Weather Related Challenges and Transitory Food Insecurity in Semiarid Mixed Crop-Livestock Systems in Manyoni District, Tanzania

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Abstract

Many studies done in Latin America, Africa and Tanzania have reported various experiences on impact of weather-related challenges; perception and adaptation strategies practiced in various farming systems mainly crop and mangrove communities. However, little is documented about the experiences of households depending on mixed crop-livestock systems in semiarid areas in Central Tanzania. Using Manyoni District of Singida Region as a study area, quantitative data were collected from 90 respondents/households. Structured questionnaire was used to explore in-depth information about knowledge on weather related challenges; number of meals taken per day; role of some demographic and socio-economic factors and constraints faced. SPSS was employed for data entry and analysis. The findings showed 92.2% had knowledge about weather related challenges including changes in temperature rainfall pattern and wind; number of meals taken per household per day varied from one (1) and two (2) meals; a Chi-Square model at $p \leq 0.05$ indicated that status of food in terms of the number of meals taken per household per day was determined by some demographic and socio-economic factors including age; size of the household, ownership and size of land; type and number of livestock owned as well as distance from areas of residence to the nearby urban centres. On the bases of these findings it is concluded that transitory food insecurity can be reduced/controlled if farmers are engaged in wide scope of income generating activities including livestock keeping. Therefore, Tanzania Livestock Research Institute (TALIRI) in collaboration with Local Government Authorities (LGA) and other development partners are encouraged to introduce livestock proven technologies and their packages for improved livestock production to cope with these challenges. In addition, livestock technologies should address production issues as well as identification of market opportunities to reduce transaction costs.

Key word: Livestock-crop producers, weather related challenges, Transitory Food Insecurity

Introduction

Transitory food insecurity which occurs when a household faces a temporary decline in the security of its entitlement and the risk of failure to meet food needs is of short duration. Transitory food insecurity is divided into cyclical and temporary food insecurity (CIDA, 1989, cited by Maxwell and Frankenberger, 1992). Temporary food insecurity occurs for a limited time because of unforeseen and unpredictable circumstances such as illness, weather instability and calamities including fire, floods or rodents devouring pastures and crops in field or crop products in store. Cyclical or seasonal food insecurity occurs when there is a regular pattern in the periodicity of inadequate access to food. It may be due to logistical difficulties or prohibitive costs in storing or transporting food. Studies conducted worldwide have shown that rural communities are highly affected by the impact of weather related challenges on food security. Studies conducted in East African region have shown how the issue of weather related challenges might be addressed in different levels including household (Thornton *et al.,* 2009). Likewise, Smit *et al.,* 2001 identifies several determinants that influence the preparation of any community to face weather

related challenges. These include economic wealth; skills or experiences; infrastructure; institution and equity. The same authors argue that the rural community members will be prepared to face weather related challenges based on the degree of these determinants. Henceforth, a present research paper builds on this framework to analyse some skills and experiences of individual households towards transitory food insecurity.

Several efforts have been in place to address the problem of food insecurity caused by weather related challenges by putting an emphasis on increased crops productivity, however, the great lakes report about regional project on food security suggests other key areas to be focused to achieve food security goals besides improving crop productivity; these include livestock production, research, extension services and access to markets (ICGLR, 2006). The same report puts an emphasis on the integration of scientific innovations and the use of farmers' indigenous knowledge/experiences in addressing the problem of food insecurity in the rural areas in a sustainable manner.

