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SMALLHOLDER FARMER'S LIVELIHOOD DIVERSIFICATION AS A RESPONSE TO CHANGED CLIMATIC PATTERNS IN CHONGWE DISTRICT, ZAMBIA.

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Abstract

Purpose: Climate change affects local and global rainfall patterns and hence has a counter effect on smallholder agriculture. Impacts of climate change on agriculture are largely due to rainfall variability resulting in reduced yields due to crop-water stress and emergency of pathogens and diseases. In Zambia, climate change has been manifested through increased intensity of droughts and floods. These rainfall anomalies adversely affect agriculture and food systems. In order to survive the impacts of climate change and variability, smallholder farmers in Chongwe have adopted their livelihoods and farming systems to the new climatic patterns.

Methodology: This study assessed how smallholder farmers in Chongwe District have adopted their livelihoods as a response to changed climatic conditions. It also investigated the perceptions of smallholder farmers as regards changes in aspects of their climatic conditions. Data collection involved a critical review of literature related to climate change and agriculture, observations, semi- structured interviews with 60 smallholder farmers and eight key informants. The data were analysed using multiple analysis techniques which included the descriptive statistics, One-way analysis of Variance (ANOVA), and the post-hoc Least Square Difference for pairwise comparisons of incomes from different livelihoods engaged in by smallholder farmers .The gendered comparisons of livelihood engagement was done using the chi-square test of association.

Findings: The results showed that all farmers perceived occurrence of changes in climatic conditions in the light of changed rainfall patterns in that there has been uncertainty in onset of rains, short rainy season, more intermittent rainfall and increased frequency of intra-seasonal droughts. These changes have led to farmers to adopt such farming techniques as potholing in preference to oxen and tractor ploughing when farming is done on smaller pieces of land. There was a significant difference in the mean annual incomes generated from on-farm livelihoods (ZMW 3677.59; n=58) and off-farm livelihoods (ZMW 6840.91; n = 58) (p= 0.001). Farmers generated the highest income returns by engaging in casual work (ZMW 10307.69; n = 13) compared to every other livelihoods common in the area such as gardening (p=0.002), petty trade (p=0.002) and on-farm livelihoods (p=0.001).

Contribution to policy, theory and practice: It was therefore concluded that diversification of income through diversified livelihoods would help smallholder farmers enhance their resilience in the face of changed climatic conditions. On-farm livelihoods should not always be the main income source for farmers as results indicated that farmers engaged in casual work generated higher incomes than those who depended on farming. It was recommended that policy direction should be towards introduction of a gender responsive credit facility that can help improve women's engagement in off-farm income generating livelihoods, as well as encourage climate change resilience.

Key words: *Climate change, Smallholder Agriculture, Livelihoods, Farming, Off-farm income.*

1.0 INTRODUCTION

Climate change affects local and global rainfall patterns and hence has an effect on smallholder agriculture (Mahato, 2014). Impacts of climate change on agriculture are largely due to rainfall variability, seasonality changes-in mean precipitation and crop-water stress as well as the emergence of new pathogens and diseases (Mahato, 2014; IPCC, 2014). Long term effects of climate change on agriculture include reduced quantity and quality of crop yield, changes in crop growth, rates photosynthesis and moisture availability. In addition, Njenga et al. (2014) reported that more frequent and more intense, extreme weather may have immediate adverse impacts on food production, food distribution infrastructure, on livelihoods assets and opportunities in both rural and urban areas.

In areas where temperatures are already close to the physiological maxima for crops, warming will likely impact yields more (Mahato, 2014). Drivers of climate change through alterations in atmospheric composition can also influence crop productivity by impacting on plant physiology. The consequences of agriculture's contribution to climate change, and of climate change's negative impact on agriculture, are adverse and are projected to impact on global food production leading to food insecurity (Anderson et al., 2010). Agriculture is also contributing a significant share of the greenhouse gas (GHG) emissions that are contributing to climate change – 17% directly through agricultural activities and an additional 7% to 14% through land use changes (Mahato, 2014). Sub-Saharan Africa has been portrayed as being most vulnerable to the impacts of global climate change (Kitor, 2010). This is as a result of its reliance on rain-fed agriculture which is highly sensitive to weather and climate variables, as well as its low capacity for adaptation (Kotir, 2010; Abdul-Razak and Kruse, 2017).

