BASELINE REPORT: CSA PRACTICES AND ADOPTION IN ZAMBIA

A BASELINE EVALUATION FOR CLIMATE SMART AGRICULTURE PRACTICES AND ADOPTION IN ZAMBIA SUBMITED TO CSAAZ

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List of acronyms and abbreviations

CSA	Climate Smart Agriculture
CA	Conservation Farming
CSAAZ	Climate Smart Agriculture Alliance Zambia
CAADP	Comprehensive Africa Agriculture Development Programme
CEO	Camp Extension Officers
FAO	Food Agriculture Organisation
MoA	Ministry of Agriculture
MFL	Ministry of Fisheries and Livestock
PACOs	Provincial Agriculture Coordinators
DACOs	District Agriculture Coordinators
GRZ	Government Republic of Zambia
HH	Household
FGD	Focus Group Discussion
NDC	Nationally Determined Contribution
ZDHS	Zambia Demographic Health Survey

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Executive summary

Introduction

In December 2021, Climate Smart Agriculture Alliance Zambia (CSAAZ), with support from FAO and technical support from Government through the Ministry of Agriculture, conducted a baseline study whose main objective was to identify and fill knowledge gaps about CSA's local- and national-level benefits, specifically under climate change, inform policy development, and prioritize investment opportunities in Zambia.

The objectives of the baseline study were;

1. To identify the Conservation Agriculture/Climate Smart Agriculture practices that farmers are using.
2. To Identify the impact of climate change on Smallholder Farmers in Zambia
3. To determine the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia
4. To determine levels of investment into conservation agriculture/climate Smart agriculture practices in Zambia
5. To Identify policy measures that support convention agriculture/climate smart agriculture in Zambia.

Methodology

The study utilized a mixed method survey approach deploying both qualitative and quantitative research methodologies. The survey used a cross sectional, non-experimental household-based survey design. This baseline was conducted in 40 districts sampled across all the ten (10) provinces of Zambia. A total of 3,384 (1,153 Female, 2,431 Male) small holder farmers who were randomly selected participated in the survey.

Findings

Land ownership: Results found that most farmers owned less than 5 hectares, of which 38.0% owned between 3 to 5 ha and 29.6% owned less than 2ha. Those who had between 6 to 10 hectares accounted for 21%, between 11 to 20ha 7.50% and more than 20 hectares (3.9%). Most of this land (91.8%) is owned by farmers themselves. Forty seven percent of small holder farmers indicated that they jointly owned the land as spouses while 30% of respondents reported that the land was owned by husbands and only 13% indicated that wives owned the land.

Training in CA: Results show that majority (52%) of farmers were trained in CA which included soil conservation/ health, CA Land Preparation (ripping and making basins), causes of climate change and early planting. The trainings were mainly supported by FAO and Ministry of Agriculture.

CSA/CA practices: Some of the CSA/CA practices farmers are using include permanent planting basins, ripping, permanent ridges, maintaining crop cover/ residue retention, crop rotation and agroforestry, though the latter is on a small scale. Conventional farming remains the most practiced tillage method (54.6%) followed by Ripping (18%), basins (17.7%), and permanent ridges (9.6%).

Duration of CA practicing: Findings also show that about 25% of farmers have been practicing CSA for about 2 to 4 years while 14% have been practicing CSA for about 5 to 9 years and 8% for less than a year. Only 6% of the surveyed farmers have been practicing CSA for over 10 years. About 10% of the farmers had at one point ceased using CSA practices citing such reasons as being labour intensive, inadequate resources, lack of equipment and limited land among others.

Farming systems: Results further show that about 47% of farmers practice crop farming with 32.6% practicing livestock farming, 17% practicing mixed farming and only 1.9% and 0.8% practicing agroforestry and aquaculture respectively. Maize (21%) tops the list of crops grown by farmers followed by soya beans and sunflower (17.9%), cassava (11.6%), and vegetables (10%).

Impact of Climate Change on farming: The impact of climate change experienced by farmers include reduced yields (21%), drying waterpoints (19.6%), increase in pest attacks (17.7%), loss of livestock (15%), and reduced grazing land (14.7%) as well a soil erosion (11%). The majority of farmers (90%) indicated that climate change has to a greater extent affected their decision making around agricultural practices. Common hazards experienced as results of climate change include droughts, experienced by 42% of respondents, strong winds (30%), seasonal fires (11%), and floods (10.7%). Ground frost was experienced by 5% of all the surveyed small holder farmers. Most famers (85.9%) reported that their production had reduced as a results of climate change.

Coping strategies to Climate Change: Survey findings show that some of the coping strategies adopted by small holder farmers to mitigate the impact of climate change include crop rotation, used by 74% of the surveyed farmers, timeliness of implementing farm activities and use of drought tolerant varieties (62%), use of climate information and early warning (59%), organic farming (45%), minimum tillage (43%), crop and livestock integration (40%), soil cover (33%), integrated pest management (26%) and improved livestock housing (23%). Agroforestry was only used by 9% of respondents.

Agricultural land under CA/CSA: Results show that 49% of the surveyed farmers use 25% of the land under agricultural production for CA/CSA while 20% reported that they use 50% of their land on CA/CSA and 13.6% use 75% of their land on CA/CSA respectively.

Investment in CSA: Almost half (49%) of famers said they use about 25% of their agriculture budget on CSA/CA, 22.7% use half of their agriculture budget on CA/CSA and 15% use almost 75% of their budget on CA/CSA. Only 13% of famers indicated that they use all of their agriculture budget on CA/CSA. Only 10.8% of farmers reported that they received financial support to implement CA/CSA activities and majority received this support from government.

Awareness of CSA: Findings show that majority (64.7%) of farmers were not aware of CSA policies being propagated by government. Among those that were aware of policies, agriculture extension officers were the greatest source of information (79%) followed by radio (11%) and NGOs (7%) while TV accounted for only 1%. The policies mentioned include National Agricultural Policy and the 7th National Development Plan. Farmers mentioned that they were not involved in the CSA policy formulation.

Conclusion

1. *To identify the Conservation Agriculture/Climate Smart Agriculture practices that farmers are using*

Some farmers were found to be using CSA/CA practices on their farms, common among them was permanent planting basins, ripping, permanent ridges, maintaining crop cover/ residue retention and crop rotation. Farmers using CSA/CA accounted for 40% of all respondents.

2. *To Identify the impact of climate change on Small Holder Farmers in Zambia*

Farmers clearly have been negatively affected by climate change as evidenced by reduction in crop yields and loss of livestock among others. While farmers have adopted some strategies such as crop rotation, use of drought tolerant varieties, organic farming to mention but a few in mitigating the impact of climate change, the uptake of other government promoted strategies such as aquaculture and agroforestry remains very low.

3. *To determine the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia*

Most farmers prefer using conventional farming especially when it comes tillage methods, meaning the adoption levels of CA is s still low, though majority of farmers are aware and were trained on CSA/CA.

4. *To determine levels of investment into conservation agriculture/climate Smart agriculture practices in Zambia*

Levels of investment in CSA/CA remains quite low as almost half of the interviewed farmers only use a quarter of their farms on CSA/CA. Interestingly, almost half of the surveyed farmers reported using three quarters of their budgets on CSA/CA. External financial support to farmers to support CSA/CA remains low as only 10% of farmers practicing CSA/CA reportedly received external finical support.

5. *To Identify policy measures that support convention agriculture/climate smart agriculture in Zambia*

Awareness on policy provisions supporting CSA/CA implementation remain largely unknown to small holder farmers and among a few that did know the policies, agriculture extension officers were a key source of that information. Farmers are seldom engaged in CSA policy formulations.

Recommendations

1. There is need to increase awareness of CSA/CA amongst smallholder farmers in the form of training and demonstrations–this will require support to implementing agencies.
2. Development agencies (government, NGOs and the private sector) needs to promote and support small holder farmers to adopt and scale up the use of aquaculture and agroforestry among the CSA/CA practices as they have potential to improve their livelihoods as well as reduce greenhouse gas emissions
3. Given that conventional farming especially the tillage practice used remains a preferred choice among many small holder farmers, more effort ought to be made in terms of sensitizing and equipping farmers to easily adopt CA practices if the impact of climate change is to be reduced.
4. Investment in CSA/CA need to be improved both at individual farmer level and from agencies that support farmers. Farmers should be encouraged to increase both the hectarage and financial outlays reserved for CSA/CA. This can be accomplished if government and other stakeholders can increase CSA/CA related financial and technological support to farmers.
5. Improve policy awareness and engagement among farmers. Policy implementation on CSA/CA will remain a challenge if those on whom the policies are meant to impact remain unaware of and less involved in the formulation of the promoted policies. Government and

other key stakeholders in the agriculture sectors should invest more in raising awareness on CSA/CA in general and on the policies and strategies propagated by the government in particular.

Chapter One: Introduction and Background of the Study

1.0 Organizational background

Registered in 2018, the Climate Smart Agriculture Alliance Zambia (CSAAZ) was established to share and combine experiences, skills, and knowledge on promoting Climate Smart Agriculture (CSA) practices and to ensure that such measures are supported with appropriate policies and legislation. The Alliance's mandate is derived from government's commitment to enhancing resilience of livelihoods and production systems to climate variability and other related risks among the farming communities in Zambia.

The Alliance hope to build a platform of dedicated stakeholders that will help address the effects of climate change on Zambia's agriculture sector and contribute to the attainment of national and global goals of food security and poverty reduction, through increased adoption of CSA practices. Specifically, the Alliance's objectives are:

- To catalyze and support the uptake and up-scaling of CSA practices of small-scale farmers in Zambia considering Africa's interests, aspirations and circumstances.
- Alliance members to collaboratively support strengthening of local/national policy and programme design capacity, skills development, and access to CSA information.
- To establish a CSA platform for partnership engagement, resource mobilization through multilateral and bilateral investment, and a results-based funding mechanism to increase financing for scaling-up CSA practices and support.
- To facilitate capacity building and inventory of targeted farmers and staff of member organizations involved in promoting CSA at national, provincial, district and community levels in Zambia.
- To engage with relevant government ministries, private sector and other stakeholders to enhance knowledge, promote policies, and support programmes that effectively integrate CSA sustainable food production systems that are environmentally sound, socially just and economically viable.

1.2 Contextual background - Climate Smart Agriculture

Zambia's agriculture sector faces challenges and is likely to become more vulnerable as a result of climate change and risk. The country has a highly variable climate, and in the past decades has experienced climatic extremes in the form of droughts, seasonal and flash floods, and extreme temperatures. Many of these events occurred with increased frequency, intensity, and magnitude[1]. One of the drivers of vulnerability to Climate Change is over-dependence on climate-sensitive sectors such as agriculture, forestry and fisheries. Under its Zambia Climate-Smart Agriculture (CSA) Strategy Framework, the GRZ is promoting the rollout of climate-smart agriculture practices that will sustainably increase productivity, enhance resilience, and reduce or remove GHG emissions. All these efforts are aimed at reducing the negative effect of climate variability on agricultural development.

The Government of the Republic of Zambia (GoZ) is integrating climate change concerns into its agriculture policy agenda. Zambia has developed several climate change-related policies and strategies, and the mainstreaming of climate change into sectoral policies is expected to continue. The National Climate Change Response Strategy (2010) emphasizes the role of sustainable land use systems in enhancing food security. Zambia's Nationally Determined Contribution (NDC) sets ambitious goals for climate mitigation and adaptation that include the agriculture sector, and which aim to reduce GHG emissions by 25 percent up to as much as 47 percent, depending on the level of international support and financing.

Zambia is divided into three major Agro-Ecological Regions (AER), thus Regions I, II and III, which are primarily based on rainfall amount but also incorporate soils and other climatic characteristics. Figure 1 shows the AER of Zambia.

[1] The World Bank (2019): Climate Smart Investment Plan, Zambia

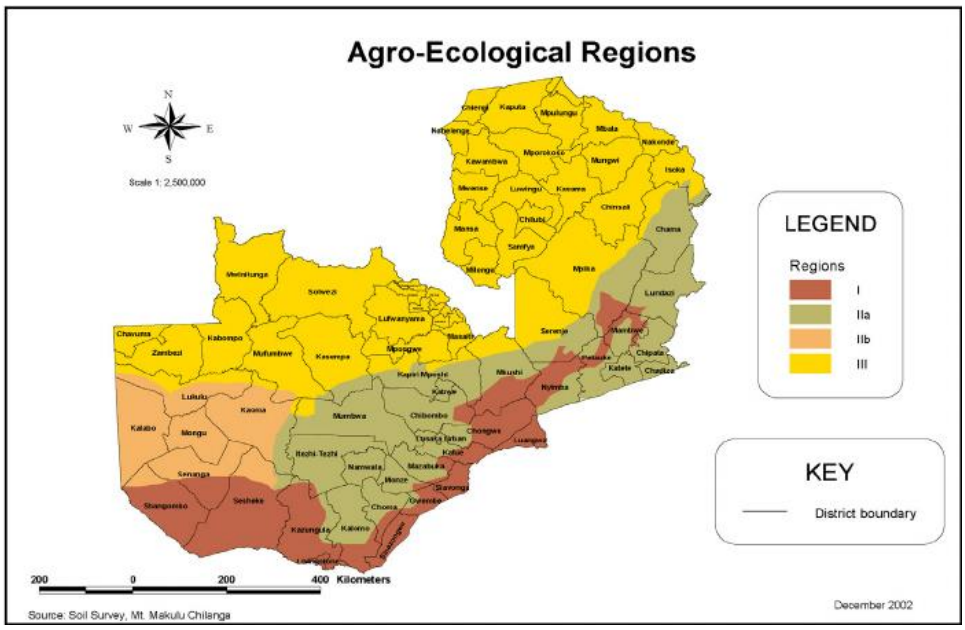

Figure 1: Agricultural zones

Semi-arid Region I include areas of southern, eastern and western Zambia: Zambia's valleys at 300-800 m altitude mostly lie in Region 1. Mean annual rainfall in Region I ranges from 600 to 800 mm. The growing season is relatively short (80-120 days) and risky for crop production, as poorly distributed rains result in crops enduring frequent dry spells. Region I contains a variety of soil types, ranging from slightly acidic loamy and clayey soils with loam topsoil, to acidic sandy soils. Characteristics of these soils which have significant constraints for crop production, include erosion, limited soil depth in hilly and escarpment areas, poor physical properties that make it difficult to till especially on cracking clay soils, crusting, and low water holding capacities in sandy soils.

Region II includes much of central Zambia, with most of Central, Southern, Eastern and Lusaka provinces. It contains the most fertile soils and most of the country's commercial farms. Annual rainfall in Region II averages 800-1000 mm, and the growing season is 100-140 days long. Distribution of rainfall is not as erratic as in Region I, but dry spells are common and reduce crop yields, especially on the sandier soils. Average mean daily temperatures range from 23- 26°C in the hottest month October to 16-20°C in the coldest months of June and July. The most common soils in Region II are red to brown clayey to loamy soil types that are moderately to strongly leached. Physical characteristics of the soils that affect crop production, include low water holding capacity, shallow rooting depth, and top soils prone to rapid deterioration and erosion. These soils also have low nutrient reserves and retention capacity, are acid, have low organic matter and nitrogen content, and are phosphorus deficient.

Region III, the high-rainfall area, lies in a band across northern Zambia, including the Northern Luapula Copper belt, Northwestern provinces and some parts of the Central province. This region receives over 1000 mm of precipitation each year, and the growing season ranges from 120-150 days. Soils in Region III are highly weathered and leached and characterized by extreme acidity. Consequently, the soils have few nutrients available for plant growth, and are high in exchangeable aluminum and manganese, both of which are toxic to most crops unless soils are limed to increase pH[2]Most agriculture and livelihoods interventions in Zambia are depended on the climatic conditions of these regions. Therefore, the recommendations of the type of CSA interventions to be implemented in the respective agroecological regions are dependent on the climatic conditions in the respective regions.

CSA, as defined by FAO is an approach that integrates the three dimensions of sustainable development (economic, social, and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars:

1. sustainably increasing agricultural productivity and income.
2. adapting and building resilience to climate change.
3. reducing and/or removing greenhouse gases emissions, where possible.

It has been observed that more evidence will be needed of CSA's benefits at the local and national levels, specifically in response to climate change, as well as improved communication about CSA benefits. Thus, there's need for a nationwide CSA baseline to be undertaken whose results will ensure effective and innovative ways of information sharing with stake holders in Zambia that are practicing CSA.