Since livestock-crop production is one of the important components in smallholder farming systems in Africa and Tanzania in particular, researches have shown that this system is also experiencing weather related challenges towards its role on food security in the community currently (Thornton *et al.,* 2009; Mongi *et al.,* 2010). Studies done in Latin America, Africa and Tanzania have reported various experiences on the impact of weather related challenges, perception and adaptation strategies mainly among crop producers and mangrove community dependants (Duivenbooden *et al.,* 2002; Mohamed *et al.*, 2002; Jones and Thornton, 2003; Mongi *et al.,* 2010; Schlenker and Lobell, 2010; Mbwambo ***et al.,*** 2012; Swai *et al.,* 2012; Richard *et al.,* 2013). The previous few studies conducted in Manyoni District on weather related challenges concentrated on climate change adaptation strategies and livelihood of smallholder crop producers (Richard *et al.,* 2013). However, little is documented about the position of the household's experiences regarding knowledge of weather related challenges and transitory food insecurity status. This is a case particularly in the communities engaged in complex farming system which involves non-farm/off-farm activities, crops and livestock production as their sources of food. This study therefore, sought to fill the present gap of knowledge by establishing the link between household's experiences on status of food under weather related challenges towards transitory food insecurity in mixed crop-livestock systems in Manyoni District particularly in Itigi division. The results obtained from this study unfold the household experiences to researchers, extension agents, Faith Based Organizations operating in the area and policy makers to design recommend and implement crop-livestock movements relevant to clients' experiences in their local areas.

Methodology

Study Area

The study was conducted in Manyoni District located in Singida Region Tanzania. The district was selected for the research because it is one of the areas situated in semiarid zones in Tanzania and it has some areas which have frequently experienced moderate to severe transitory food insecurity (URT, 2005). The district is characterised by inadequate and unreliable rainfall, high temperature and evaporation. Manyoni District has a uni-modal rainfall regime, which spans from November to April.

Research Design and Methods of Data Collection

A cross-sectional research design was used to collect data once from smallholders engaged in mixed crop-livestock systems in the community, an individual household being the sampling unit. The sampling frame consisted of all livestock-crop smallholders in Itigi division, Sanjaranda ward whereby three villages distinctively Gurungu, Kitopeni and Sanjaranda were surveyed. The surveyed villages were purposively selected based on the availability of integrated livestock and crop production systems where limited or no research especially on household experiences on whether related challenges and transitory food insecurity had

been conducted. Furthermore, the surveyed villages were within the project area where one of the Faith Based Organisations in Itigi named Sanjaranda Bible College and Rural Training Centre sought to understand the existing experiences in order to initiate farmers practical trainings to cope with challenges at the household level. The study used systematic sampling to select 30 households from each village to get a sample of 90 respondents from their respective households. Both primary and secondary data were collected. Quantitative data were collected using structured questionnaire while qualitative data were obtained through focus group discussion and key informant interview. A prepared checklist of items was used for the interview with nine (9) key informants (three interviewees in each of the three villages); and a focus group discussion guide was used in discussion to gather information from 24 (crops - livestock) smallholders who participated in three group discussions (eight participants in each of the three villages). The recommended number of focus group participants per session was eight (Barbour, 2011). Likewise, secondary data were obtained from the village and district offices.

Data Analysis

The quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) whereby descriptive statistics including means, percentages, frequencies and multiple responses were computed. Likewise, inferential analysis was done by using Chi-square model at $p \leq 0.05$ concomitantly with cross tabulations to analyze associations between some categorical variables such as demographic and socio-economic factors along with the number of meals taken per household per day.

The Chi-square model used is:

$$\chi^2 = \sum \frac{(o-e)}{e}$$

Where:

$\chi 2$ = the value of Chi-Square statistics

o = Observed frequencies in the contingency table

e = expected frequencies in the contingency table

Results and Discussions

Socio-Demographic Characteristics of the Households

The summarized socio-demographic characteristics of respondents that were involved in the study include: age; sex; marital status; education levels of the respondents; household size and household annual income. The interviewed sample was dominated by the active age group 36-49 years (66.7%) as shown in Table 1. People in this age group of 36-49 years are known to be in their active and productive ages. The average age of respondents was 42.8 years. This implies that in rural areas middle aged people were engaged in both livestock and crop production more than people of other age groups do because mixed farming activities require very active people to cope with hardships of crop-livestock production at the same time. Furthermore, active age group is capable for undertaking a range of economic activities including investments in the mixed crop-livestock production and non-farm activities to cope with weather related challenges.