Climate change will greatly affect the majority of farming households as rain fed agriculture is their main source of income. Agriculture is also the major national employer with 85% of the labor force working as subsistence farmers (DFID, 1999) while 90% is established in informal farming (CSO, 2010). But with the rural poverty levels hovering around 83% (CSO, 2010), the impacts of climate change will likely have adverse effects on the economic livelihoods of farmers. The agriculture sector in Zambia generates about 18% to 20% of the country's Gross Domestic Product (GDP) and provides a livelihood for more than 60% of the population (Jain 2007). There are three main categories of farmers in Zambia, defined in terms of the size of the land they cultivated

(Chikowo, 2013). Small-scale farmers cultivate less than five hectares, use few external inputs, and consume most of their produce. They have a partial engagement in the input and output markets and use simple technologies in their agriculture. Medium-scale farmers cultivate between 5 to 20 hectares and use improved seeds and fertilizers while selling most of their produce. These farmers commonly use a combination of manual, animal draft power and tractors. Large-scale farmers or commercial farmers cultivate over 20 hectares annually. These farmers apply high levels of purchase inputs and use oxen or machinery for farm operations. They also use improved technologies and produce almost exclusively for direct market sale or feed their grain to livestock kept on the farm. According to Chikowo (2013), large-scale farmers make up only 4% of farm households, but cultivate 22% of all crop land.

In Zambia's Chongwe district, smallholder farmers face many challenges to their agriculture, ranging from unpredictable rainfall patterns, high poverty levels, reduced access to agricultural inputs such as seed or fertilizers, changing rainfall patterns and intra-seasonal droughts. These hindrances may render agriculture less sustainable as an economic activity. Sitali (2015) conducted a study on smallholder farmer's awareness of conservation agriculture in Chongwe District and concluded that there was minimal training for small scale farmers from government agriculture extension officers as regards resilience techniques to impacts of climate change. Many of the farmers depended on tacit knowledge of their area and their agriculture to cope with the changed climatic situations, which usually followed a 'business as usual' approach their agriculture. This was because agriculture choices made by smallholder farmers in rural Zambia were driven by market availability rather than weather and climate change (Mubanga and Ferguson, 2017). This approach towards agriculture has resulted in small scale farmers getting adversely affected by the effects of changed climatic patterns, leaving them vulnerable to climatic perturbations (Speranza, 2010). Hence, this study will assess the potential resilience techniques available for smallholder farmers in Chongwe and how these can improve their adaptive capacity in the face of changed climatic patterns.

Nyanga (2011) conducted a study of smallholder farmers' perceptions of climate change and conservation agriculture in Zambia uses respondents from Choma, Kalomo, Mazabuka, Monze, Sinazeze, Chibombo, Chongwe, Kapiri Mposhi, Mumbwa, Chipata, Katete and petauke. The study concluded that most smallholder farmers perceived shifts in the timing of seasons, increase in temperature, floods and droughts. Perceptions related to changes in floods and droughts were significantly associated with adoption of conservation agriculture. However the extent to which conservation agriculture was perceived by smallholder farmers as an adaptive strategy to climate change was very low. The failure to adapt to conservation agriculture, which has been promoted as a climate smart agricultural technique could have contributed to the reduced resilience by small scale farmers in Chongwe. The aim of this study was to establish how small scale farming systems in Chongwe had adapted to changed climatic patterns and how off-farm livelihoods had contributed to small scale farmers' resilience to the changed climatic patterns.

Study Area

Chongwe district is located between 15° 19' 45" S and 28° 40' 55" E. The district is approximately 35km East of Lusaka District. Three study sites within Chongwe were selected for administering semi-structured interviews. These included Chainda, Chikondwa and Lusoke (Figure 1).