1.3 State of CSA/CA in Zambia

Among the range of CSA/CA practices, crop diversification into legumes, commercial horticulture, agroforestry, and strategies of reducing post-harvest losses seem most promising in achieving welfare and sectoral development goals. However, adoption of CSA seems constrained by inadequate access to finance, input and output markets, and capacity building for small holder farmers to adopt CSA practices.

[2] Description of cropping systems, climate, and soils in Zambia (By Dr. R. Chikowo)

According to a report done by Ngoma *etal* 2020, climate change has an effect on several development factors such as household welfare, food and nutrition security, agricultural trade and development, agricultural production and yields of various crops.

The results of this survey will provide the much-needed information to stakeholders for planning and decision making in their interventions on CSA/CA, to enhancing resilience to climate variability, and to help improve the capacity of small holder farmers by investing in resilience building.

1.4 Purpose of the evaluation

The baseline survey aims to identify and fill knowledge gaps about CSA's local- and national-level benefits, specifically under climate change, inform policy development, and prioritize investment opportunities in Zambia. The focus of this survey was around policy measures that support CSA, level of CSA adoption among SHF, levels of investment into CSA practices in Zambia and impact of climate change on Small Holder Farmers in Zambia

Though there have been several assignments on CSA, one being the Climate-Smart Agriculture Investment Plan (CSAIP) supported by World Bank, which aimed at producing evidence of climate-smart agriculture (CSA) technologies that offer the greatest potential as Zambia seeks to sustainably increase productivity, enhance household and agroecosystem resilience, and reduce or remove its greenhouse gas emissions. Going forward, it will be critical to have an understanding of how best to address the trade-offs and synergies between achieving agricultural and economic goals on one hand and preparing for emerging climate challenges on the other. However, there is information gaps as evidenced by the CAADP report of 2021 where Zambia did not provide data on progress indicators such as percentage of farm, pastoral, and fishery-based households that have improved their resilience capacity to climate and weather-related shocks and share of agriculture land under sustainable land management including climate smart agriculture (CSA) practices.

Furthermore, the baseline will help to influence policy adjustments, investment into CSA both from public and private sectors and/or rapid adoption of CSA technologies. Therefore, it is key to undertake the baseline which will address the information gaps on CSA in Zambia in relation to identification of the Conservation Agriculture/Climate Smart Agriculture practices that the farmers are using, the impact of climate change on smallholder farmers in Zambia, the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia, determination of levels of investment into conservation agriculture/climate Smart agriculture practices in Zambia

and identification of policy measures that support convention agriculture/climate smart agriculture in Zambia.

With financial support from FAO and technical support from Government through the Ministry of Agriculture, the Climate Smart Agriculture Alliance (CSAAZ) undertook a country wide baseline survey to gather missing data on climate smart agriculture (CSA).

1.5 Objectives and a statement of the scope of the evaluation

The main objective of the assignment is to undertake a baseline survey on the status of CSA in Zambia. To achieve the main objective, the assignment will be supported by the following sub objectives.

6. To identify the Conservation Agriculture/Climate Smart Agriculture practices that the farmers are using.
7. To Identify the impact of climate change on Smallholder Farmers in Zambia
8. To determine the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia
9. To determine levels of investment into conservation agriculture/climate Smart agriculture practices in Zambia
10. To Identify policy measures that support convention agriculture/climate smart agriculture in Zambia

1.6 Limitations of the Study

Due to time and financial constraints, the study team was not able to visit all the district in Zambia nor conduct a census of all legible farmers, however, the team endeavored to ensure all AER were adequately sampled as well as ensuring a statistically representative sample of respondents. The terrain in some remote parts of the country coupled with the rains made it difficult to reach some areas. Additionally, it was difficulty to mobilize farmers to respond to the survey as it occurred during their busiest period during the planting time. Covid 19 posed yet another challenge in terms of restrictions imposed on gatherings, impacting on numbers of people that could participate in FGDs. Despite these challenges, the team managed to collect data in all the target sites, this was achieved by firstly hiring 4-wheel drive vehicles that could navigate the challenging terrain, farmers were followed into their household, especially in the noon times after they had been to their fields and Focus Group Discussion attendance was minimized to 8 participants, all provided with masks and maintaining social distancing to reduce the likelihood of covid transmission.

Chapter Two: Survey Methodology

2.1 Introduction

To address the above cited baseline survey objectives, the study team utilized a mixed method study approach deploying both qualitative and quantitative research methodologies. While quantitative data provided descriptive statistics using Tables and graphs to describe the observed trends around climate smart agriculture and conservation agriculture qualitative data provided detailed, rich descriptions outlining reasons behind the observed trends.

The survey utilized a cross sectional, non-experimental household-based study design. A cross-sectional study is a type of observational research design in which data is collected from many different individuals at a single point in time (without follow up). This enabled researchers to measure variables as they naturally occur since this type of research is mainly observational, and as is the intent of this study, the results of nonexperimental studies are purely descriptive, i.e. describing the observed phenomenon. The study was household based as a household was used as the sampling unit.

2.2 Sampling procedure

A multi-pronged sampling approach was utilized to arrive at individual farmers who participated in the survey. All the ten provinces were purposively sampled to cover the entire country, within each province four districts were purposively sampled to represent the country's agroecological regions. Within each district, two agricultural camps were conveniently sampled in close consultation with DACO (taking into account the time available for researchers to be in any given district, geographical spread, the terrain and activities that relate CSA/CA). Within each camp, farmers were randomly selected to participate in the survey using the Camp Farmer Registers.

The data collection process collected GPS coordinates which were used to map geographical location of respondents that were visited. The geospatial map below show that baseline survey respondents were evenly drawn across all the agroecological regions as well as across all the provinces in the Zambia, providing a balanced and representative sample for inclusive perspectives among farmers.

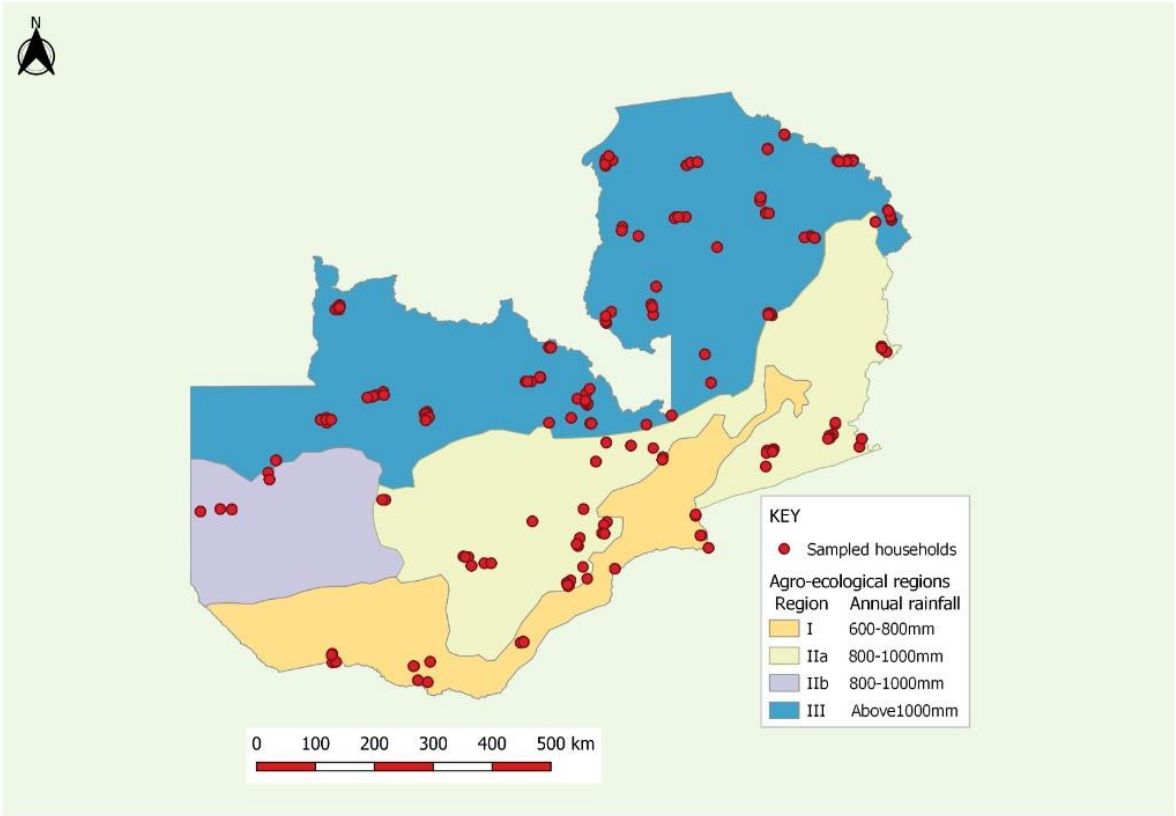

Figure 2: Sampled household, field data, 2021

2.3 Data collection

A combination primary data (interviews with sampled respondents) and secondary data (desk reviews of published reports) collection methods were used. The evaluation team took into consideration public health guidelines on Covid – 19 golden rules such as masking, sanitizing, keeping social distance, frequently washing of hand. Given the Covid-19 situation, all interviews were carried out in outdoor locations and FGDs consisted of no more than eight (08) participants in an open area.

2.4 Primary Data collection

The survey team consisted of a technical support team from FAO & MoA, one overall Team Lead, five Provincial Team Leaders, 20 Enumerators and a Data Analyst. The Survey Team operationally reported to the National Coordinator of the Alliance who in turn reported to the FAO desk office who were the principles funders of the activity. Each data collection team comprising a team leader and 4 research associates visited 2 provinces and covered a total of 8 districts.

Primary collection data from respondents in the targeted four districts in each of the ten provinces of Zambia utilized three methods of data collection, individual questionnaire interviews, key informant questionnaire interviews and focus group discussion interviews.

*Household/Farmer Questionnaire***:** an interview guide was developed and deployed on digital devices using the CommCare platform to capture farmers' perspectives, information which mainly was used to create the quantitative data displayed in tables and or graphs. For household questionnaires, in each district, the team visited 2 camps, in each camp they selected 3 zones and each of the 3 Research Associate conducted a total of 10 interviews per day across the 2 camps, thus each data associate conducted 30 interviews per district and each team conducted 90 interviews per district, translating to 360 interview per province, culminating to 3,600 interviews across the ten provinces. At 99% confidence level and a confidence interval of 5, the statistically acceptable sample size for an estimated population of 13,096,666 (2010 CSO population estimates) is 666 (https://www.surveysystem.com/sscalc.htm). This study reached a far greater sample to improve data reliability.

Key Informant Interviews **(KII):** A KII tool was administered to each of the DACOs in the 10 provinces. As such, a total of 40 KIIs were conducted, 4 in each province.

Focus group discussions

Two focus group discussions were conducted per district with beneficiaries and other community members. The baseline survey targeted and conducted a total of 80 focussed group discussions in all the targeted districts

Secondary data collection

Literature review: desk study involved accessing information from national and international sources and reviewing existing grey and published literature on CSA/CA in Zambia was conducted. Furthermore, the literature review also looked at the existing laws and policies that support CSA practices in Zambia. A desk review of relevant documentation was done including the Climate Smart Agriculture Investment Plan, Climate Smart Agriculture Strategy, Agriculture policy, the Climate Change policy and Livestock policy, CASU (CA Scaling UP) from FAO, among others.

Chapter Three: Presentation and discussion of the evaluation findings

3.1 Demographics

For this study, demographics refers to socioeconomic information expressed statistically, including employment, education, income, marriage rates, birth and death rates, and more.

3.1.1 Provincial Representation

The baseline survey provides a wealth of information on the geographic locations where the study was conducted. This baseline was conducted in 40 districts sampled across all the ten (10) provinces of Zambia. The figure below shows provincial representation. On average, about 10.0% of interviews were conducted in each province. The highest representation was Western province with 10.6%, this was followed by Central & Northern at 10.4%, this was followed by Luapula at 10.2%, followed by Northwestern 10.1%, Copperbelt & Eastern both at 10.0%, Muchinga 9.7%, and lastly Lusaka 8.3%. as shown in Figure 1

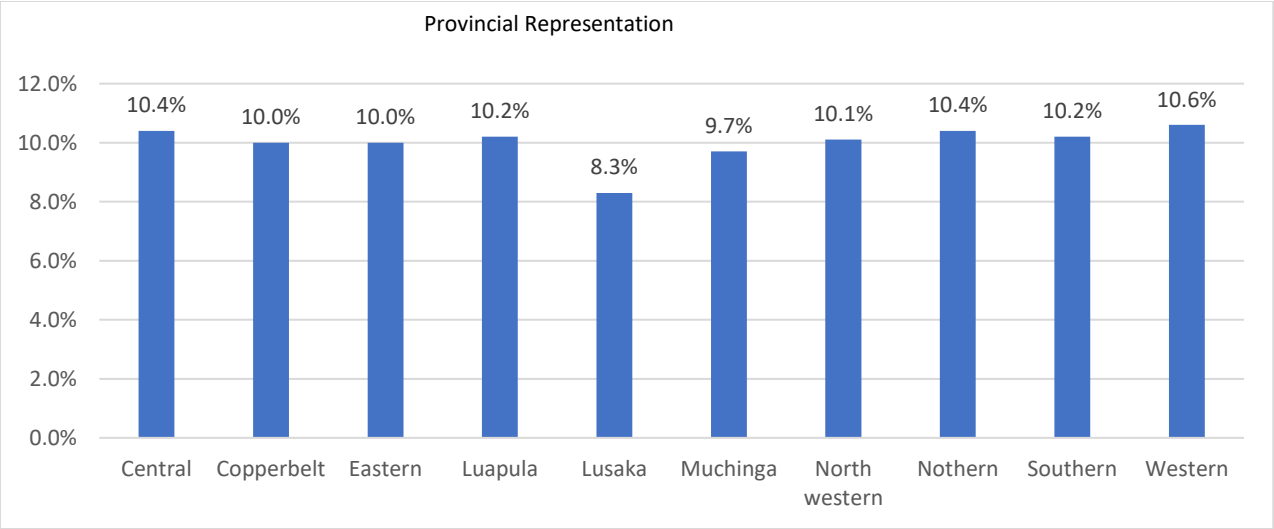

Figure 3: Provincial Representation. Source: Field Data, 2021

3.1.2 Sex & Nature of Household Head

Compared to the sex of the household and age, majority of household heads were adult (18 years and above) male headed at 67.1% while adult female headed household were at 32.1%. Child headed

household (below 18 years old) males were at 0.1 %, and females were at 0.3%. The figure below shows this information. This shows that the areas evaluated are patriarchal societies.

Table 1: Sex & Nature of the HHH. Source: Field data, 2021

Sex & Nature of household head						
	Female		Male		**Total**	
	N	%	N	%	N	%
Adult headed household 18 years & above	1151	32.1%	2419	67.5%	3570	99.6%
Child headed household below 18 years	2	0.1%	12	0.3%	14	0.4%
Total	1153	32.1%	2431	67.8%	3584	100.0%

The figure below further shows head of the household by province. All the provinces showed a bias toward patriarchy. Central province showed 6.1% male household heads and 4.4% female households heads, Copperbelt showed 6.2% male household heads and 3.8% female household head, Eastern province showed 8.0% male household head and 2.0% female household head, Luapula showed 6.9% male household heads and 3.3% female household head, Lusaka showed 6.0% male household heads and 2.3% female household heads, Muchinga showed 6.5% male household heads and 3.2 household heads, North western showed 7.2% household heads and 2.9% female household head, Northern showed 8.9% male household head and 1.5% female household head, Southern showed 5.9% male household heads and 4.3% female household head, and Western province showed 6.1% male household heads and 4.5% female household head. The results indicate that the households in the areas sampled are predominantly male headed.

Table 2: Sex by household. Source, Field data, 2021

Sex of household head by Province			
	Female	**Male**	**Total**
Central	4.4%	6.1%	10.4%
Copperbelt	3.8%	6.2%	10.0%
Eastern	2.0%	8.0%	10.0%
Luapula	3.3%	6.9%	10.2%
Lusaka	2.3%	6.0%	8.3%
Muchinga	3.2%	6.5%	9.7%
Northwestern	2.9%	7.2%	10.1%
Northern	1.5%	8.9%	10.4%
Southern	4.3%	5.9%	10.2%
Western	4.5%	6.1%	10.6%
Total	**32.2%**	**67.8%**	**100.0%**

3.1.3 Marital Status and Education Level

The figure below marital status of the respondents. Most respondents (76.4%) were married, this was followed by widowed 9.8%, divorced 6.6%, single 5.6%, and lastly widower 1.6%.

