	38	1.97	.944	-.421	.750
Collecting and eating wild foods	21	2.43	1.076	-1.272	.972
Movement to key resource areas	21	2.67	.913	-.245	.972
Casual labour (Work for cash)	54	1.78	.816	.287	.639

The viability of adaptation measures	N	Mean	Std. Deviation	Kurtosis	Std. Error
Casual labour (Work for food)	46	1.72	.834	.654	.688
Migrating to other places	23	2.78	1.043	-.347	.935
Buying food	56	1.32	.543	1.326	.628
Getting assistance from relatives	31	2.23	1.055	-1.393	.821
Selling household assets to buy food	38	2.00	.900	-.648	.750
Borrowing food	34	1.88	.880	-.798	.788
Reducing the number of meals	39	1.59	.715	-.580	.741
Eating unusual foods	26	2.12	.952	-1.373	.887

It is not easy to predict the future of farming activities because of unpredictable weather conditions. However, farmers anticipated an increase in income if more education will be provided to smallholder farmers. The result revealed that smallholder farmers are using traditional indigenous strategies and conventional measures/strategies in increasing resilience, adapting and mitigating the impact of climate change and variability. Traditionally smallholder farmers in the study area adapt to changing climate through replanting, controlling pests, timely farming preparation, use of early maturing crop variety seeds, using draught tolerant crop and irrigation. Also, in rice production, farmers do use seedlings instead of seeds. The most effective adaptation strategies reported during FGDs include access to extension services, environmental management/ protection such as tree planting, use of proper farming methods and growing weather tolerant crop varieties.

3.2 Adaptation challenges of smallholder farmers

Erratic weather conditions and environmental degradation are among the important factors which impinge on the sustainability of food production systems among smallholder farmers. There are crops that require less water and can make use of available soil moisture to give reasonable yield levels. Dynamics in crop production involves changes and adjustments on the cropping calendar which is synchronized with the period that is expected to have more steady rainfall, and by considering the water requirements of crops at different stages of growth and development. The production challenges, including climate change and variability that increase pests and diseases and soil exhaustion that increased demand for inputs, especially, fertilizers and pesticides that are too expensive for them. Production cost in crops is very high because of the need of fertilizer and pesticides which are expensive for low income farmers as compared to the output. For example, round potatoes have high production cost due to high price of fertilizers and pesticides. This resulted to many small farmers, especially those with the low income to abandon the crop. Figure 1 below shows the smallholder farmers' adaptation challenge in the southern highlands of Tanzania.

Major gaps in infrastructure for research, extension services, input supply, post-harvesting losses and marketing degradation of the agricultural base, droughts and other processes posed greater challenges in agricultural production. A dynamic cropping calendar, cropping season/ growing season and modification of cropping system or crop combination, or crop rotation (Daniel and David, 2011;

Kangalawe, 2012) form the bases for deciding on what crops to produce. Such challenges in agricultural production call for the rationality in the production process.