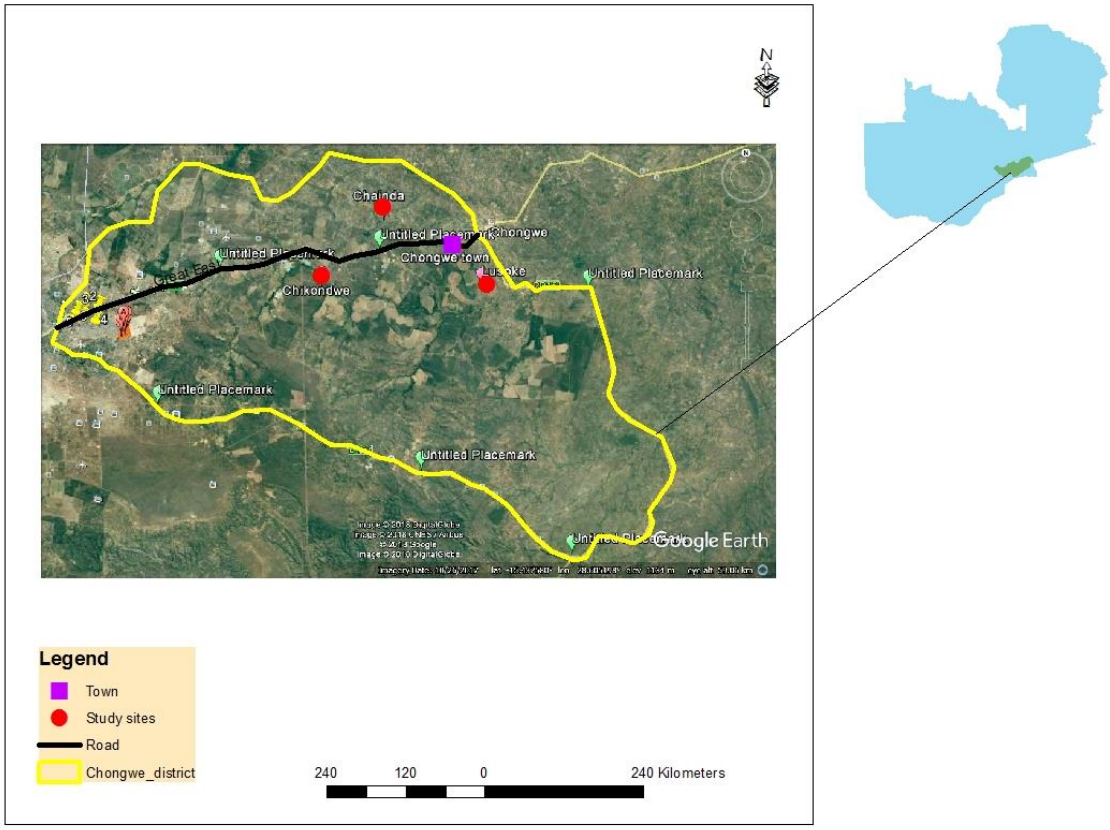

Figure 1. Map of Chongwe showing the study sites

The Chongwe's climate is arid and it is nestled in the valley region surrounded by numerous hills. Chongwe District falls in agro-ecological region IIa which is characterized by rainfall of between 800-1000mm/year with a growing season of 100-140 days (Moonga et al., 2013). The region has three main seasons, namely cool and dry from May to August, and hot and dry from September to October and warm and wet season from November to April.

The total population of Chongwe district is 192,303 of which 98, 268 are males and 94, 035 are females, who accounts for 8.8% of Lusaka Province's total population (CSO, 2012). Of the 192,303 people, 45.3% are below the age of 15 years while 3.2% are above 65 years. Chongwe district has a total area of 8, 669 square kilometres with a population density of 15.9 populations per square kilometre (CSO, 2012).

Agriculture is the main economic activity by residents of Chongwe. Commonly cultivated crops by the farming households included maize, cassava and sweet potatoes. Besides farming other forms of livelihoods engaged in by residents of Chongwe included petty trade, poultry farming, rearing of goats, and cattle. Even residents engaged in petty trade resorted to smallholder farming during the rainy season and only use petty trading as an off-farm income generating livelihood (CSO, 2003).

2.0 METHODOLOGY

Data Collection

Two sampling procedures were used in this study and these are purposive sampling and simple random sampling. Three study sites were purposively selected, namely; Chainda, Chikondwe and Lusoke. Compared to areas further from the main roads, these study sites were accessible and provided a representative sample. The sample size for the study was 60 smallholder farmers and eight key informants from the Zambia National Farmers' Union, traditional authorities, Ministry of Agriculture and Conservation Agriculture Unit. The key informants were sampled purposively as only those with required information were identified. The smallholder farmers were sampled randomly using village registers collected from traditional authorities who are the custodians of the land upon which the farmers practice their agriculture.

Data for this research was collected using a semi-structured interview schedule, key informant interview and observations, while desk research was used for secondary data. Semi-structured interviews incorporated both open ended and closed ended questions. They were designed for the purpose of getting intended information in a more systematic way and the open ended questions allowed respondents to express their experiences and feelings on their livelihood practices. Observations were used in order to confirm responses on livelihoods engaged in by small scale farmers. Further, some on-farm and off-farm livelihoods were also observed. Secondary data collected included information on demographic characteristics of Chongwe district from the Central Statistics Office (CSO) and published books, journals and the internet on how smallholder farmers adapt their farming to minimize impacts of climate change. Further, literature on climate change and its impact on small scale agriculture, small scale farming, resilience and adaptation were reviewed in order to broaden the general understanding of the nature and extent to which climate change can impact on a small scale.

Data Analysis

Qualitative data analysis of semi-structured interviews were performed using thematic analysis and then coded using excel. Thematic analysis involves isolating responses in key emerging themes or related/similar themes (Sunday, 2016). Quantitative data was being analysed using the correlation statistical method in order to evaluate the correlation between income generated from off-farm livelihoods and income generated from farming. Further, the income generated from each of these off-farm livelihood activities was compared to the income generated from on-farm livelihood activities, using the Least Square Difference (LSD) method. The same method was also used to make pairwise comparisons of mean incomes from different off-farm livelihood activities.