Contrary to other studies conducted in many rural areas, the sample for this study was dominated by female respondents (53.3%) than males (46.7%) as shown in Table 1. The higher proportion of females than males was assumed to be contributed by the existing habits whereby males tend to migrate from rural to urban areas searching for other income generating activities not related to agriculture especially when the household faces transitory food insecurity crisis. It may also be attributed by the rapid changes on the gender roles with women increasingly holding roles that were more traditionally held by men. Thus, during off season more females were engaged in daily household tasks including access to food for consumption of their household members.

Regarding the marital status among the 90 respondents as it is indicated in Table 1 it shows that, four - fifths (80%) were married; 7.8% widowed; 8.9% were divorced and/or separated and some who represented household heads (3.3%) were still young to be married. The

majority of the interviewed respondents were mostly married (80%) this may have positive effects on the availability of family labour for diverse economic activities. Regarding levels of education, of the respondents 97.8% had attained primary school education (1.1%) had secondary education. while 1.1% did not have any formal education. Since the use of crop-livestock proven technologies requires basic level of education to cope with extension services provided, it shows that the literacy level of majority (97.8%) can have a positive effect on the adoption of recommended good practices on crop-livestock production technologies and weather related tips for daily farming activities. The findings are in line with (Makura *et al.* (2002); Martey *et al.* (2012) and Adeoti *et al.* (2014) who suggested that basic education helps farmer to improve the understating for better management of their production environment and timely decision-making leading to market participation.

Household Size

It was found that the sizes of the surveyed households ranged between one (1) and 13 members where as majority are used as source of labour for livestock and farm activities. This is not far from the fact that many African communities consider family members as their major source of labour (IAC, 2004 and Swai *et al.,* 2012) .The major economic activities carried out by the entire surveyed sample (n = 90), which is more than Seven-eighths (94.4%) were crop and livestock production as shown in Fig.1 based on the multiple responses given by respondents. This is due to the nature of the environment mostly characterized by agro-pastoral activities. Some farmers were also engaged in off-farm activities including petty trade 4.4%, and formal employment 1.1% to earn their daily breads.

Table 1: Background characteristics of respondents/households in Gurungu, Kitopeni and Sanjaranda villages (n=90)

Age group	Frequency	Percent
Young age (21-34)	23	25.6
Active age (36-49)	60	66.7
Elderly (50<)	7	7.7
Total	**90**	**100.0**
Sex		
Male	42	46.7
Female	48	53.3
Total	**90**	**100.0**
Marital Status		
Married	72	80.0
Single	3	3.3
Separated/divorced	8	8.9
Widowed	7	7.8
Total	**90**	**100.0**
Education		
Attained formal education	85	98. 9
No formal education	5	1.1
Total	**90**	**100.0**

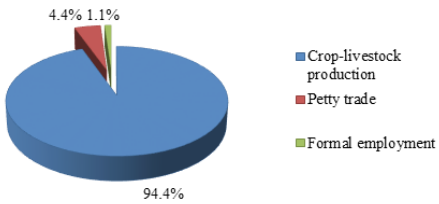

Figure 1: Types of economic activities carried out by respondents

Distribution of Respondents by Land Ownership and Utilization Styles

Access to land is vital in any farming business including mixed crop-livestock farming; land is defined as an essential resource and a crucial factor of production in facilitating subsistence farming and livestock systems setting for development (Rich *et al.,* 2009). Research findings revealed that 98.7% of respondents had access to land, whereas the size of land owned ranged between one (1) acre and 50 acres with an average of 12.38 and standard deviation of 10.484 as summarized in Table 2. Likewise, it was established that farmers had different styles of land use in the study area, data in Table 2 showed that the size of land used for cultivation had an average of 9.21; area used for grazing had an average of 1.08; area used for renting had an average size of 0.27 and the area left un used had an average of 1.77. Farmers had various reasons for the farm areas left un-used, these include shortage of labour as one factor of production, land infertility, in-adequate livestock proven technologies and un-predictable weather variations. This implies that some areas which are not fertile enough for crop production could have been useful for livestock production via introduction of pasture and other livestock technologies which are complimentary to cope with semiarid areas in central Tanzania for reduced transitory food insecurity in the rural areas. Swai *et al.* (2012) and Komwihangilo *et al.* (2012) also suggested the same land practices in Kondoa, Manyoni and Bahi districts in central Tanzania.