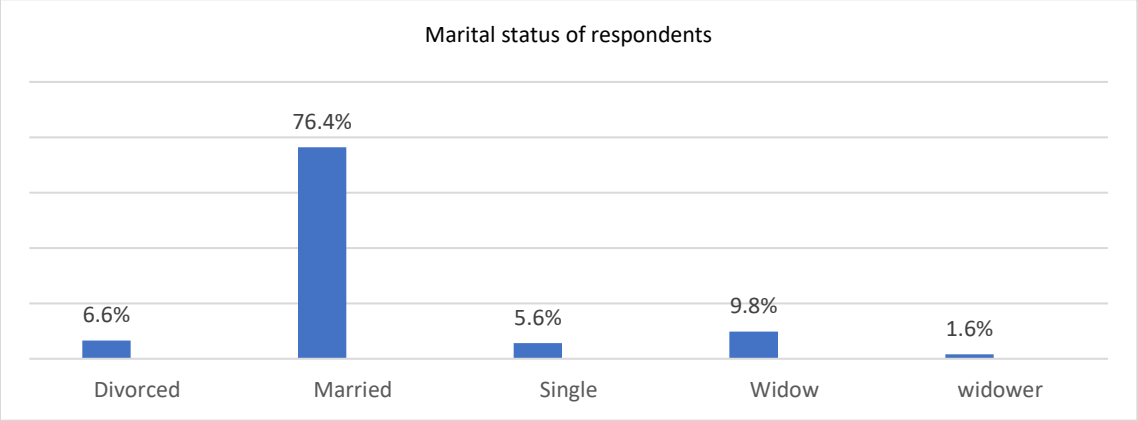

Figure 4: Marital status of respondents. Source; Field data, 2021

Respondents were asked as to how far they had gone in obtaining education. Results show that majority of respondents (55.7%) had attained primary school as their highest level of schooling while 36.3% of respondents had attained secondary school and 5.7% indicated that they never went to school. Only 2.2% of respondents reported having attained tertiary education.

Table 3: Education levels by province. Source; Field data, 2021

Education levels of HH heads per province										
	None		Primary		Secondary		Tertiary		Total	
	N	%	N	%	N	%	N	%	N	%
Central	20	0.6%	237	6.6%	108	3.0%	9	0.3%	374	10.4%
Copperbelt	14	0.4%	180	5.0%	158	4.4%	8	0.3%	360	10.0%
Eastern	44	1.2%	194	5.4%	119	3.0%	3	0.1%	360	10.0%
Luapula	14	0.4%	237	6.6%	111	3.1%	4	0.1%	366	10.2%
Lusaka	26	0.7%	164	4.6%	92	2.6%	15	0.4%	297	8.3%
Muchinga	26	0.7%	165	4.6%	142	4.0%	14	0.4%	347	9.7%
Northwestern	30	0.8%	159	4.4%	168	4.7%	6	0.2%	363	10.1%
Northern	9	0.3%	198	5.5%	151	4.2%	13	0.4%	371	10.4%
Southern	12	0.3%	228	6.4%	120	3.3%	5	0.1%	365	10.2%
Western	11	0.3%	235	6.6%	132	3.7%	3	0.1%	381	10.6%
Total	**206**	**5.7%**	**1997**	**55.7%**	**1301**	**36.3%**	**80**	**2.2%**	**3584**	**100.0%**

3.1.4 Household total size

According to the Zambia Demographic Health Survey 2018, the average household size in Zambia is 5.0 persons. The result for this survey is consistent with ZDHS 2018 as the figure below shows the mode was the range between 5-8 members at 52.1%, which was followed by less than 5 at 24.9%, 9-12 members was at 18.9%, 13-15 members was at 2.7% and more than 16 both ranges had lowest representations.

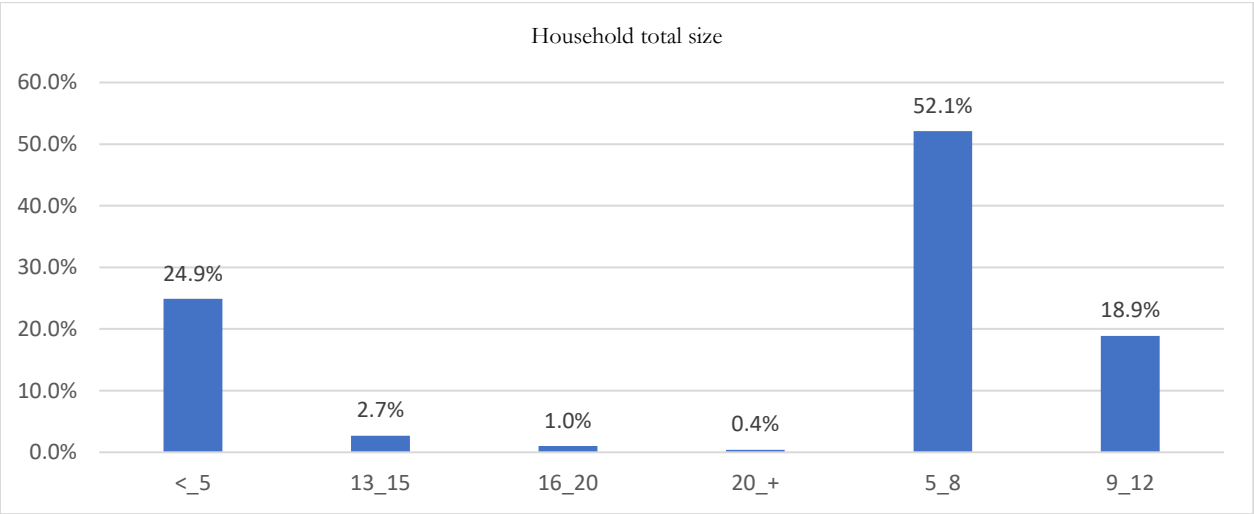

Figure 5: Household total size. Source; Field data, 2021

3.2 Description of results by study objective

3.2.1 Conservation Agriculture/Climate Smart Agriculture practices that the farmers are using.

Qualitative discussions with the teams at DACOs' offices reviewed that farmers are using a wide range of CA/CSA practices. These include permanent planting basins, ripping, permanent ridges, maintaining crop cover/ residue retention and crop rotation. Though on a small scale, agroforestry is also practiced as part of Climate Smart Agriculture alongside the CA/CSA practices.

3.2.1.1. Land size

Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land under permanent crops is land cultivated with crops that occupy the land for long periods. This study sought to find out the size of the land owned by small holder farmers. Results of the study show that 38.0% of respondents reported that their land size was between 3 to 5 hectors, followed 29.6% who owned less than 2 hectors, 21.0% owned between 6 to 10 hectors, 7.5% owned between 11 to 20 hectors and 3.9% of the respondents owned more than 20 hectors of land as shown in figure 5 below.

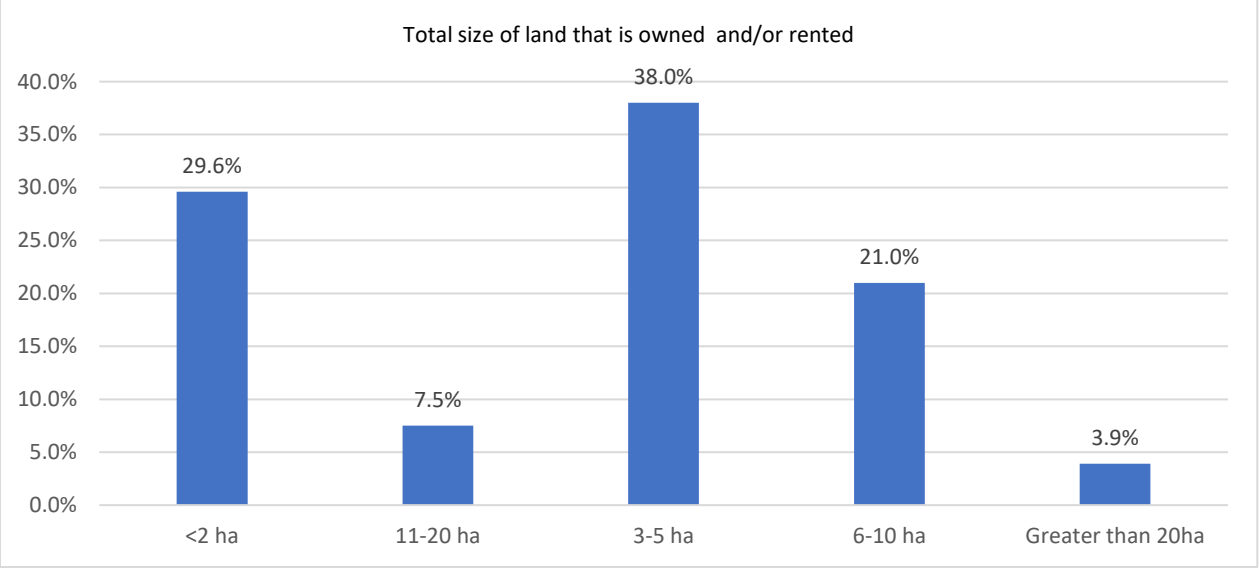

Figure 6: Land distribution. Source; Field data, 2021

Zambia covers 75 million hectares (752,000 km2), out of which 58% (42 million hectares) is classified as medium-to high-potential for agriculture production. However, only 15% of this land is currently

under cultivation. A detailed review of size of land owned by province shows that Central and Copperbelt had 0.7% farmers who owned more 20 hectares of land, this was followed by Northern & Muchinga (0.4%), Northwestern (0.3%), Eastern, Luapula, and Southern all with only 0.1%. of farmers who own more than 20 hectares of land. Western and Lusaka provinces had no farmer who owned more than 20 hectares of land as shown in Table 3 below.

Table 4: Distribution of respondents by size of land owned and location. Source: Field data, 2021

Total size of land owned and/or rented by province												
	<2 ha		10 - 20 ha		3 - 5 ha		6 - 10 ha		>20 ha		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Central	66	1.8%	55	1.5%	103	2.9%	124	3.6%	26	0.7%	374	10.4%
Copperbelt	136	3.8%	27	0.8%	112	3.1%	60	1.7%	25	0.7%	360	10.0%
Eastern	80	2.2%	18	0.5%	175	4.9%	83	2.3%	4	0.1%	360	10.0%
Luapula	41	1.1%	52	1.5%	129	3.6%	105	0.9%	39	1.1%	366	10.2%
Lusaka	198	5.5%	5	0.1%	82	2.3%	12	1.7%	0	0.0%	297	8.3%
Muchinga	124	3.5%	22	0.6%	124	3.5%	61	2.0%	16	0.4%	347	9.7%
Northwestern	117	3.3%	34	0.9%	128	3.6%	72	2.5%	12	0.3%	363	10.1%
Northern	106	3.0%	27	0.8%	134	3.7%	88	1.7%	16	0.4%	371	10.4%
Southern	76	2.1%	13	0.4%	204	5.7%	70	2.0%	2	0.1%	365	10.2%
Western	118	3.3%	16	0.4%	170	4.7%	76	2.1%	1	0.0%	381	10.6%
Total	1062	29.3%	269	7.5%	1361	38.0%	751	21.0%	141	3.9%	3584	100.0%

3.2.1.2 Land usage

Respondents were asked about the proportion of the land they either own or rent was utilized for agricultural purposes. Findings revealed that 29% of respondents utilized all the land they had for agriculture while 26.8% indicated that they used half of the land they had for agriculture and 22% said they use a quarter and three quarters of their land for agricultural purposes as shown in Figure 6 below.

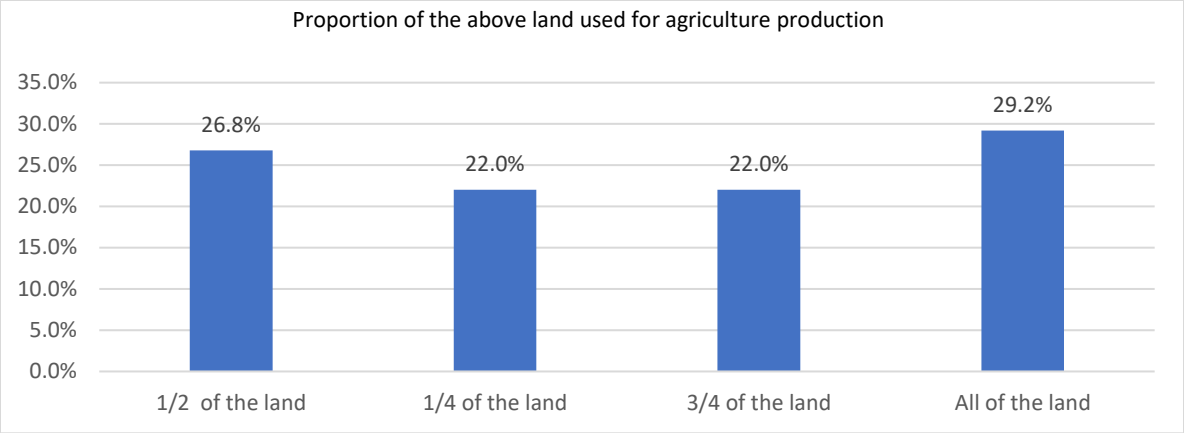

Figure 7: distribution of respondents by proportion of land under agricultural production. Source; Field data, 2021

Discussions with farmers revealed that there was no proper allocation of land to CA practices by farmers as the practice is done randomly without following proper CA guidelines. However, farmers that followed the CA practices, mentioned that on average 30% of their land size is allocated to CA.

3.2.1.3 Land ownership

The study wanted to establish if the land used for agriculture is owned or rented. Results show that 91.8%of the respondents owned the land while 5.2% of survey participants reported that the land they were using for agriculture purposes was rented and 3.0% of respondents had a combination of both owned and rented land. See figure 6 for more details.

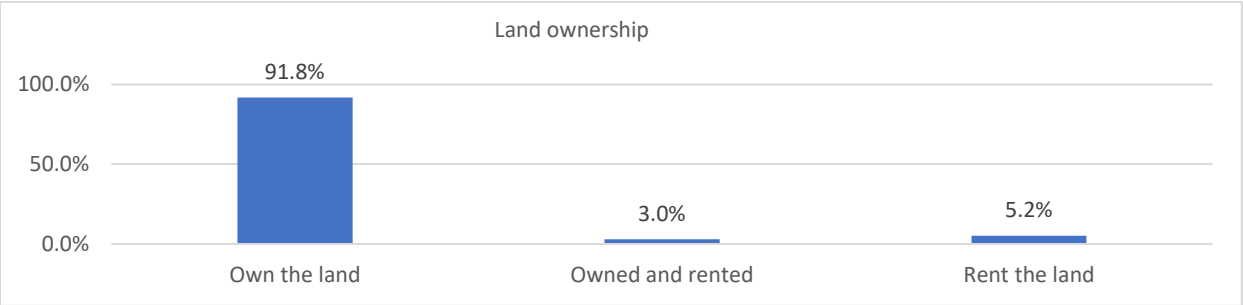

Figure 8: Distribution of respondents by type of land ownership. Source; Field data, 2021

Gender differences in land tenure should be recognized if land objectives, such as increasing land productivity, providing affordable housing, or promoting sustainable resource management, are to be met. There is a need for land tenure policy frameworks that explicitly address gender inclusive access to land. Without specific attention to gender inclusiveness, important segments of society may be excluded from the benefits of land administration, management, and development schemes. This study therefore wanted to assess who owned land at household level. The findings show that 40.7%

of respondents jointly (spouses) owned the land they use for agriculture production while 30.5%. of respondents reported that the land belonged to the husband. The study further show that 13.4% of women/wives owned land as shown in figure 8 below.