3.0 RESULTS

Demographic characteristics in Table 1 seem to indicate a gender bias of respondents as it comprised of 60.3% women and 39.7% men. The increased number of women interviewed could have been due to the fact that during data collection, which was done in the off-season, most men were rarely at homes as they were either engaged in casual work or looking for resources to sustain their households. As such, it was mostly the women who were available at homes to be

interviewed. On the other hand, some households were just female-headed (23.7%) as opposed to the male-headed households (76.3%). Despite of these seemingly female oriented demographics, the women were able to answer the researcher's questions effectively. Table 1 shows the demographic characteristics of the sample.

Table 1. Demographic characteristics of respondents in Chongwe District

Village	**Frequency**	**Percentage**	**Education**	**Frequency**	**Percentage**
Chainda	22	37.9%	None	4	6.9
Chikondwe	17	29.3%	Primary	25	43.1
Lusoke	19	37.8%	Secondary	23	39.7
Gender	**Frequency**	**Percentage**	Tertiary	6	10.3
Male	23	39.7	**Years**	**Frequency**	**Percentage**
Female	35	60.3	**Engaged in Farming**		
			<5	9	15.5%
Age	**Frequency**	**Percentage**	6-10	4	6.9%
≤20	7	12.1	11-15	4	6.9%
21-30	12	20.7	16-20	5	8.6%
31-40	18	31	21-25	23	39.7%
41-50	15	25.9	>25	13	22.4%
≥51	6	10.3			

Nearly half of the respondents were married (49.2%) while the rest were divorced, widowed or single. Very few of the respondents had not been to any formal school (6.9%). While most of them had only gone up to the primary level of education (44.1%), about 10% had reached tertiary levels of education having been to college. Considering this was a relatively educated community, the researcher was at times able to explain concepts in English and some respondents could still readily understand and respond in the English language.

Perceptions of Respondents towards Climate Change

Farmers were asked if they waited for rainfall before they could start their field preparation, and all of them responded affirmatively. In times of delayed rainfall, 62.1% of the farmers opted to plant early maturing maize seed while 37.9% mentioned that their choice of maize variety was not affected and they continued to plant local maize seeds. Most farmers felt that the rainy season started later and stopped earlier in the recent past. The response of one elderly farmer from Chikondwa village summarized the farmers' perceptions of rainfall patterns in Chongwe District:

> *"We are aware of what you call climate change. The amount of rainfall we receive now is much less that we used to in the old days".*

Figure 2 summarizes the responses from the respondents.

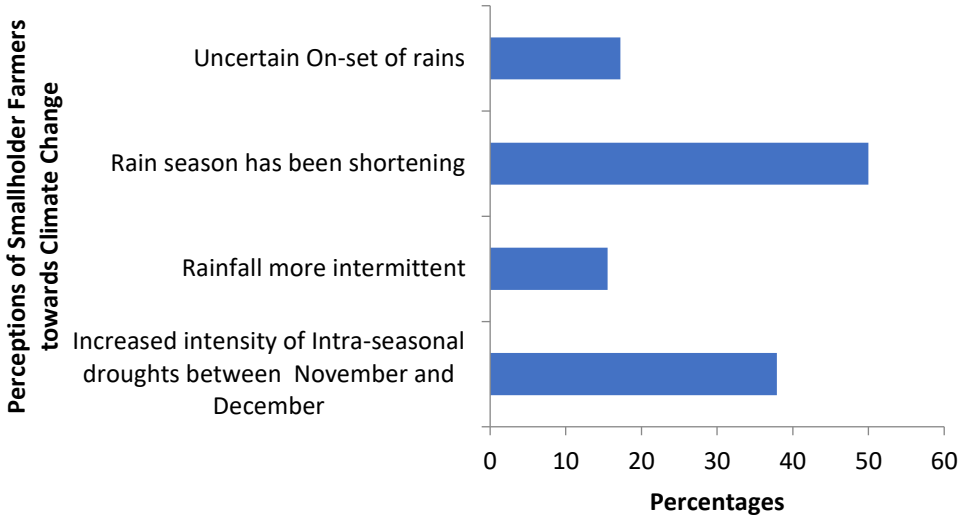

Figure 2. Perceptions of Smallholder Farmers towards Changed Climatic Patterns in Chongwe, 2018

All the respondents in the study area had perceived a change in some aspects of the rainy season as regards rainfall patterns. Delayed onset of rains, a shortening rainy season, increased intensity and frequency of intra-seasonal droughts were the main factors observed as having changed over-time. One respondent summarized the perceptions when he said:

> "*There are a lot of inconsistencies in the start of the rainy season, and the time of the end for the rainy season. It is shorter as of recent years with the rains starting around late November up to December and then it stops only raining for a few weeks in March".*

Farming Practices Adapted by Small Scale Farmers

Three types of farming systems were commonly utilized by small scale farmers in the Chongwe district during the study period, namely; hand hoeing, oxen ploughing and tractor ploughing (Figure 3).