Distribution of Respondents by the Ownership of Livestock

The study revealed different types and size of herds for livestock categories owned by smallholder farmers. As indicated in Table 3 the number of cattle owned in the surveyed area ranged from a minimum of one (1) cattle and a maximum of 65, with an average of 12 cattle in each herd; minimum of one (1) and maximum of 84 goats; minimum of three (3) and a maximum

Table 2: Land ownership and Utilization Styles (n = 90)

Size of land	Minimum	Maximum	Mean	Std Deviation
Total land owned in acres	1	50	12.38	10.484
Area used for cultivation	1	30	9.21	7.072
Area used for grazing	1	30	1.08	4.507
Area used for renting	1	20	0.27	2.145
Un used area	1	20	1.77	4.142

Table 3: Types of Livestock Kept by Respondents (n = 90)

Category	Minimum	Maximum	Mean	Std Deviation
Cattle	1	65	11.89	14.864
Goats	1	84	7.90	13.176
Sheep	1	10	0.62	1.726
Pigs	2	13	0.58	2.459
Chicken	3	60	20.16	13.501
Ducks	1	8	0.44	1.522
Donkeys	1	3	0.03	0.316

of 60 chicken; minimum of two (2) and 13 pigs implying that some smallholder farmers were also engaged in livestock keeping as reliable sources of income, self employment and food security for poverty reduction.

Findings in Table 4 revealed that 92.2% of smallholder farmers involved in this study had some knowledge concerning weather related challenges as results of climate change and weather variability from various sources. These include Radio 72.2% and Television 11.5% while 8.5% had got awareness through fellow farmers, news paper village meeting and farmer field school (FFS). Similarly, data obtained from Focus Group Discussion (FGD) and Key Informants Interview (KIIs) indicated that some of the smallholder farmers had this knowledge from their fellow farmers, and direct physical observation of the environmental and weather changes. One of the interviewed farmers and key informant both from Gurungu and Kitopeni villages reported in Swahili that:

"Tumesikia kwa wakulima wenzetu ambao ni wazee walioshi hapa kijijini zaidi ya miaka 35 iliyopita, vile vile, sisi wenyewe tumeshuhudia mabadiliko makubwa kwa kutazama mazingira yetu yalivyobadilika hivi sasa kutokana na ukame tofauti na miaka 10 iliyopita" meaning that:

"We have heard from our elderly farmers who have been here in the village over the last 35 years, and also we have witnessed a dramatic change in our current environmental status mainly associated by drought, the situation appears to be different than it was in 10 years ago".

However, research results indicated that 7.8% of respondents had no knowledge regarding weather related challenges, implying that those who possessed innovative communication devices including radio and Television were able to access various important agricultural information including climate change and variability.

Table 4: Knowledge of Climate change and its Source (n = 90)

Knowledge of climate change	Frequency	Percent
Respondents had knowledge about weather related challenges	83	92.2
Some respondents had no knowledge on weather related challenges	7	7.8
Total	90	100.0
Source of knowledge		
Television	10	11.5
Radio	65	72.2
Farmer Field School, fellow farmers, news paper and village meeting	5	8.8

Challenges experienced

With regard to weather related challenges, it was generally established that 95.5% of respondents as summarized in Fig. 2 had observed various challenges including (high temperature 44.4%, changes in onset of rains and decrease in rainfall 25.0%, and increased wind 26.1%) while 4.5% were not aware of the existing challenges. All these challenges had influenced the occurrence of transitory food insecurity to the household due to low amount of crop harvest obtained by the farmers. It was also revealed that the majority of interviewees linked the occurrence of declining rainfall, increased temperature and inadequate soil moisture challenges to disobedience of traditional fundamentals laid by their fore elders. Similar observation regarding changes in, rainfall variability, temperature and