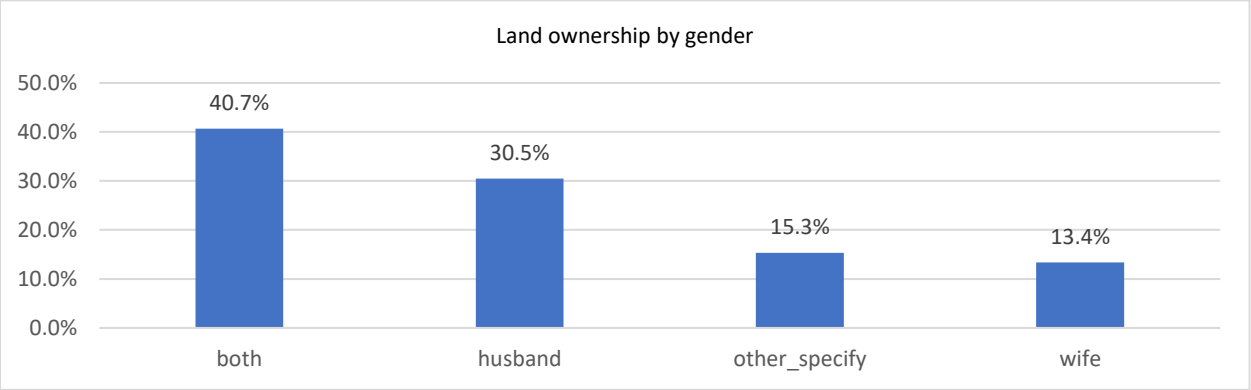

Figure 9: distribution of respondents by land ownership and gender. Source; Field data 2021

3.2.1.4 Conservation Agriculture (CA) Trainings

Conservation Agriculture is a farming system that can prevent losses of arable land while regenerating degraded lands. It promotes maintenance of a permanent soil cover, minimum soil tillage, and diversification of plant species (FAO, 2014). CA practices with increased acceptance across the globe are being considered as harbinger for sustainable intensification of smallholder production systems. Its positive impact on natural resources, and resilience to climate change effects are widely acknowledged. In developing countries such as African countries, CA is a relatively new introduction and hence capacity development is vital for development, adaptation and scaling CA based technologies for impact at scale on smallholder farmers in these regions. The study assessed whether some households had received trainings in CA and results show that 52.4% of respondents reported having received trainings in CA while 47.6% did not as shown in Figure 9.

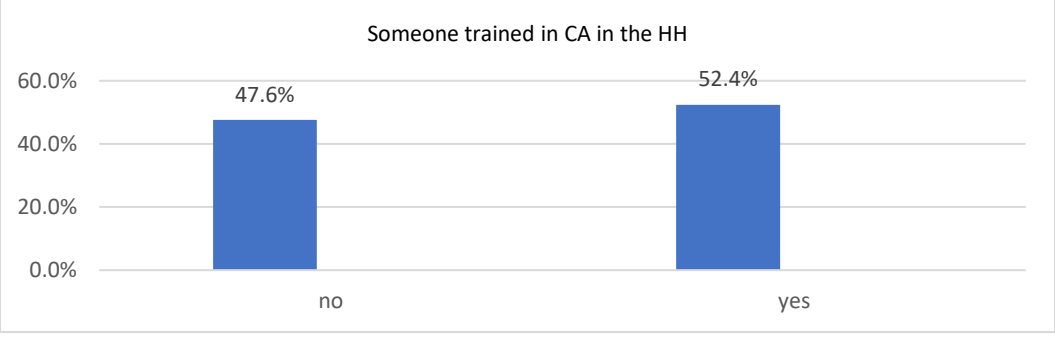

Figure 10: Received CA training. Source; Field data, 2021

The study compared regions to have an understanding on which province received more CA training and results show that Central province had more respondents who received CA training than any other province (14.0%), followed by Southern province (13.4%), Eastern, Luapula, and Lusaka (average 11.0% respectively). The provinces with the lowest number of respondents trained in CA were Northern, Muchinga, Northwestern, and Western at 8.2%, 6.6%, 8.0%, and 5.6% respectively. See Table 10 for more details.

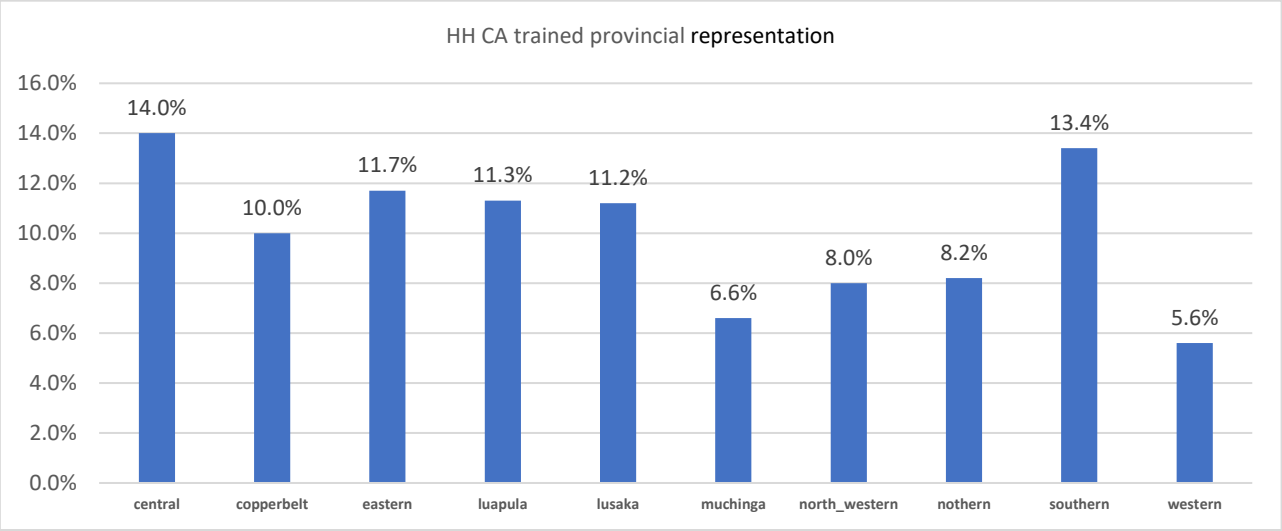

Figure 11: HH CA trained by provincial. Source; Field data, 2021

It has been established that all the smallholder farmers had access to land, be it rented or self-owned and that most farmers (52%) have been trained in conservation agriculture. This puts the small holder farmers in a better place to practice CA/CSA.

Farmers acknowledged that they benefited from training in CSA/CA related initiatives. Trainings that were cited included soil conservation/ health, CA Land Preparation (ripping and making basins), causes of climate change and early planting. These trainings were supported by Sustainable Intensification of Smallholder Farmers in Zambia (SIFAZ), Food and Agriculture Organization Conservation Farming Scaling Up (FAO-CASU) and the Conservation Farming Unit (CFU). Though there is low knowledge of CA, farmers believe that CA increases levels of productivity

3.2.2 Impact of climate change on smallholder farmers in Zambia

Climate change impacts agriculture through increased frequencies of extreme climatic events such as droughts and floods that directly affect agricultural productivity and production (Jain, 2007; Thurlow et al. 2012). Like other countries in the region, Zambia has been affected by climate change. Climate

change and variability have led to crop failure, livelihood losses, increased incidents of food insecurity, and a reduced contribution of agriculture to GDP in the country (Alfani et al. 2019; Chisanga et al. 2017; Chisanga et al. 2018; Mulenga et al. 2019). This section of the study tried to determine the impact of climate change on small holder farmers.

3.2.2.1 Type of Agriculture farming system practiced at the farm

Respondents were asked about the type of farming they practiced. Results in Figure … below shows the type of agriculture system practiced among the small holder farmers interviewed. Findings show that on average, 47.3% of respondents practiced crop farming, 32.6% practiced livestock farming and 17.3% practiced mixed farming. The lowest practices system of farming was Agroforestry and Aquaculture farming at 1.9% and 0.3% respectively.

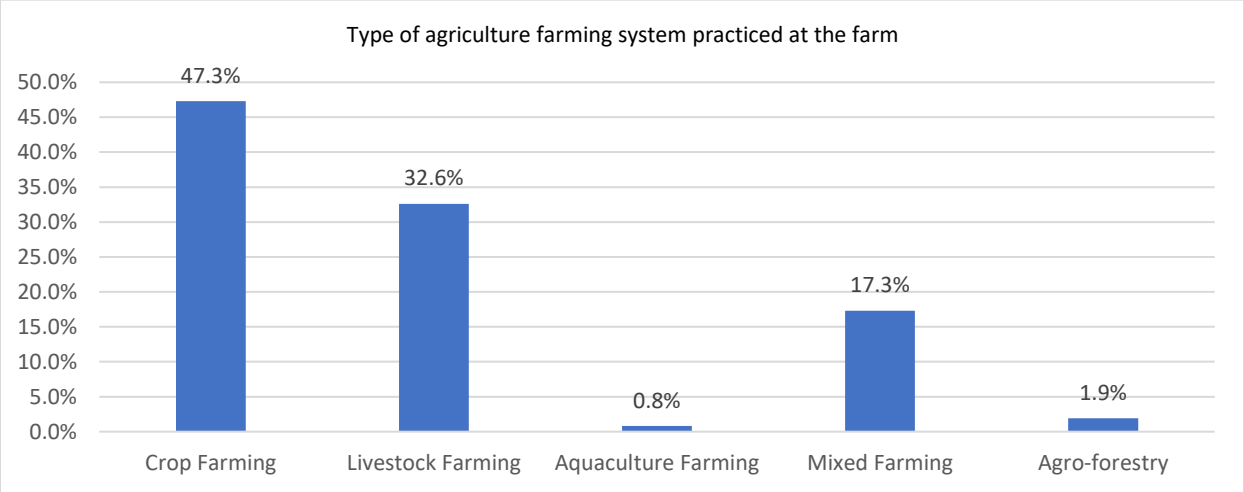

Figure 12: Type of agriculture farming system practiced at the farm. Source; Field data 2021

3.2.2.2 Types of crops grown at the farm

Smallholder farmers are largely concentrated in regional I of agriculture zone. Region I has predominantly small-scale farmers in the major valley systems. In the Luangwa Valley, sorghum, finger millet and maize are the major starchy food crops, while groundnuts, cowpeas and pumpkins are also grown. Farmers use hand hoes for cultivation. Other areas of the region mainly produce bulrush millet, sorghum, and cassava. For this study, each part of the country and ecological zone was sampled. Respondents were asked what crops they grow on their farms and results show that majority (21.5%) grew maize this was followed by Soya beans and Groundnuts (17.9%), Cassava 11.6%. 10.2of small holder farmers grew vegetables and Sunflower and 7.3% respectively. The least crops mentioned to be grown were sorghum and Agroforestry (0.7%) and (0.2%) respectively as shown in Figure 12 below.

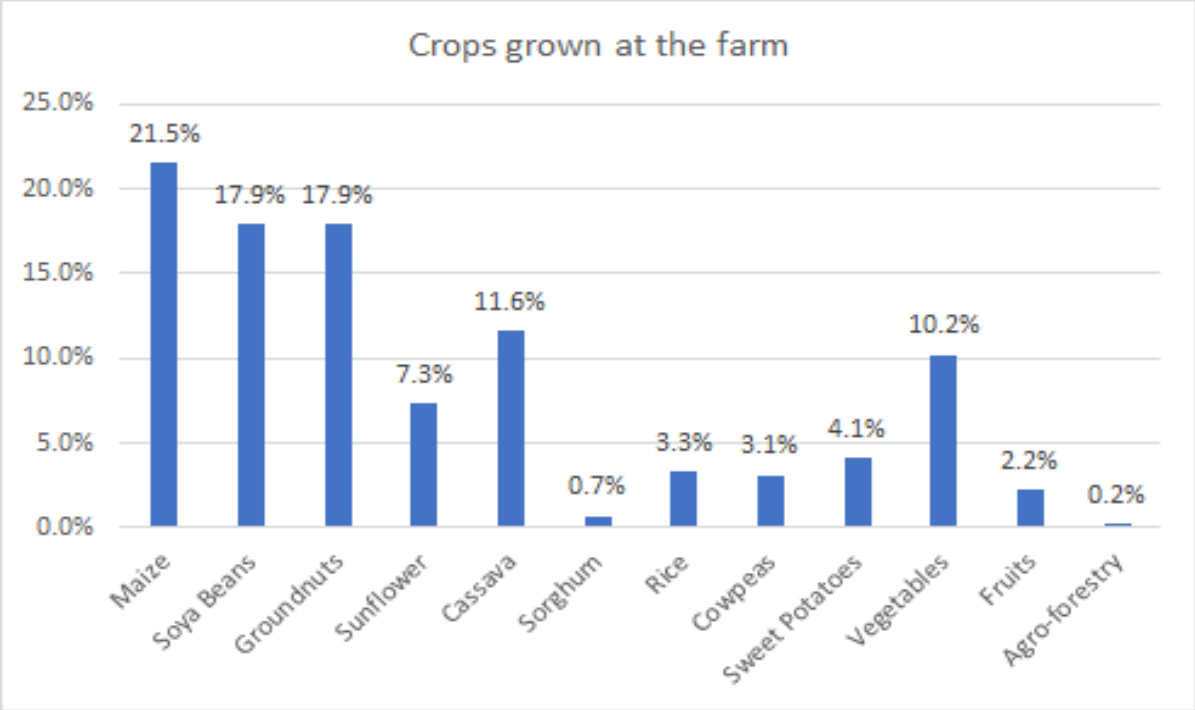

Figure 13: distribution of respondents by type of crops grown. Source; Field data, 2021

From the above figure, it shows that maize is the crop which is grown by most farmers. In terms of regional representation, the table below shows that all the provinces mainly grow maize. Among notable crops grown in large quantities at provincial level is soya beans in Eastern province at 8.2%, Cassava was shown to be grown in large quantities Northern province at 7.6%, Groundnuts are grown in Eastern province also showing 8.2%. The results shows that Sunflower was grown mostly in Eastern and Luapula provinces 7.4%. Sorghum and Rice were shown to be grown highly in Western province both at 2.1%. Sweat Potatoes and vegetables were shown to be grown highly in Central province at 4.3% and 1.0% respectively.

Table 5: Crops grown per province representation

Crops grown per province representation											
	Maize	Soya Beans	Groundnuts	Sunflower	Cassava	Sorghum	Rice	Cowpeas	Sweet Potatoes	Vegetables	Fruits
Central	10.4%	6.8%	6.8%	7.0%	3.1%	0.3%	0.1%	0.9%	4.3%	1.6%	1.0%
Copperbelt	10.0%	1.7%	1.7%	4.9%	0.5%	0.2%	0.0%	0.1%	0.9%	0.4%	0.3%
Eastern	10.0%	8.2%	8.2%	7.4%	0.4%	0.1%	0.1%	0.3%	1.7%	1.5%	0.1%
Luapula	9.8%	2.6%	2.6%	7.4%	9.0%	0.7%	0.4%	0.1%	4.5%	2.2%	1.0%
Lusaka	8.3%	0.8%	0.8%	4.3%	0.3%	0.7%	0.0.%	1.1%	1.6%	1.9%	0.4%
Muchinga	9.4%	1.7%	1.7%	4.6%	3.8%	0.9%	0.4%	0.3%	2.8%	2.2%	0.2%
North-western	9.9%	1.4%	1.4%	3.4%	3.6%	0.3%	0.0%	0.1%	0.7%	0.4%	0.1%
Northern	10.1%	3.9%	3.9%	7.4%	7.6%	0.7%	0.2%	0.6%	4.2%	2.9%	0.7%
Southern	10.2%	1.4%	1.4%	5.5%	0.0%	1.8%	0.1%	1.9%	0.4%	0.5%	0.2%
Western	10.6%	0.3%	0.3%	6.5%	5.6%	2.1%	2.1%	0.9%	0.6%	0.4%	0.6%
Totals	98.7%	28.9%	28.9%	58.5%	33.8%	7.6%	3.3%	6.2%	21.6%	14%	3%

3.2.2 .3 Tillage Practice used by farmers

Soil tillage has been and will always be integral to crop production. Tillage can result in the degradation of soil, water, and air quality. Of all farm management practices, tillage may have the greatest impact on the environment. A wide variety of tillage equipment, practices and systems are available to farmers, providing opportunities to enhance environmental performance. These opportunities have made tillage a popular focus of environmental policies and programs. The study assessed the type of tillage practice being practiced by stallholder farmers and the results show that most of the small holder famers (54.6%) practiced Conventional/Maximum tillage, this was followed by ripping (18.2%), and basin (17.7%). The least tillage practiced was permanent ridges at 9.6%. See figure 13 for more details.