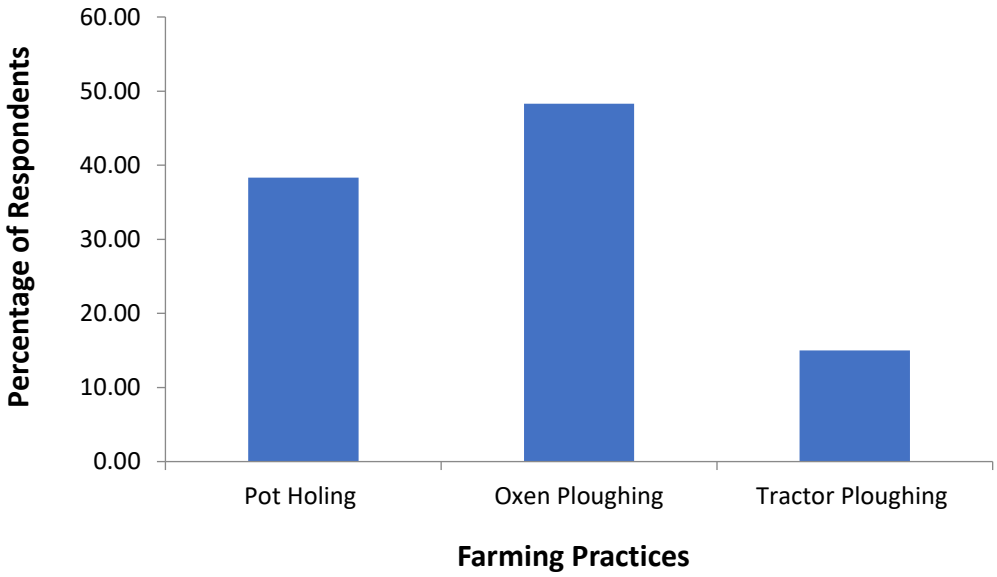

Figure 3. Farming Practices Adopted by Smallholder Farmers in Chongwe District 2018

Farmers in Chongwe adopted particular farming practices which helped them to diversify not just their farming systems, but also their livelihoods. For example, other than tillage methods, types of crops cultivated by some farmers were also influenced by changing climate patterns. From the sampled farmers, 62% cultivated early maturing maize seeds while 38% did not change their choice of crops. All the sampled farmers practiced intercropping while60% practiced crop rotation, and 36 practiced legume technology.

Types of Off-Farm Livelihood Activities

All the farmers interviewed were engaged in some type of off-farm livelihood activities which was petty trade, casual work, or gardening. The mean income from on-farm activities engaged in by the respondents was ZMW 3677.59 (n=58, std. error 424.927). This was lower than the income farmers got from engaging in off-farm livelihood activities; petty trade (ZMW 6840.91; n = 23; std. error =1828.806), casual work (ZMW 10307.69; n = 18; std. error=2863.082), and gardening (ZMW 3038.46; n = 18; std. error = 478.585). Farmers generated the highest income returns by engaging in casual work compared to every other livelihood, on-farm or off-farm (Table 2).

The income generated from each of these off-farm livelihood activities was compared to the income generated from on-farm livelihood activities, using the Least Square Difference method in SPSS (Table 2). The same method was also used to make pairwise comparisons of the incomes from different off-farm livelihood activities. Income from petty trade (p=0.032) and casual work (p=0.001) were significantly higher than income from on-farm activities. However, there was no significant difference in on-farm income and income from gardening (p=0.721).

Table 2. Mean Income (ZMW*) from Livelihood Activities

	N	Mean	Std. Error	Minimum	Maximum
on farm income	58	3677.59	424.927	200	15000
petty trade	22	6840.91	1828.806	200	41000
casual work	13	10307.69	2863.082	1000	30000
gardening	13	3038.46	478.585	1000	7500
Total	**106**	**5068.87**	**603.103**	**200**	**41000**

- 1 USD = ZMW 12.20 at the time of data collection

Pairwise comparisons of mean incomes between livelihoods were also made (Table 3). There was a significant difference between mean income from on-farm livelihoods and petty trade (p=0.032), between mean income from on-farm income and casual work (p=0.001). However, no significant difference existed between mean income from on-farm livelihood and gardening (p=0.721).