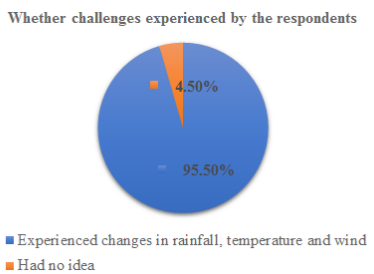

Figure 2: Weather challenges experienced

drought was also reported by other scholars in Nigeria and Tanzania to have effects on wild animals, crops and livestock production which resulted in waters and food shortage. (Odjugo, 2008; Lema and Majule, 2009; Mongi *et al.,* 2010; Elisa *et al.,* 2011).

Possible cause of weather challenges

The interviewed respondents were asked multiple-response questions to understand the existing knowledge regarding possible causes of weather related challenges in the study area. Figure 3 presented multiple responses which indicated that weather related challenges had been associated by the destruction of natural resources (plants, animals and water sources) 98.9%, destruction of natural vegetation 78.8%, drought 18%, natural tragedy 2.2% and soil erosion due to floods and human activities 1.1%. Studies by Agrawala *et al.* (2003); Majule *et al.* (2008); Odjugo (2008); Majule (2008); Lema and Majule (2009); NEMA, (2010); Odjugo, (2010); Elisa *et al.* (2011) reported similar experiences on various climate related

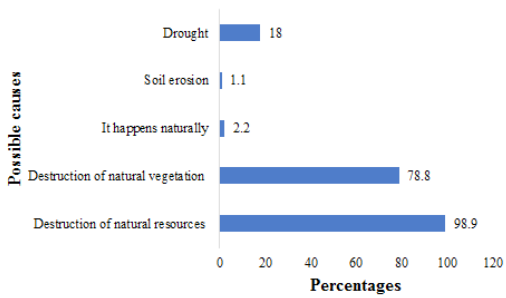

Figure 3: Possible causes of weather related challenges

challenges and impact being attributed by destruction of natural resources (wild plants and animals), floods, land degradation and droughts. This was ultimately resulted in substantial effects on economic performance and livelihood of communities in rural areas that depend on rain-fed agriculture.

Status of food availability for the surveyed household

Status of household food security was also assessed; although January and February were generally reported as the critical months which shortage of food was highly experienced, it was also revealed that most of the households were food secure. Findings summarized in Table 5 showed that 38% of respondents had enough food to sustain their families to the year round until next harvesting season. Nevertheless, 37% of the respondents had experienced shortage of food in their households and they were only in a position to sustain their family members for six to nine months (6-9); 17.8 %; of the respondents had food that could support their family members for three to six (3-6) months while 8% were able to sustain their family members for one to three (1–3) months.

Table 5: Distribution of respondents based on duration of food availability till next harvest

Food availability duration	Percent
1 -3 months	8
3 - 6 months	17
6 - 9 months	37
All the year around	38

Copping strategies during the period of food shortage

The types of of coping strategies used by the respondents were studied to inform alternative solutions applicable in the study area when need arises. Results in Fig. 4 indicated that 48% of the respondents were selling their livestock and provision of physical labour to other income generating activities; 37.5% were selling livestock especially small stock and non-ruminants to buy grains and other food materials; 22.5% were selling labour to different socio-economic activities including constructions, bricks making and other handcrafting practices while 15% who had accumulated some cash were able to buy food for their family members at the time of shortage. Other coping strategies mentioned include selling of both livestock and family assets 5%, relying on assistance from the relatives 5% and food borrowing 2.2%. This implies that livestock could play a significant role to save the household members as immediate alternative solution to food during the critical period of transitory food insecurity. A study by Odjugo (2008) and Richard *et al.*

Figure 4: Copping strategies applied during the period of food shortage

(2013) conducted in Nigeria and Tanzania also, suggested diversification of adaptive strategies including integration of livestock as crucial alternative in the household during shortage of food.