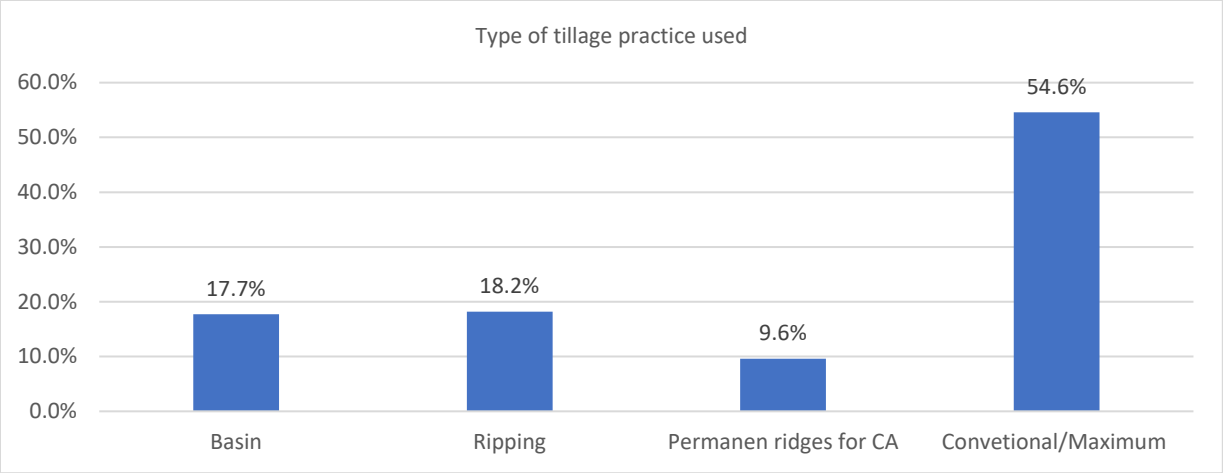

Figure 14: Distribution of respondents by type of tillage being practiced. Source; Field data, 2021

3.2.2.4 Tillage Practice Preferred by farmers

The need to adapt CA to the local context of smallholder farmers has been well established in literature (Erenstein et al., 2012; Giller et al., 2009; Wall, 2007). Among the tillage practices being used by smallholder farmers, they were further asked to indicate the practices they actually preferred. The result show that conventional/maximum tillage was the most preferred tillage system preferred by 56.3% of small holder farmers, this was followed by ripping (22.7%), and basin and permanent ridges for CA at 11.9% and 9.1% respectively. See figure 14 for more details.

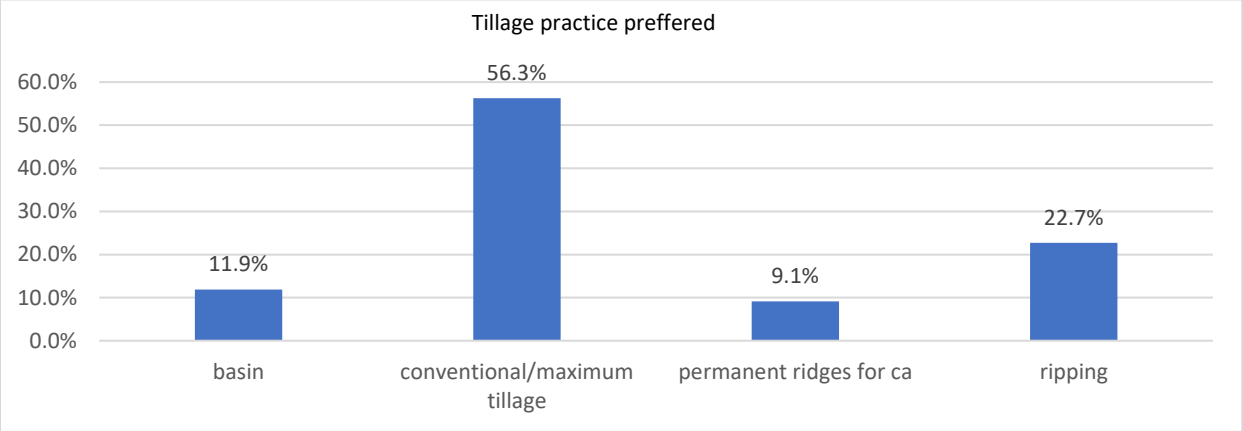

Figure 15: distribution of respondents by most preferred tillage system. Source; Field data, 2021

While quantitative data showed that the most practiced land tillage or preparation method is the conventional method (maximum tillage), discussions with farmers in FGDs also prefer the use of permanent planting basins, locally known as potholes. Potholing was the commonly used CA land preparation method as it was the one which most people have knowledge of. Alongside potholing,

ripping was recognized as another commonly used tillage method. Both these methods were appreciated because of their ability to store water and soil nutrients for the crops. Respondents acknowledged the fact that ripping saved time and labor to prepare the land but bemoaned the labour intensity of basin making.

The topography of western province is constituted by sandy loam to sandy soils which impacts negatively on practicing conservation agriculture methodologies. One unique soil manuring approach commonly applied to the area is kraal shifting- this is a practice where animals kraal is shifted around one area so that cow manure and animal urine collects for a fixed period before moving to the next point. In this way soil fertility in enhanced and improved for crop production

3.2.2.5 Types of Livestock at the Farm

Livestock plays a key role in the economy of farmers. The farmers in Zambia maintain mixed farming system i.e., a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realizing resource efficiency. The livestock serve the farmers in diverse ways. This study wanted to find out common livestock which are kept on the farm and the results show that poultry was kept by 47.9% of respondents, this was followed by goats (24.9%), and Beef cattle (16.1%). The least kept are sheep and donkeys kept by 0.7% and 0.1% of respondents, respectively. As shown in figure 15 below.

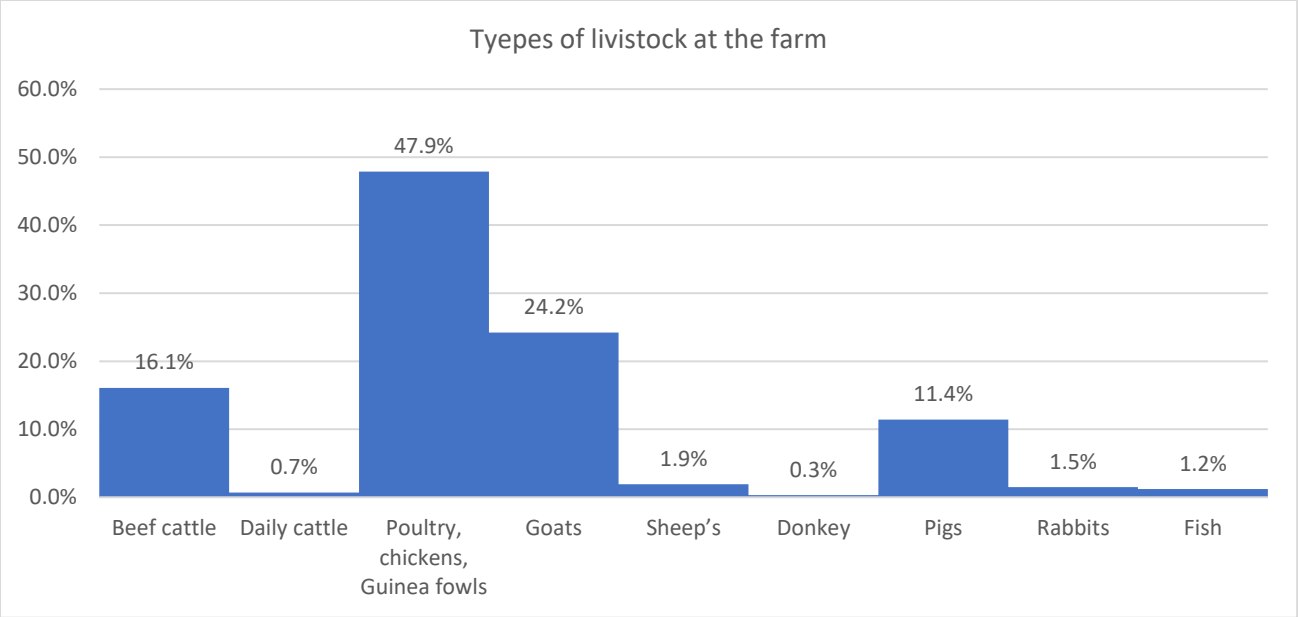

Figure 16: Types of livestock at the farm. Source; Field data, 2021

The study made a comparison of the livestock reared in each province. The results shows that beef cattle had a largest representation in Southern province 6.9%. Daily cattle were found to be more in central province at 0.2%. Poultry, chickens, guineafowls were found to be kept more in central province 9.0%. With sheep, they were found to be kept mostly in central, Eastern, and Southern which all showed 0.2% while goats were found to be domesticated mainly in Southern province 7.4% and Western province 7.3%. See table 5 below for more details.

Table 6: Distribution of respondents by type of livestock kept. Source: Field data, 2021

	Province Representation for Livestock Keeping								
	Beef cattle	Daily cattle	Poultry, chickens, Guinea fowls	Goats	Sheep's	Donkey	Pigs	Rabbits	Fish
Central	1.9%	0.2%	6.4%	3.2%	0.2%	0.1%	0.8%	0.2%	0.1%
Copperbelt	1.0%	0.0%	4.4%	2.6%	0.0%	0.0%	0.8%	0.1%	0.0%
Eastern	2.2%	0.1%	5.1%	2.2%	0.2%	0.1%	1.8%	0.1%	0.1%
Luapula	0.3%	0.1%	3.3%	2.2%	0.2%	0.0%	1.5%	0.2%	0.1%
Lusaka	1.4%	0.0%	4.2%	3.3%	0.1%	0.1%	0.5%	0.1%	0.0%
Muchinga	0.6%	0.0%	5.2%	3.6%	0.0%	0.0%	0.7%	0.3%	0.2%
Northwestern	0.7%	0.1%	5.30%	2.7%	0.0%	0.0%	1.4%	0.1%	0.0%
Northern	1.3%	0.1%	5.3%	2.3%	0.1%	0.0%	1.8%	0.4%	0.7%
Southern	4.9%	0.0%	4.4%	3..9%	0.2%	0.0%	1.4%	0.0%	0.0%
Western	1.8%	0.1%	4.3%	1.1%	0.0%	0.0%	0.6%	0.0%	0.0%
Total	16.1.%	0.7%	47.9%	24.9%	1.9%	0.3%	11.4%	1.5%	1.2%

During focus group discussions, it was disclosed that animal husbandry was not a major enterprise. Few reared livestock for draught power, consumption, and sale (income) in stressful situations.

3.2.2.7 Knowledge of Climate Smart Agriculture

To assess respondents' knowledge on CSA, they asked to give some of the examples of CSA as a proxy to their knowledge or understanding of CSA. Results show that 30.2% of respondents had a medium knowledge of CSA as they were able to give 2 examples while 28.9% exhibited low knowledge levels on CSA as they were only able to cite provide one example and only 13% of survey respondents had high knowledge on CSA and these were able to provide 3 of CSA. Twenty eight percent (27.9%) could not provide a single example of CSA practices as shown in figure below. The findings demonstrates that the majority have an "average" knowledge of CSA.

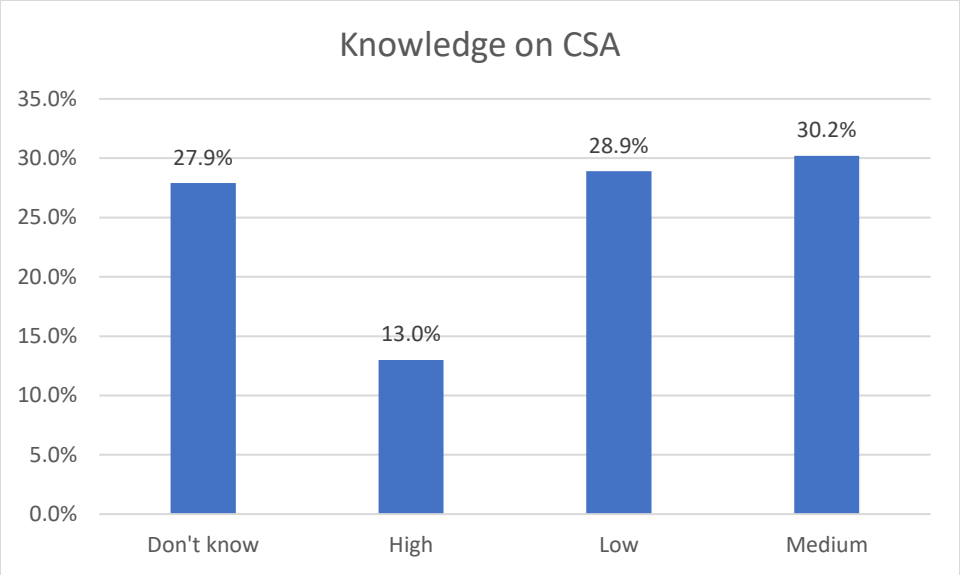

Figure 17: Knowledge levels on CSA. Source; Field data, 2021

The table below shows percentage representations in terms of knowledge awareness on the crops practiced at the farm. The table shows an average of 10% per in term of knowledge awareness. The province showed a high percentage was Eastern province with 4.2% for giving 3 examples, this was whilst the rest had an average of 1%.

Table 7: Knowledge of CSA per province

Knowledge of climate smart agriculture per province					
	Don't know	High 3 examples	Low 1 example	Medium 2 examples	Total
central	2.5%	1.1%	3.3%	3.6%	10.5%
Copperbelt	4.3%	1.2%	1.9%	2.7%	10.1%
Eastern	0.8%	4.2%	1.4%	3.7%	10.1%
Luapula	3.7%	1.3%	2.2%	3.1%	10.3%
Lusaka	0.8%	1.2%	2.2%	4.1%	8.3%
Muchinga	4.0%	1.0%	2.7%	2.0%	9.7%
Northwestern	5.4%	1.2%	2.2%	1.4%	10.2%
Nothern	4.0%	0.7%	3.4%	2.1%	10.2%
Southern	1.6%	0.9%	2.2%	5.5%	10.2%
western	0.8%	0.3%	7.5%	2.0%	10.6%
Total	27.9%	13.1%	28.9%	30.2%	100.0%

3.3.8 Solutions to climate impact

Climate change is of ultimate concern to economist, ecologists, and agriculturalists as agriculture and climate change closely relate. While farmers must amend their practices suffering from weather changes, the impact of modern agriculture on climate change cannot be denied. Thus, the connection between agriculture and climate change demands keen attention as the influence is far beneficial. Climate change adaptation strategies in agriculture and mitigation of negative effects are primary tasks nowadays.

Respondents were asked to state some of the solutions they feel are feasible for climate change. The result shows that majority mentioned crop rotation at 11.7% this was followed by timely planting 9.3%, crop diversification and drought torrent seeds were both at 9.1%, this was followed by use of climate early warning systems 8.7%, livestock feeding 6.4%, cover crops 6.1%, timeliness in farm activities, and crops & livestock integration both at 5.7%. The least mentioned possible good practices were soil cover 5.5%, Integrated Pest Management (IPM) 4.2%, improved livestock housing 3.9%, grazing & frost management 3.1%, and lastly Aquaculture 0.4%grazing and frost management, agricultural liming, agroforestry, water harvesting, and aquaculture as shown in figure 17 below.