Table 3. Comparisons of Mean Income (ZMW) between Livelihoods

Livelihood	Livelihood	Mean Difference	Std. Error	P-Value
On-farm income	Petty trade	-3163.323*	1457.622	0.032*
	Casual work	-6630.106*	1786.359	0.001*
	Gardening	639.125	1786.359	0.721
Petty trade	On farm income	3163.323*	1457.622	0.032*
	Casual work	-3466.78	2036.462	0.092
	Gardening	3802.448	2036.462	0.065
Casual work	On farm income	6630.106*	1786.359	0.001*
	Petty trade	3466.783	2036.462	0.092
	Gardening	7269.231*	2283.33	0.002*
Gardening	On farm income	-639.125	1786.359	0.721
	Petty trade	-3802.45	2036.462	0.065
	Casual work	-7269.231*	2283.33	0.002*

The mean difference is significant at the P=0.05 level of significance

Generally, smallholder farmers in Chongwe had less returns from on-farm livelihoods as compared to off-farm livelihoods, the highest livelihood earner was casual work which, however, had a high variability compared to other livelihood activities. This could have been due to the gulf of difference between the highest earning and the lowest earning casual workers. On the other hand, agricultural products from gardening and on-farm livelihoods resulted in relatively less varied income between the highest and lowest earners (Figure 4). The mean income for gardening was generally low as income returns generated from gardening did not differ much from one farmer to the other.

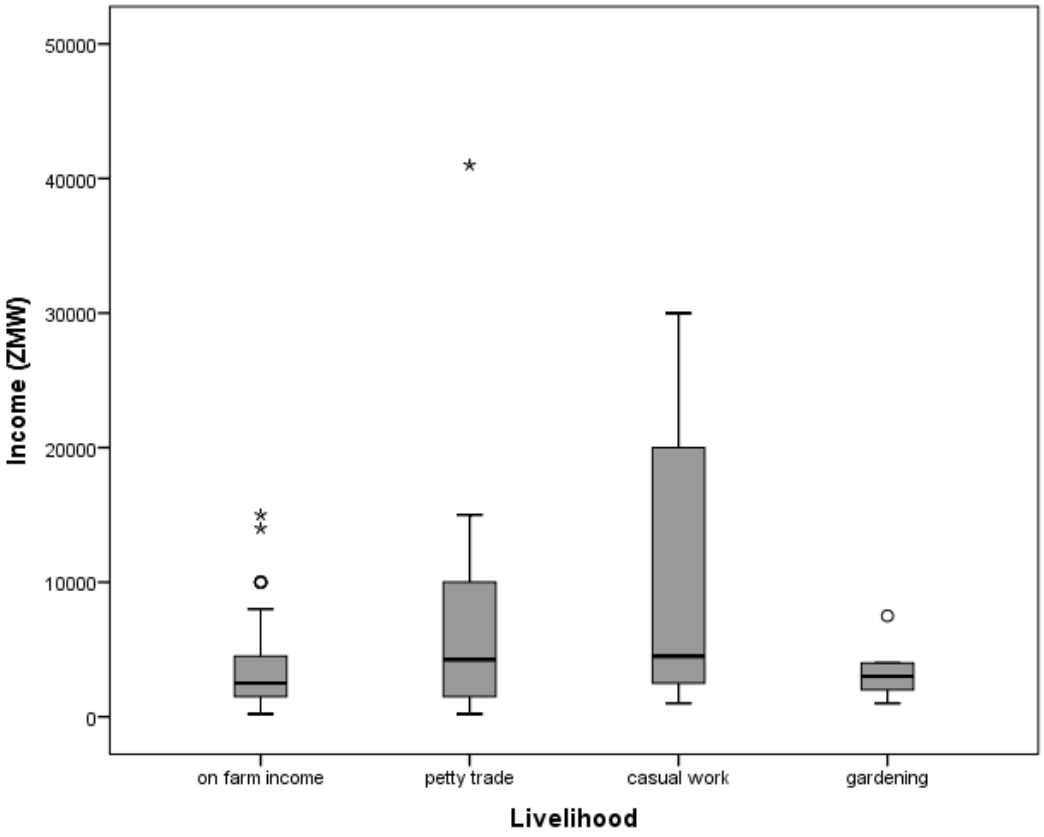

Figure 4. Variability in Incomes from on-farm Livelihood and Off-farm Livelihoods among Smallholder Farmers in Chongwe District, 2018

Gender Dimensions of Smallholder Farmer's Engagement in Income Generating Livelihoods

Both men and women were engaged in income generating activities in the Chongwe district but to differing extents. Of the sampled farmers, 55 males and 58 females were engaged in on-farm livelihoods, while 11 males and 12 females were engaged in petty trade despite being also involved in on-farm livelihoods. Casual work only had 18 males with no women in the study area engaged in the practice (Table 4).