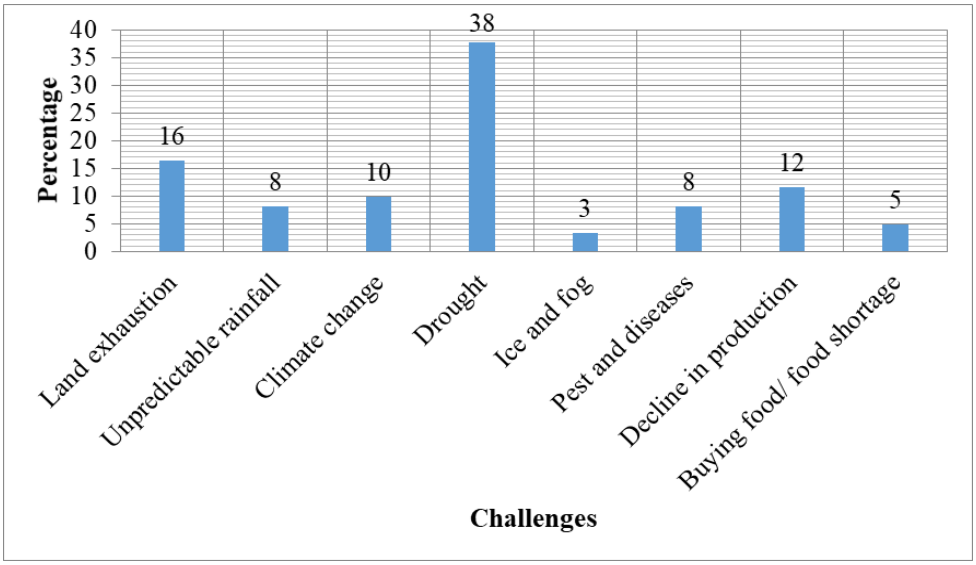

Figure 1 Agricultural crop production challenges

The effort is needed for the generation of information and the development of innovative and improved technologies to adapt to future situations, and to enhance the climate resilience of vulnerable communities. This requires substantial planning and adjustment of adaptation measures and improvement in knowledge and experience. Such improvements should include long-term and comprehensive (integrated) programs that promote an understanding of agricultural production, the interactions between social/political structure and functions as well as ecosystem attributes.

Building resilience in adapting to the negative impact resulting from climate variability and environmental changes, is essential to reduce the risks of climate change in the agricultural sector. This can be achieved through addressing many of the main challenges related to land use, food security, as well as biodiversity and ecosystem management. The results indicate that such adaptation and mitigation measures were affected by farmers' incentives and conditioning factors that hindered or promoted adaptation strategies. For instance, changes in agricultural practices accelerated impact on crop productivity and affected household income. This will need the provision of extension to farmers which provides a forum whereby technical information is disseminated to the end users. The concerted effort of the extension services to reach smallholder farmers meant more information going to the target group and thus a positive impact on production.

3.3 Smallholder farmers' adaptation options and resilience

Development of agricultural technologies and adaptive strategies ought to incorporate a complete understanding of why farmers do what they do and how they can do better, reduce cost and effort. Smallholder farmers need to be trained in adaptation and mitigation strategies that can be attained in their capacity. Increasing resilience for smallholder farmers requires improving food security, income and substantial changes in policy and practice. These changes need to enhance the adaptation and resilience of smallholder farmers against changing climatic conditions and providing the enabling environment for increasing adaptive capacity.

The results revealed that smallholder farmers adopt new technology and practices based on rational choice and security in production. Thus, incentives are needed to influence the choices of individuals in crop production for food and livelihood security under increasingly constrained environmental conditions. Incentives in crop production maintain and enhance environmental and cultural services concurrently sustain productivity and increase diversity of food production. Figure 2 shows the factors that prompt smallholder farmers' decision on adaptation measures.