Conceptual Framework Predictions

Basing on the four socio-economic categories presented in conceptual framework. The

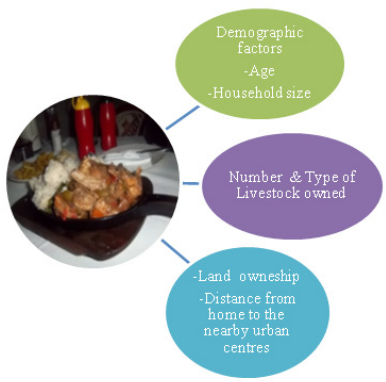

Figure 5: Hypothetical Model

hypothetical model predicts that the number of meals taken per household per day is highly determined by socio-demographic and economic factors. These include age of respondent; size of household; number of possessed livestock, types of livestock owned; land ownership; size of land owned and distance from area of residence to the nearby urban centres.

Associations between Response Variable experienced challenges and Socio-demographic Predictors

According to statistical analysis of the household experiences there was no significant association between number of meals taken per household per day and experienced weather related challenges as measure to transitory food insecurity. Rather, a Chi-Square model indicated direct association between socio demographic factors and number of meals taken per household per day. It is important to note that household experience on transitory food insecurity in terms of meals consumed per day was also linked with socio-demographic factors including age, size of household and properties owned. In order to establish conceptual framework facts, three hypotheses were also tested to establish associations between the number of meals taken per household per day and demographic, socio and economic factors. It was revealed that there were significant associations between number of meals taken per household per day and demographic factors including age ($\chi 2 = 41.270$; $p \leq 0.016$) and the household size respectively as shown in Table 5. Implying that, the household dominated by the active age group between 36 - 49 years with enough labour that engaged in various economic activities are capable to access two to three meals per day. Findings are in conformity with Kayunze (2000); Jaleta *et al.* (2009); Jagwe and Ouma (2010) and Nhemachena et al. (2010); Martey *et al.* (2012) who argued that a large household sizes with enough family labour

Table 6: Results of Chi-Square model for hypothesis 1 (n=90)

Pairs of variables entered in the model	n	($\chi 2$)	p-value
Number of meals taken per day	90	41.270*	0.016
Actual age of respondent	90		
Number of meals taken per day	90	37.805***	0.001
Household size	90		

*Note: ***, **, * significant at 0.1, 1 and 5% levels respectively ($P \leq 0.001$, $P \leq 0.01$ and $P \leq 0.05$)*

working together is associated with increased yields access to meals and market participation leading to increased household food security. These authors further indicated that large family sizes are an important asset when almost all of them take part in production and/or service provision to contribute to the economy of the household.

drought. Also, livestock could have access to supplementation from feeds extracted from short period crops like sunflower seeds. Similar results were presented by Lema *et al.* (2009); Swai *et al.* (2012) in the studies conducted in Singida and Dodoma where these authors indicated that sunflower crop was utilized as source of household food, income and livestock

Table 7: Results of Chi-Square model for hypothesis 2 (n=90)

Pairs of variables entered in the model	n	(χ2)	p-value
Number of meals taken per day	90	35.695*	0.012
Number of goats owned	90		
Number of meals taken per day	90	43.848***	0.002
Number of cattle owned	90		
Number of meals taken per day	90	44.258***	0.001
Number of chickens owned	90		
Number of meals taken per day	90	10.675*	0.014
Number of pigs owned	90		

Note: ****, **, * significant at 0.1, 1 and 5% levels respectively ($P \leq 0.001$, $P \leq 0.01$ and $P \leq 0.05$)*