Table 4. Chi-square test for Significant Difference in Gender Engagement in Income Generating Livelihood of Smallholder Farmers in Chongwe

Livelihood	Male Observed	Female Observe	Statistic	Value	df	p-value
On-farm	55	58	Pearson Chi-Square	8.000	6	.238
Petty trade	11	12				
Casual work	18	0	Likelihood Ratio	11.090	6	.086
Gardening	6	12				

Difference significant at p 0.05 level of significance

As shown in Table 4, there was a significant difference between the number of males and females involved in income generating activities (X^2 = 8; p=0.238). While more females were engaged in on-farm activities, petty trade and gardening, there were a lot more males doing casual work. None of the women who were interviewed was involved in casual work. Most of them were involved in petty trade such as making and selling fritters. Others were selling tomatoes, a larger percentage of women were involved in selling home-made beer *(kachasu)*. Most women considered casual work such as being a maid and doing piece work as not being independent, whilst they considered casual work such as bricklaying and carpentry as jobs for men, hence they did not indulge in such casual works. These findings highlighted the effect of traditional gender roles in rural societies on respondent engagement in income generating off-farm livelihood activities. Certain roles and works were generally reserved for certain genders and within the community; this was taken as a norm. This could explain why the women interviewed were selective in particular types of casual works to engage in, and the common types of casual works mentioned were said to be male dominated gender roles.

4.0 DISCUSSION

Perceptions of Small Holder Farmers towards Climate Change

Most farmers showed awareness of climate change because they felt that the rainy season started later and stopped earlier in the recent past. These results agree with the findings of Nyanga (2011) who reported that smallholder farmers in Zambia were aware of climate change through their experiences. Farmers perceived the recent rainfall patterns as having changed with the uncertain onset of rainfall, a shorter rainy season, increased intensity of intermittent rainfall and increased frequency and intensity of intra-seasonal droughts between November and December. The observed uncertainty in the onset and offset of rainfall in Chongwe agrees with Mulenga and Wineman (2014) who stated that "the onset of the rainy season has become less predictable". These changes in rainfall patterns have led to reduced crop yields as most crops die before reaching maturity stage. As a result of these variations in the rainy season, farmers have resorted to planting early maturing maize seeds that do not require a long growing season.

How farmers have adapted to changed climatic conditions

Farmers have used crop rotation, intercropping, changed maize varieties and legume technologies as a way of adapting to climate change. Intercropping some crops with maize allows farmers to diversify their crops to include drought tolerant ones. This means even when the maize does not do well due to its high sensitivity to climatic changes, the other crops may enable farmers to be food secure. Furthermore, when the maize is intercropped with legumes, the legume help in improving soil fertility. At the same time, the legume is not only used as a food crop by farmers, but also a cash crop which helps to improve farmers' household economic status. The fact that crops intercropped with maize can be used as cash crops as well as food crops, provide a coping strategy for smallholder farmers against impacts of climate change, when the staple crop maize yields falters. On the other hand, farmers have opted to planting early maturing maize varieties, as an adaptation to changed climatic conditions, because this type of maize variety does not require a long growing season. Hence, when encountered with the perceived reduced growing season, farmers who plant early maturing crop varieties are not adversely affected.

Income Generating Activities

Off-farm Livelihoods

Most farm households in developing countries rely almost exclusively on agriculture and undertake little or no off-farm activities (Babatunde, 2015). This perception has led policy makers to concentrate on the farm sector at the expense of the off-farm sector (Babatunde, 2015).This study has shown that smallholder farmers can possibly generate higher returns from off-farm livelihoods as was the case for farmers engaged in casual work who generated over three times more than they did from engaging in on-farm activities. This result meant that smallholder farmers could be better placed to adapt to changed climatic patterns if they diversified their livelihoods to include those they may have a competitive advantage in and which had low risk and uncertainty. This could imply engaging in both on-farm and off-farm activities, with a higher concentration on the livelihoods that could be more sustainable at particular times. For example, farmers could engage more in off-farm livelihoods during drought seasons in order to minimize agricultural losses and ensure food security.

Off-farm income is said to account for between 35% and 50% of total income of rural households in developing countries (Davis et al. 2007). The share of off-farm income is expected to increase substantially in the coming years, especially in sub-Saharan Africa, where increasing population growth and limited agricultural resources are threatening the growth of the agriculture sector (Babatunde (2015). This prediction by Babatunde (2015) has been validated in this research where higher incomes from off-farm activities could compel smallholder farmers to engage in diversified livelihoods as a way of combating impact of climate change. While it cannot be said for certain that most farmers will shift to off-farm livelihood activities instead of focusing on farming, the increased numbers of smallholder farmers diversifying their livelihoods is an indication of a quest for the search for sustainable adaptation methods for combating impact of climate change. There is a possibility that farmers who realize they have a relative comparative advantage in particular off-farm livelihoods than in agriculture may choose to switch their major livelihoods. However, there is a need for further research on this in order to make conclusive assertions.