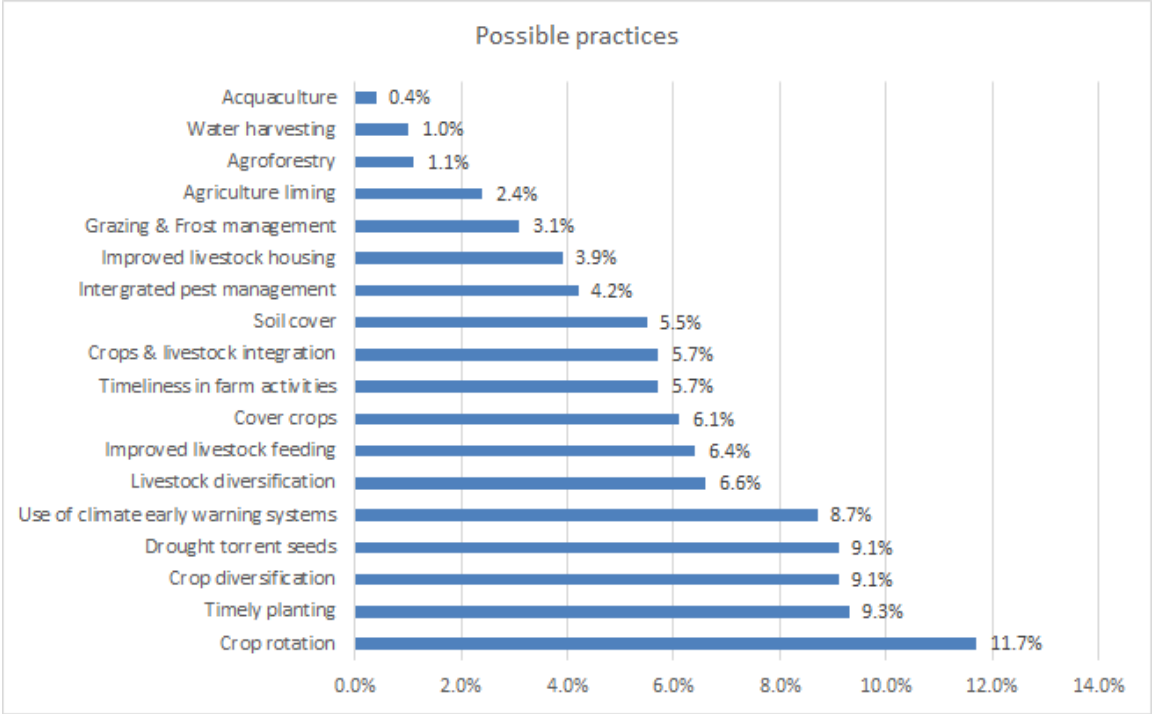

Figure 18: Distribution of respondents by type of climate change solution utilized. Source; Field data, 2021

To promote CA/CSA, small holder farmers in focus group discussions indicated that the solutions lie in planting of early and medium maturing varieties, planting more of drought tolerant crops, delayed planting until rainfall becomes steady (effective planting rains), use of irrigation i.e., furrows and the keeping of livestock and aquaculture.

Further discussions with small holder farmers revealed that Knowledge of CA/CSA technologies is still low. The high reliance on maize as a food security crop discourages farmers from diversifying their production system. As a result, even where inter-cropping and crop rotations are promoted, the focus and priority of small holder farmers is largely on maize. There is a need to develop input and output market systems for a range of agricultural commodities within diverse and climate change-smart production systems. And there is need to undertake wide awareness raising and sensitization through national workshops, farmer outreach, print and digital media and learning visits to ensure that there is a collective understanding of what CSA comprises in the Zambian context. This will reduce misinterpretation of messages and promote a shared vision for CSA in the country.

3.3.9 Impact of Climate Change

The impacts of climate change are threatening food security in Zambia and globally. Smallholder farmers that rely heavily on rainfed agriculture are acutely aware of this, as they regularly suffer from droughts, floods, and the resulting failed harvests. Respondents were asked to state the major impacts of climate change that they face, and the results show that majority have experienced reduced yields 21.4%, which was followed by drying of water points (19.4%), increase in pest attacks (17.7%), loss of livestock (15.4%). The least impacts mentioned were reduced grazing lands, and loss of soil erosion cited by 14.7% and 11.2% of respondents, respectively. See figure 9 for more details

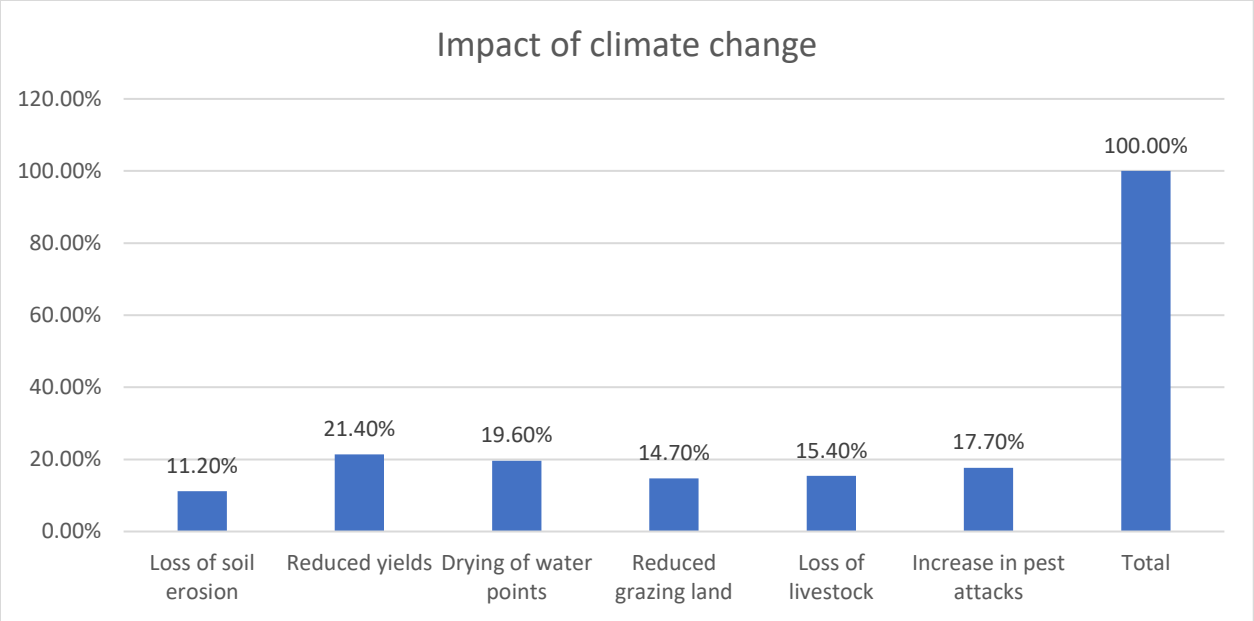

Figure 19: Impact of climate change

3.3.10 Effect of climate change on decision making

To make informed decisions about climate change, farmer need timely and useful information about the possible consequences of climate change, people's perceptions of those consequences, available adaptation options, and the benefits of slowing the rate of climate change. Respondents were asked if their decision-making process has been impacted by climate change and the results showed that 90.1% indicated that climate change has impacted on their decision making to a greater extent while 9.9% indicated that their decision process has been impacted by climate change but to a lesser extent as shown in Figure 18.

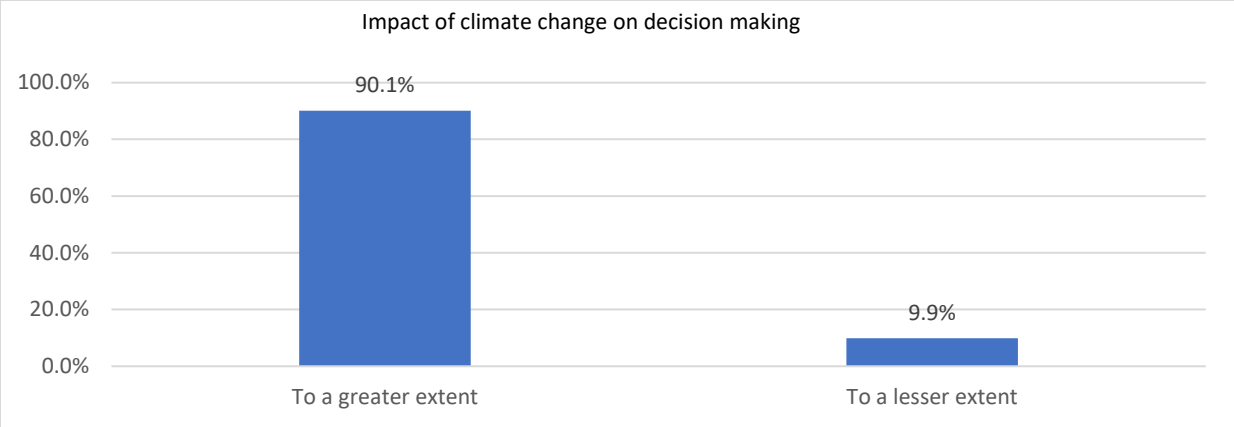

Figure 20: distribution of respondents by how climate change has impacted their decision making. Source; Field data, 2021

3.3.11 Impact of climate change by gender

An assumption is that climate change impacts women and men differently. Women and girls face particular vulnerabilities resulting from cultural norms and their lower socioeconomic status in society. Women's domestic roles often make them disproportionate users of natural resources such as water, firewood, and forest products. Respondents were asked to state which gender is impacted most and majority (54.0%) indicated that both genders have been impacted while 33.2%. felt that women were the most impacted and 11.7% of the respondents indicated that men were the most impacted as shown in figure 19 below.

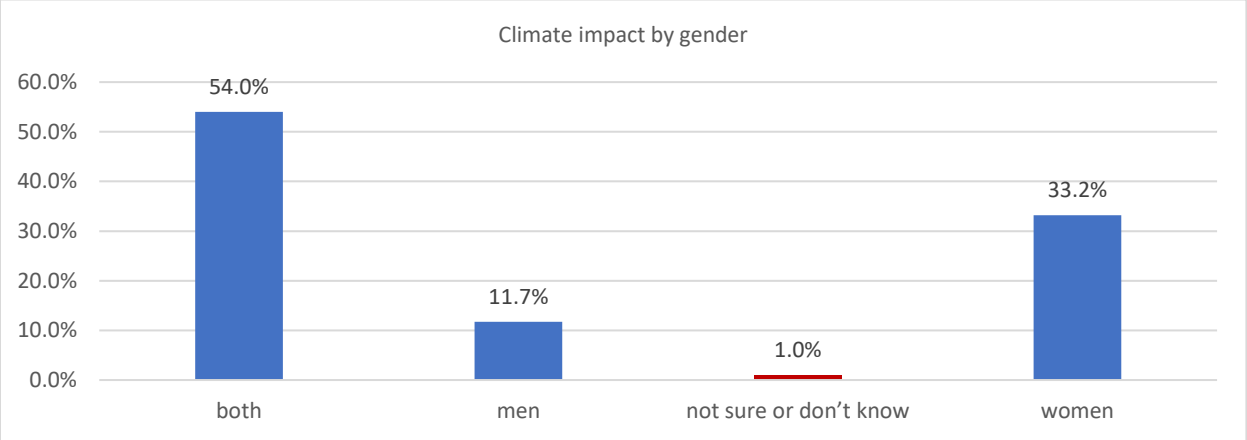

Figure 21: distribution of respondents by whom they thought was most impacted by climate change. Source; Field data, 2021

3.3.15 Common climate related Hazards experienced at the farm

Smallholder Farmers across the country face a wide range of climate related hazards. Respondents for this study indicated drought as the most hazard experienced 42.5%, this was followed by strong winds

30.5%, relatively less mentioned hazards were seasonal fires and floods which were 11.1% and 10.7% respectively.

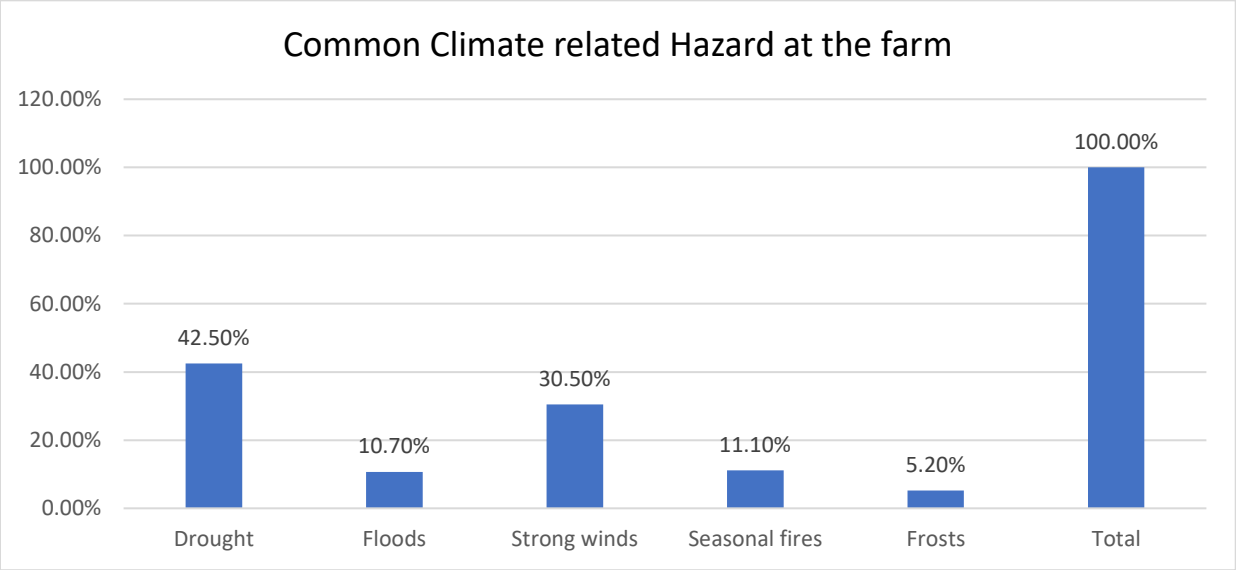

Figure 22: Common climate related Hazard at the farm. Source; Field data 2021

The study further tried to establish the hazards by region and droughts were strongly mentioned as having been experienced in western province (n=379), Southern (n=360), Central (n=359), Eastern (n=355), while droughts were least experienced in Muchinga (n=272). With floods, they were highly experienced in Luapula (n=185), Western (n=155), and Central (n=139), while they were least experienced in Southern (n=4). Strong winds were highly mentioned in Eastern (n=351) and Southern (n=326), while they were least mentioned in Northwestern (n=159). Seasonal fires were highly mentioned in Luapula (180), Central (n=177), and Muchinga (n=106), while Northwestern had the least mentioned. Frost they were mainly mentioned as being experienced in Luapula (n=118), and Central (n=113), and least experienced on the Copperbelt and Northwestern provinces (n=2), respectively. See table 8 below for more details

Table 8: distribution of respondents by type of climate related hazard and location. Source; Field data, 2021

	Climate Impact at the farm per province representation					
	Drought	Floods	Strong winds	Seasonal fires	Frosts	**Total**
Lusaka	295	94	222	103	36	297
Copperbelt	268	50	234	52	2	314
Southern	360	4	326	57	21	365
central	359	139	183	177	113	368
Northern	319	66	176	42	3	362
Western	379	155	240	86	60	379
Muchinga	272	84	235	106	29	334
Northwestern	337	21	159	13	2	344
Eastern	355	33	351	45	16	359
Luapula	347	185	237	180	118	365
Total	3291	831	2363	861	400	3487

Discussions with the farmers revealed that drought and floods are the common hazards that are experienced in the surveyed districts. Pest infestation is usually experienced especially during the main farming season and is common in maize fields. Some of the visible effects of the impact of climate change include low yields. Farmers also mentioned that poor germination is one noticeable effect of climate change when the season is characterized by a poor onset of effective planting rains. An example given was that there is a lot of gapping which tends to be expensive on the farmer's part as replanting is inevitable.

When dry spells/ droughts are experienced, there is a problem in accessing water for agricultural use (crops and livestock) in the communities as most water points where water can be accessed get dried up. Community members have limited water sources such as boreholes to use for both animals and human consumption. Respondents mentioned that some crops usually show signs of wilting and pest and diseases especially Fall Army Worm (FAW) in maize. Another impact of climate change on agricultural activities was cited as being late onset of effective planting rains coupled with prolonged dry spells. The concern has therefore been that farmers were experiencing extremely low yields. Reduced crop yields (productivity and production) have subsequently led to low/reduced household incomes as the quantity of agriculture produce that was offloaded on the market was drastically reduced.

3.3.1.6 Change in production due to Climate Change

Respondents were asked to indicate if they have observed any change in production due to climate change and most of them (85.7%) indicated that their production has reduced drastically while 8.3% said that production had remained the same, and only 6.0% indicated that they had experienced an increase. The results are illustrated in figure 20 below.