Associations between Response Variable and Socio-economic Predictors

Likewise, data presented in Table 7 showed significant associations between number of meals taken per household per day and type and number of livestock owned. For example findings showed that there was a strong associations between number of meals taken per household per day and number of indigenous chicken owned ($\chi2 = 44.258$; $p \leq 0.001$); followed by number of cattle owned ($\chi2 = 43.848$; $p \leq 0.002$); number of goats owned ($\chi2 = 35.695$; $p \leq 0.012$) and number of pigs owned ($\chi2 = 44.258$; $p \leq 0.014$). This implies that households which are engaged in other economic activities including livestock keeping particularly the four tested categories, stand a better chance of being food secure as compared to those involved in crop production only do. This may be attributed by many reasons including access to livestock feeds from crop residues and retarded plants that were not able to attain their maturity stage due to effects of feed. Thus, villagers who were engaged in both crop-livestock production stood better chance of coping with weather related challenges because they could diversify economic activities than fellow farmers who were engaged in crop production alone. Henceforth, ownership and accumulation of livestock might be sold to purchase food when need arises.

Land Ownership and Distance from Area of Residence to the Nearby Urban Centre

It is seen in Table 8 that the size of land owned by respondents was one of predictors that contributed to the number of meals taken per day in the study area where as the average size of land owned and styles of land utilization are as presented in section 3.3. In addition, Chi-square model results showed significant associations between the average size of the total land possessed, amount of land left unutilized and the number of meals taken per household per day. This implies that household with sufficient access to planned and well utilized land were

likely to have some amount of crop harvest and residues for their livestock to cope with weather related challenges to avoid transitory food insecurity. Likewise, Chi-square test showed significant association between distance from the residence to the nearby urban centres and the number of meals taken per household per day. This implies that respondents nearby urban centres stood a better chance to access food materials from various areas than those located far from urban centres. Distance from areas of residence to the nearby urban centres ranged between one (1) and 22 km. Jagwe and Ouma, (2010); Olwande *et al.* (2015) and Fredriksson *et al.* (2017) also, observed that geographic location of the household and the availability from Television, radio and fellow farmers. Experienced challenges observed being changes in rainfall pattern, wind and temperature which influenced the amount of crop production. However, these challenges indicated no significant association with status of household food security. Findings also indicated that number of meals taken per household per day was determined by some demographic and socio-economic factors including age; size of the household, ownership and size of land; type and number of livestock owned as well as distance from areas of residence to the nearby urban centres. On the bases of these findings it is concluded that transitory food insecurity can be reduced/controlled if farmers are engaged in wide

Table 8: Results of Chi-Square model for hypothesis 3 (n=90)

Pairs of variables crossed	n	(χ2)	p-value
Number of meals taken per day	90	41.289*	0.039
Total land owned in acres	90		
Number of meals taken per day	90	35.633* **	0.001
Unused land	90		
Number of meals taken per day	90	18.444* **	0.001
Distance from the residence to the nearby urban centres	90		

*Note: ***, **, * significant at 0.1, 1 and 5% levels respectively (P ≤ 0.001, P ≤ 0.01 and P ≤ 0.05)*

of physical and market infrastructure had positive influence to decision of the household in accessing social services including food materials, assets and application of technology significantly. Thus, location of the household may have a positive effect on the decision of respondents to participate in the market where many other opportunities are easily accessible.

Conclusions and Recommendations

This study sought to understand the link between household's experiences and knowledge weather related challenges and transitory food insecurity in mixed crop-livestock systems in Manyoni District and Itigi division in particular. It was revealed from the household experiences that majority of the interviewed respondents had knowledge about weather related challenges scope of income generating activities including livestock keeping. Therefore, the Tanzania Livestock Research Institute in collaboration with Local Government Authorities (LGA) and other development partners are encouraged to introduce livestock proven technologies with their packages for improved livestock production to cope with these challenges. In addition, livestock technologies should address not only production issues but also identification of market opportunities and reduce transaction costs. Further study is required to examine issues of nutrition security in the study area particularly at the time of transitory food insecurity episode.

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