Towards a framework for sustainable smallholder adaptation to climate change

This study has provided insight into how smallholder farmers can sustainably adapt to the impacts of climate change. Below is a discussion of some lessons learnt:

Planting of drought resistant varieties of crops: Farmers in Chongwe district have resorted to planting early maturing maize seed varieties which do not require a long growing season. observed with the shortening of the rainy season emphasis on more drought tolerant crops in drought-prone areas could help in reducing vulnerability to climate change (Mubanga, 2014). Crops such as wheat and cassava requires significantly less water compared to local maize (Akinnagbe & Irohibe, 2014). The use of drought tolerant crop varieties has been tried by smallholder farmers as adaptation methods to climate change in Nigeria, Senegal, Burkina Faso, Ghana and Zambia (Ngigi,2009; Mubanga, 2014). Further, strategies against drought were adopted by nomadic pastoralists living in the desert margins of Kenya (Ngigi, 2009).

Use of sustainable farming systems: Some smallholder farmers in Chongwe had adopted the potholing farming system as a way of preparing their fields in readiness for planting. Potholing was used as an adaptation technique to reduced rainfall because the holes dug, stored water when it rains making the moisture available to plants longer than in ploughed fields. Potholing is a climate smart farming system as it allows water to collect and thus prevent loss through run-off (FAO, 2013; Moyo, 2013). Chomba (2004) also reported similar findings when he said intercropping and pot holing practices are likely to be more appealing to households living in areas where inadequate rainfall occurs. Potholing also maximizes residue and water retention by restricting tillage to only where the crop will be planted (Mhambi-Musimwa, 2009). This helps maintain soil health conditions for longer periods as the soils remain undisturbed in areas where planting is not done.

Gardening: Gardening is important as one of the livelihood activities. It saves income as farmers may not need to buy every vegetable, onions or tomatoes they need. Besides, if gardening is used as an off-season livelihood when farmers are not cultivating the fields it ensure a constant flow of income to households even when income from on-farm livelihoods has dried.

Intensify Engagement in Off-farm livelihood Activities: During periods of extreme climatic conditions, crop production becomes a challenge as a result, farmers do not harvest enough to sell and acquire enough income to sustain themselves. Intensifying engage in off-farm livelihoods, provide smallholder farmers with insurance during the periods of reduced farm productivity. Maintaining off-farm income resources also help farmers to cope and rebuild their farm based livelihoods after an extreme event. Diversification into off-farm livelihoods is not only a critical short term coping strategy, it is also critical for the resilience of agricultural livelihoods themselves.

Policy Implications: There is a need for a policy that provides favourable conditions for intensifying smallholder farmers' engagement in off-farm livelihoods. Encouraging and sensitizing smallholder farmers' involvement in off-farm livelihoods such as casual work and petty trade could prove helpful to farmers' development of improved adaptive capacities as well as resilience. Governance strategies that are gender sensitive can provide crucial support systems to both male and female smallholder farmers in times of weather related yield loses by providing

access to information and credits. Such strategies should promote women's involvement in off-farm livelihoods and decision making by making it relatively easier for women to access such credit facilities that can help them set up their low-risk and more-certain off-farm livelihoods. Formation of agricultural cooperatives and partnerships can enable farmers' share knowledge and success stories which could be motivating to other farmers who could be encouraged to engage in off-farm income generating livelihoods as a way of combating the impacts of climate change.

5.0 CONCLUSION

The study has shown that most smallholder farmers in the Chongwe district are aware of changes in the climatic patterns. Climate Change has impacted smallholder agriculture in many ways through drought and floods. Effects have manifested through the uncertain onset of rainfall, more intermittent rains, reduced crop growing season and intra-seasonal droughts. As a result of these effects, yields from on-farm activities have been affected too. In order not to be affected by climate change, farmers have resorted to diversifying their livelihoods in order to broaden income generating sources and ensure food sustenance. These off-farm livelihoods included casual work, petty trade and gardening. Engaging in off-farm livelihoods do not mean stopping agriculture, off-farm livelihoods compliment on-farm activities. This study also highlighted the influence of traditional gender roles among farmers on the selection of income generating livelihoods. Most female farmers abstained from most forms of casual work despite its ability to generate high incomes as they felt it was work suited for men. There is a need for gender sensitive strategies that can promote both male and female engagement in off-farm livelihoods as a way to adapting to the impacts of climate change. As such, there is a need for increased sensitization of farmers on engagement in not only climate smart farming systems, but also off-farm income generating livelihoods as this will improve the smallholder farmers' resilience towards the impacts of climate change. Further, introduction of a credit facility that is gender responsive can also improve women's engagement in off-farm income generating livelihoods and encourage their resilience to impacts of climate change.

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