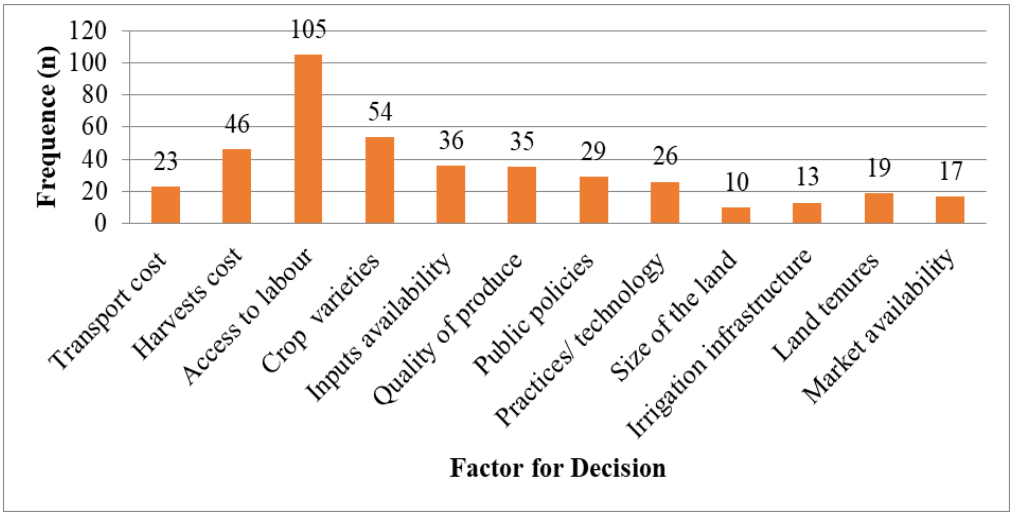

Figure 2 Factor on crop production decisions among smallholder farmers

Low technology, shortage of farm labour and low labour productivity limit output in smallholder farmers and subsistence production systems. Although farmers can plant in rows using the traditional hoe, there is an acute shortage of labour to perform this task. The harvest in most cases is hampered by the lack of efficient tools that need to put in place mechanisation and practices to improve crop production. More efficient forms of appropriate technology and the concerted effort of the extension services to farmers are thus needed. It has been suggested that measures to improve smallholder farmers' capacity to increase food production and productivity, as well as to link to markets, will not only enhance their purchasing power but also increases wider food availability and so contribute to global food security (Obasanjo, 1989; Oxfam, 2011).

3.4 Resilience to climate change through changes in policy and practice

The results indicated that the policies, laws, strategies have impacted on agriculture, livestock and natural resources. Some policies, policy initiatives and strategies especially, at the level of implementation, have discriminated against the smallholder farmers. Yet in the country, over 75% of food marketed surpluses and supplies come from smallholder farmers. Basing on the focus group discussions and key informant interviews bylaws and policy that impacted smallholder farmers include inputs subside, market and land tenures. The input subsides reported to be inappropriate and late coming that benefited more the business group.

Policy implementation is among the structural and management challenge in crop production, for instance, within the agricultural sector itself, the policies are also inappropriate; often favouring the large farmer. In most African countries, the majority of agricultural producers are smallholder farmers. Neglecting the small farmers in any agricultural policy formulation means that strategies that define the

local circumstances will often be missed and consequently the policies will often meet passive resistance from the people (Oxfam, 2012). Also, this bias in policy within the agricultural sector failed the Green revolution to meet the needs of the small farmers. It is important to illustrate further the effect of this policy regarding food security and for designing appropriate policies. Individual, small farmers, too often lack awareness that they have a role to play in the national development efforts.

There is the need to ensure the use of the recommended amount and qualities of agricultural inputs (Seeds, fertilizers and agrochemicals) and facilitate the use of modern agricultural implements (machines). Also, educate farmers on recommended crop husbandry practices and training of farmers on irrigation techniques and management of irrigation structures to increase the agricultural out-put in order to improve the livelihood farming community.

4. Conclusions

The situation where farmers lack appropriate tools for agricultural production and are unfamiliar with appropriate techniques, the future of farmers and agriculture is uncertain. The absence of or frail adaptation and lack of support for smallholders that play a key role in ensuring food security in the face of current and future climate change accelerated uncertainty situation in agricultural production. Knowledge systems and initiative in science, technology, practice and policy are required in meeting the challenges, opportunities and uncertainties in agricultural production for smallholder farmers. From the farmer's perspective, the factors that have contributed to the present agricultural problem in smallholder farmer include; inappropriate policies with a bias against, and neglect of, the food and agriculture sector; inadequate investment in production, research, marketing, storage and extension services. Other problems are lack of technological change, environmental limitations; and institutional weakness and the lack of basic infrastructure. In reducing the vulnerability and increasing farmers' resilience more training on environmental management in farming practices within the area are needed for sustainability of agricultural production and the environment. In addition, implementation of long-term land, rental agreements, which would motivate farmers to invest in mid and long-term climate change adaptation measures. Moreover, the government needs to improve and promote advice to smallholder farmers/ peasants through a network of agricultural extension services. The extension workers must be able to recognize the adaptation strategies and the appropriate land management practices and they must, however, not lose sight of the existing traditional soil management methods and local adaptation measures.

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