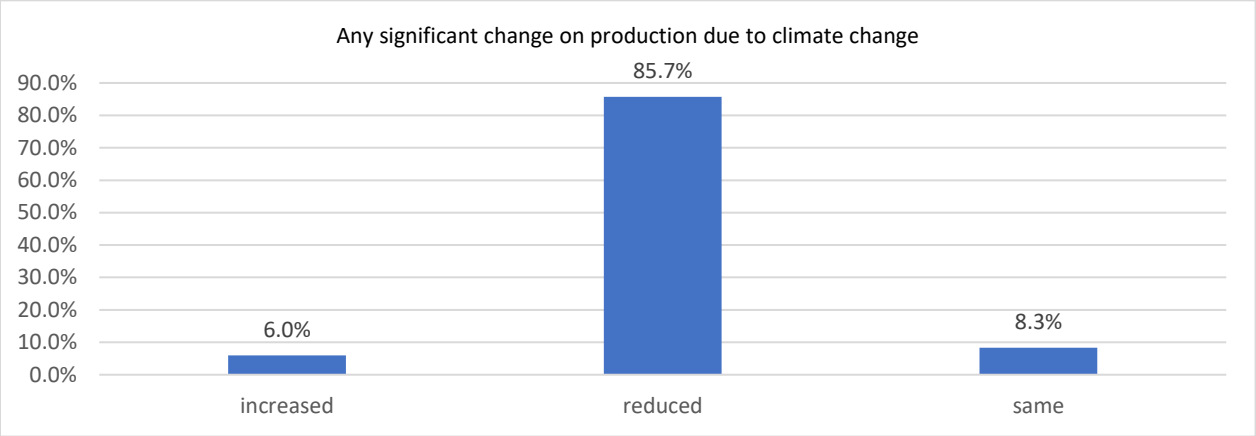

Figure 23: distribution of respondents according to experienced changes in production output. Source; Field data, 2021

Focus group discussions with farmers revealed that climate change impacts were mainly seen in low yields in crop production due to inadequate rainfall and short seasons of available rainfall, prolonged dry spells, and droughts. It was however reported that farmers that practiced conservation farming improved their productivity and crop yields than those engaged in conventional farming. These practices are more common in the southern province.

3.2.3 Determining the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia

3.2.3.1 Most used CSA practices

Respondents were asked to mention some CSA practices that they use the most at their farms. Results show that crop rotation was the most utilized CSA practice reportedly used by 74% of respondents, timeliness of implementing farm activities and use of drought tolerant varieties were the second most utilized CSA practices implemented by 62% of respondents, this was followed by the use of climate information and early warning (59%), organic farming (45%), minimum tillage (43%), crop and livestock integration (40%), soil cover (33%), integrated pest management (26%) and improved

livestock housing (23%). Agroforestry was only used by 9% of respondents. See figure 24 for more details.

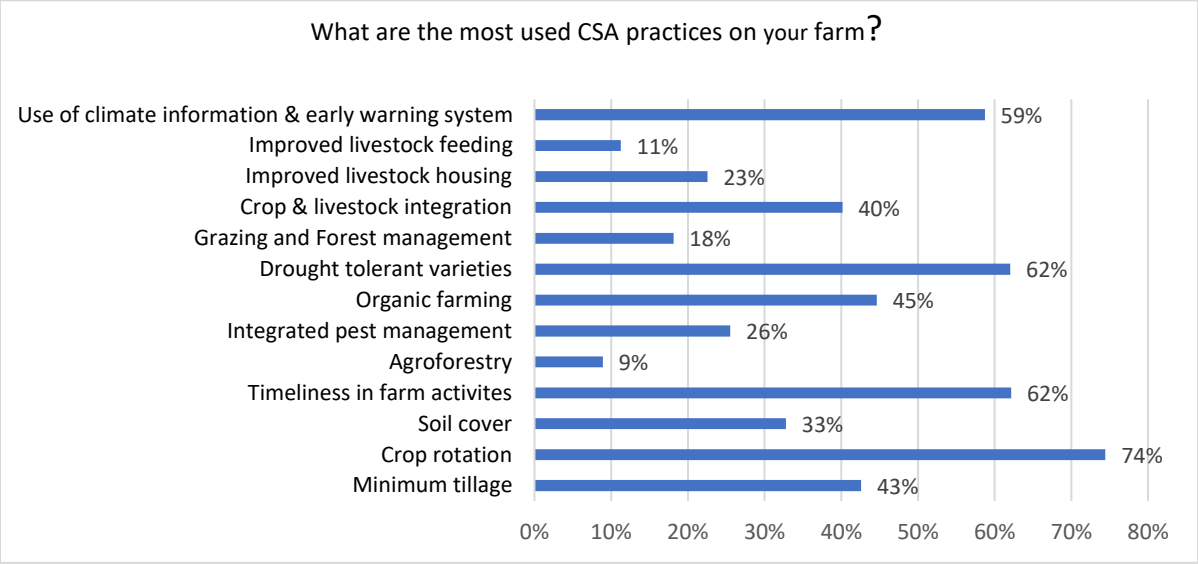

Figure 24: Distribution of respondents by type of CSA practice mostly utilized. Source; Field data, 2021

3.4.2 CSA practices likely to be continued

Survey respondents were asked if they were likely to continue using any of the CSA practices among their current CSA practices. Results show that 83% of respondents are likely to continue using crop rotation, this was followed organic farming (72%), timeliness of farm activities (67%), use of climate information and early warning (62%) and integrated pest management (52%). Agroforestry is the least likely CSA practice with only 14% of respondents indicated they will continue using it. See Figure … for more details.

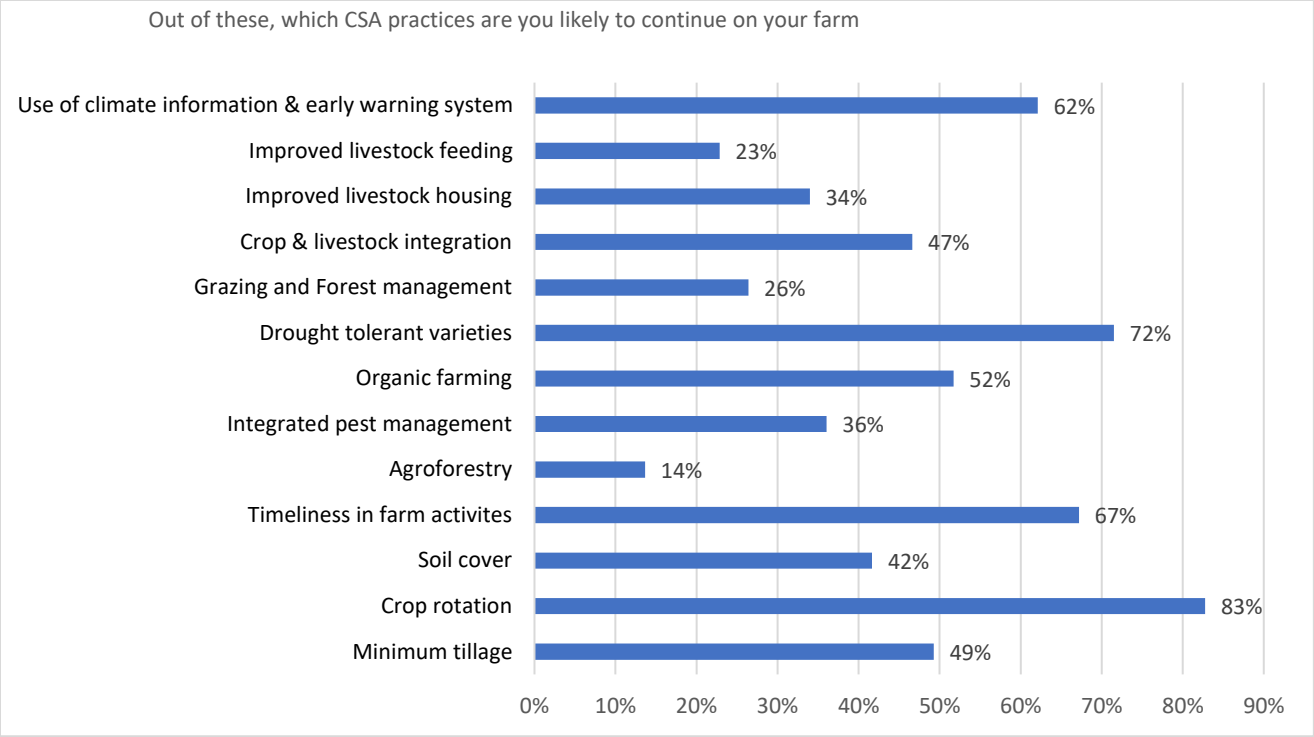

Figure 25: distribution of respondents by CSA practices likely to be continued. Source; Field data, 2021

3.4.2 Years of CSA practice

Promotion of CSA practices in Zambia has seen a sharp increase in most areas, The study wanted to establish how long smallholder farmers have been practicing CSA and the results show that amongst those that have been practicing CSA, the longest years were of practicing was between 2 to 4 years represented by 24.9% of respondents, followed by famers who have been practicing CSA for between 5 to 9 years (14.3%), less than a year (8.3%) and more than 10 years (6.3%) as shown in figure 23 below.

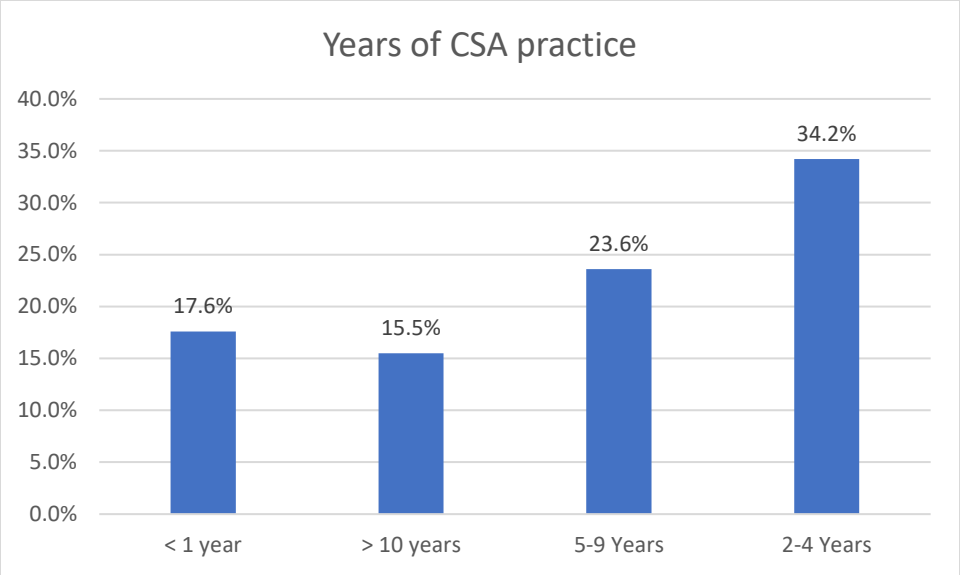

Figure 26: Distribution of respondents by length of CSA practice. Source; Field data,2021

3.4.3 Discontinuity of CSA

The study sought to establish if farmers were able to maintain implementation of CSA practices. Respondents were therefore asked if they had at any time discontinued practicing CSA. Results show that 41.3% of the surveyed small holder farmers had never discontinued using CSA practices while 9.7% indicated that they had at some point discontinued using CSA practices as shown in figure 24 below.

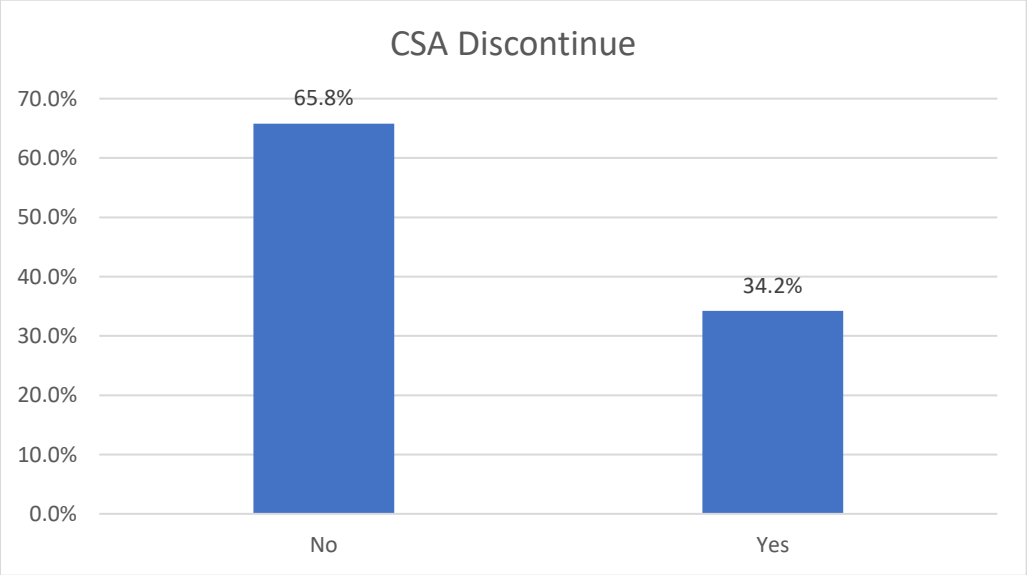

Figure 27: distribution of respondents based on whether they had discontinued use of CSA practices. Source; Field data, 2021

Small holder farmers who indicated that they had discontinued using CSA practices, they were further asked on the major reasons for discontinuing, Results show that 39.0 % indicated that CSA practices require too much labor, this was followed by 32.1% of respondents who cited inadequate resources, others cited not having CA equipment (17.5%), limited land (9.6%) and land being not owned by the farmer (0.9%). The results are shown in figure 25 below.

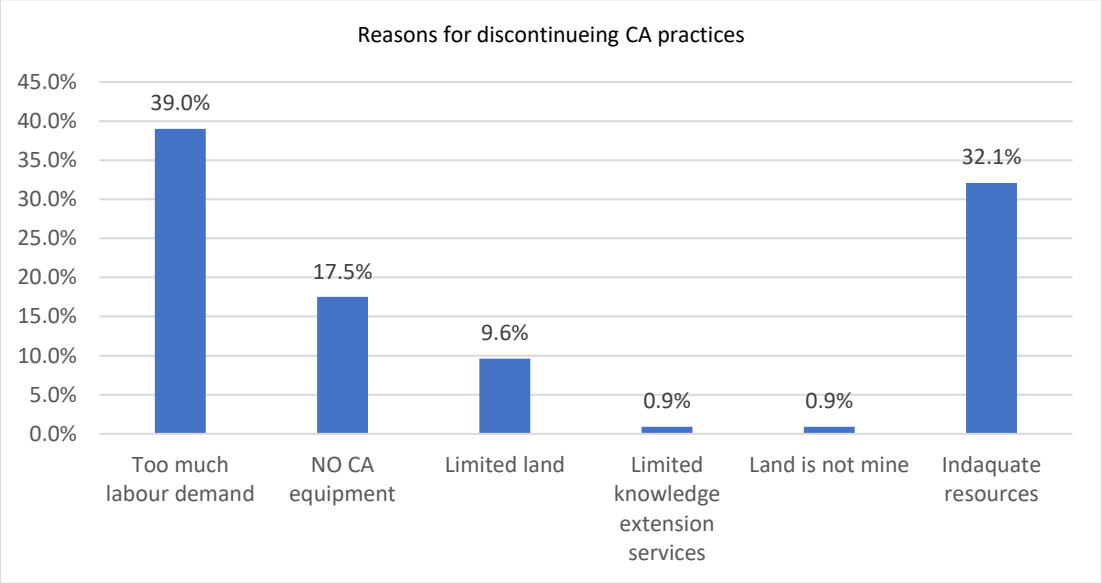

Figure 28: distribution of respondents who had discontinued CSA by reasons for stopping. Source; Field data, 2021

Focus group discussions with farmers showed that the CA/CSA practices commonly used by farmers are basins, use of organic manure through compost making with crop residue, crop rotation, inter-cropping, livestock and crop integration, aquaculture, minimum tillage specifically ripping, permanent ridges and agroforestry. Crop rotation, inter-cropping, and organic farming on small portions of land are the most preferred farming practice among small scale farmers. The reasons behind practicing CA/CSA by farmers include a) CSA/CA do not require many resources, they are cheap to use, the practice of crop rotation causes soil to be fertilized which increases yields, lack of excessive labour, and practice such as minimum tillage prevent soil erosion and fertilizer is concentrated in the basins and not washed away.

Farmers interviewed cited some challenges associated with practicing CA/CSA in their respective communities. Farmers noted that basins are hard to practice as the labour demands are high. This tillage method also allows weeds in most crops to grow quickly making it challenging to manage crops during the growth stages. Another challenge of practicing CA is the inadequacy of appropriate

machinery and implements to support the CA technology of farming. Farmers lamented that most of the animals that are used for ripping are dying due to diseases thereby making it difficult to prepare land on time because of limited animal draught power. A negative practice that was mentioned was the uncontrolled burning of fields after harvest which destroyed crop residue retention.

3.2.4 Determining the levels of investment into conservation agriculture/climate smart agriculture practices in Zambia

3.2.4.1 Portion of the land under CSA

This study sought to establish the portion of the land being used for CSA. Results show that the 49.4% of the respondents used a quarter (1/4) of their agriculture production land on CSA while 20.2% of respondents reported that they use half (1/2) of their land on CSA and 13.6% of respondents indicated that three quarters (3/4) of their land is used for CSA. Only 16.9% of respondents indicated that all of the land was under CSA. The results are shown in figure 26 below. This demonstrates that a small proportion (only a quarter) of the land for agricultural purposes is under CSA. Thus, land being a key resource in agriculture, the use of CSA practices or approach has a low investment put to it.

Some of the reasons that support the low investment were the issues to do with provision of relevant equipment, especially tillage equipment for CSA such as rippers, work oxen and sprayers coupled with limited skills that can be acquired from trainings. Follower Farmers bemoaned that this (CSA) support was not enough as most of these services are given only to Lead Farmers. "They are not adequate because only a small percentage of farmers are reached," said a respondent from the Copperbelt district of Mpongwe. Further observation was made by the farmers that most CA projects are short lived and only targeted a few farmers, especially Lead Farmers. The other investment or support that was mentioned was the government supported Farmer Input Support Program (FISP). It was mentioned that private sector support provision to farmers for CA was very limited. Farmers are proposing that agroforestry should receive more investment/ support.

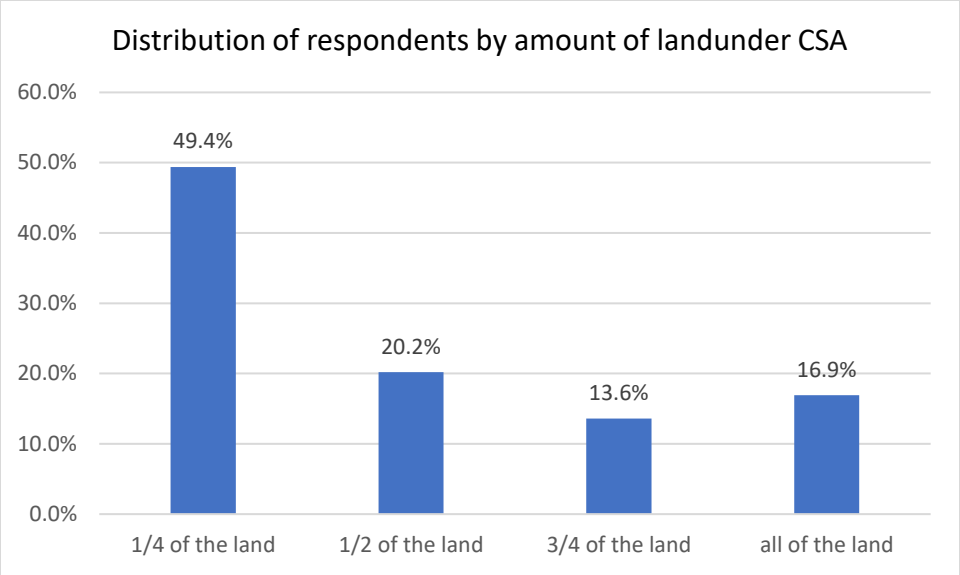

Figure 29: Distribution of respondents by amount of land under CSA. Source; Field data, 2021

3.2.4.2 Budget allocated for CSA

On the overall agriculture budget, respondents were asked the portion they allocate for CSA. Findings show that about half (49.1%) of small holder farmers allocate a third (1/3) of their overall agriculture budget to CSA, followed by 22.7% of respondents who reported that they allocate half of their agriculture budget to CSA, 15.2% allocate three quarters (1/4) of their budget to CSA and 13% indicated that all the agriculture budgets consist of CSA as shown in figure 27 below. The results show a similar pertain of investment levels to the one on the proportion of land under CSA. A small proportion of the budget is set aside for CSA out of the total household budget. From a farmer's perspective, it was found that most of them use their own resources to carry out CA practices as no external funding is directly received by the farmers when it comes to CA.

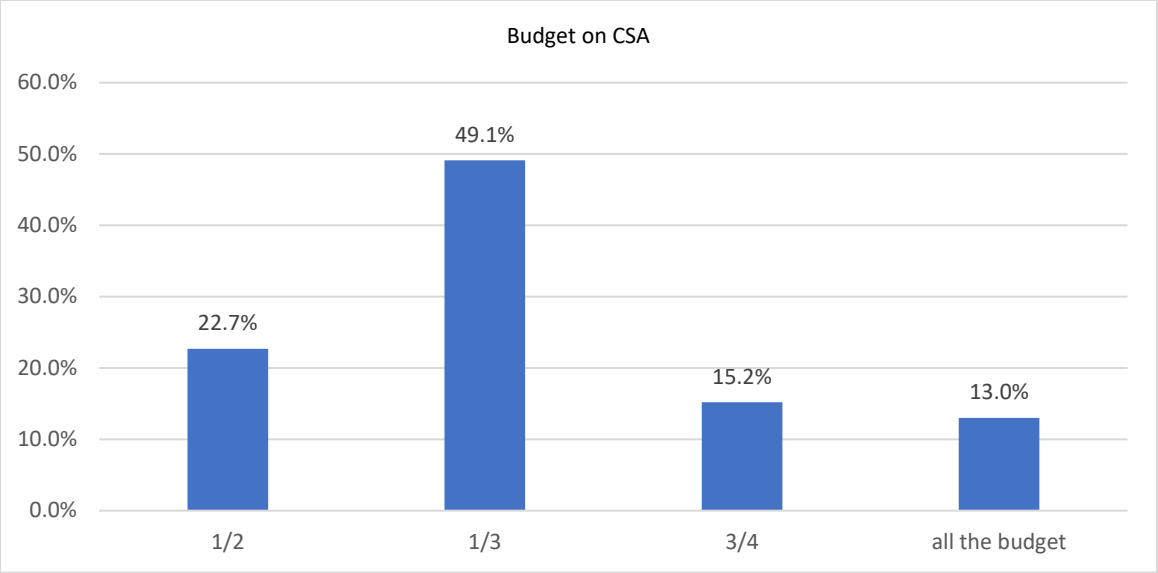

Figure 30: Distribution of respondents by amounts allocated for CSA. Source; Field data 2021

3.2.4.3 Convention Agriculture or Conservation Agriculture: Profitability

Survey respondents were asked as to which one they find more profitable between conventional or conservation agriculture, based on their experience. Findings show that 59.5% of respondents reported that they find conservation agriculture to be more profitable compared to convention agriculture while 13.6% reported that they find conventional agriculture more profitable. Results further show that 26.9% of respondents were not sure as which of the agricultural practices was more profitable between the two. The results are presented in figure 27 below. The farmers used increased yields as a proxy of profitability as their experience was that when CA practices were used, farmers realized higher yields compared to conventional agricultural practices.

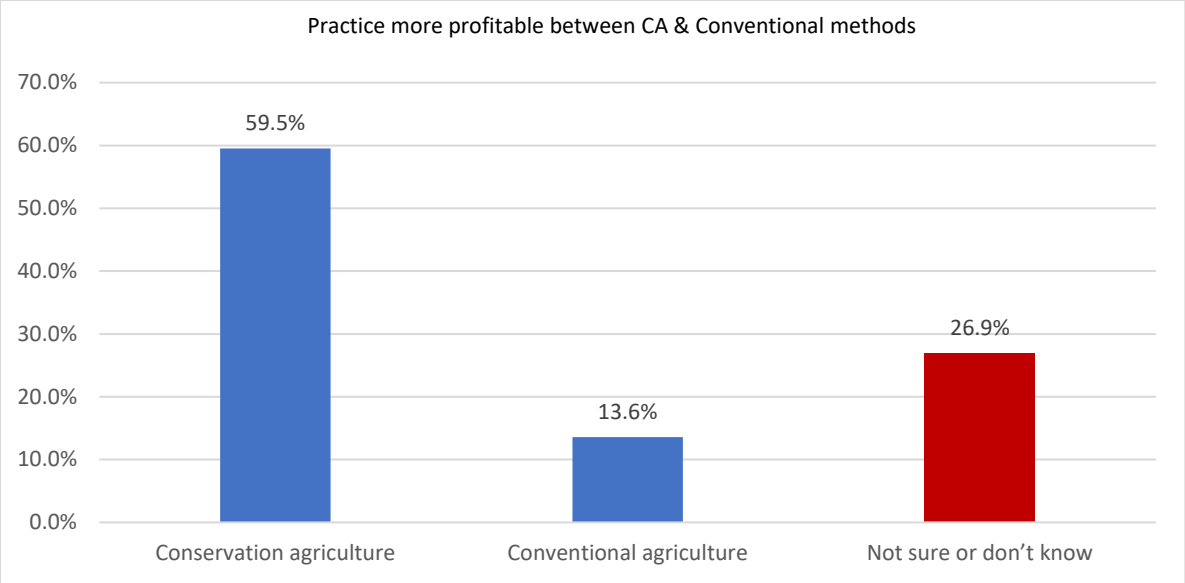

Figure 31: Distribution of respondents by experience of profitability of either convention or conservation agriculture practices. Source; Field data, 2021

3.2.4.4 Receiving Financial Support

Zambia's agricultural sector represents the backbone of its rural economy and holds great potential for the entire country. Zambia's agriculture sector faces challenges and is likely to grow more vulnerable as a result of climate change. The Government of the Republic of Zambia (GRZ) is integrating climate change concerns into its agriculture policy agenda. Under its Zambia Climate-Smart Agriculture (CSA) strategy framework, GRZ is promoting the rollout of CSA practices that will sustainably increase productivity, enhance resilience, and reduce or remove greenhouse gas (GHG) emissions. The CSA investment plan (CSAIP) aims to identify and fill knowledge gaps about CSA's local- and national-level benefits, specifically under climate change, inform policy development, and prioritize investment opportunities. (World Bank, 2019). In this regard, the study wanted to find out if respondents have or are receiving financial support for CSA. Results in figure 29 below shows that majority (70.8%) of respondents do not receive any financial support while 10.8% indicated that they receive some financial support. The results are presented in Figure 29 below.

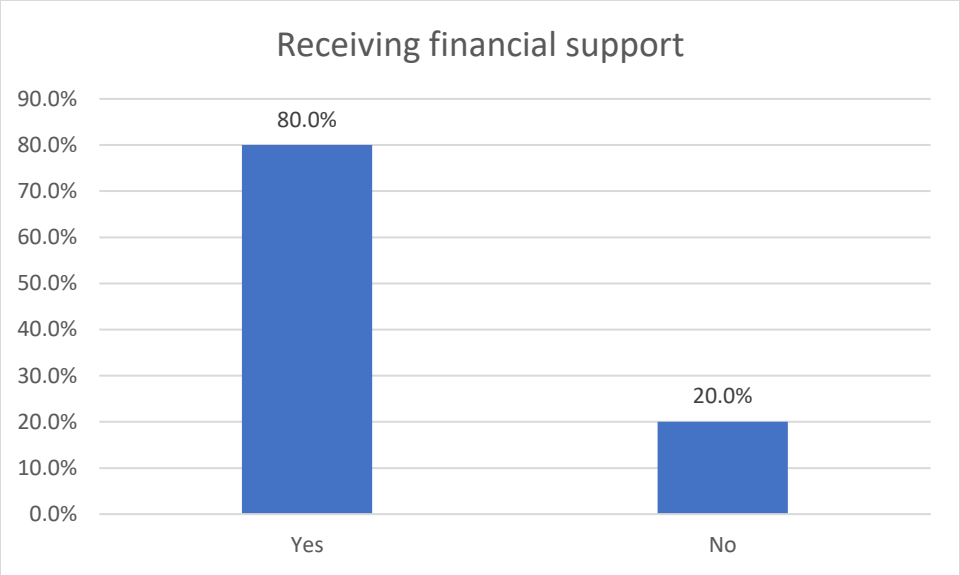

Figure 32: distribution of respondents by whether they receive financial support for CSA. Source; Field, 2021

Farmers acknowledged that one of the support that was received was in form of training in CSA related initiatives. Trainings that were cited included soil conservation/ health, CA land preparation (ripping and making basins), causes of climate change and early planting. These trainings were supported by Sustainable Intensification of Smallholder Farmers in Zambia (SIFAZ), Food and Agriculture Organisation Conservation Agriculture Scaling Up (FAO-CASU) and the Conservation Farming Unit (CFU).

3.5.5 Source of financial support

Respondents who indicated that they receive some financial support for CSA were further asked to state their source of support. Findings in figure 30 below shows that majority received this financial support from government (n=279), this was followed by cooperatives (n=99), other private sectors was also indicated (n=56) and last NGOs (n=35). The results are shown in Figure 30 below.

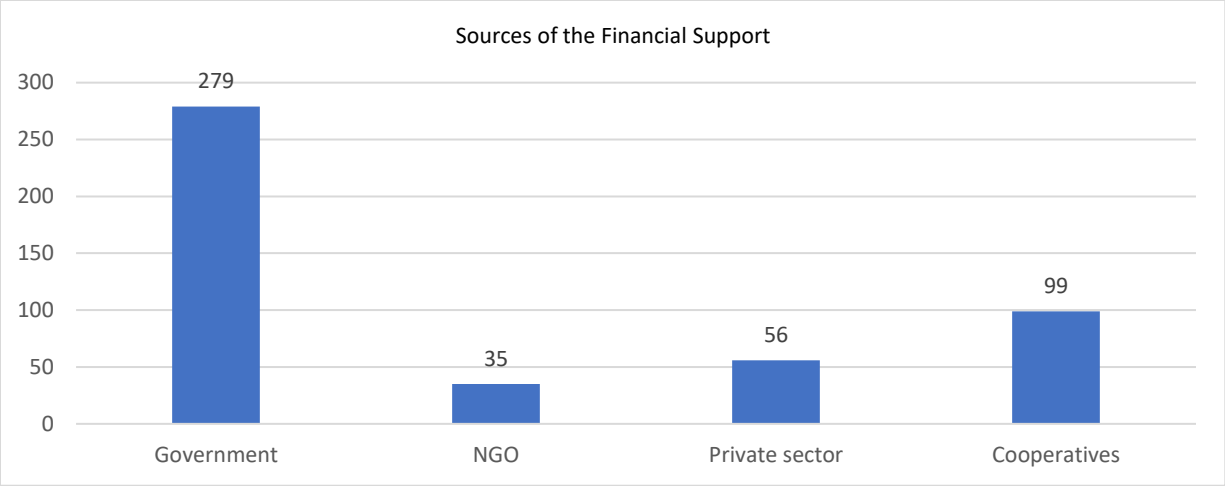

Figure 33: Distribution of respondents who receive support for CSA by source of financial support. Source; Field data, 2021

The average annual income from agriculture enterprises for most farmers was K7,000 and less than one third of the income is invested in CSA practices. Almost all communities that were interviewed have benefited from training in CSA related initiatives with youth and women involved in training such as aquaculture, conservation agriculture, crop rotation and inter-cropping, compost making, minimum tillage, crop diversification especially legumes, organic farming and the planting of trees. The training providers have been the Ministry of Agriculture, agriculture extension officers, FAO through SIFAZ, some NGOs such as Caritas Zambia, World Vision and Golden valley Agricultural Research Trust (GART).

From a farmer's perspective, it was found that most farmers use their own resources to carryout CA practices as no external funding is directly received by the farmers when it comes to CA. Farmers on the Eastern reported earning between K3,000 to K10,000 annually from their agricultural enterprises. Out of this annual income, about half is invested in CA/ CSA practices. One major benefit farmers have obtained have been trainings in CSA related initiatives. The training was provided by the Camp Extension Officers in the respective districts and mostly the training was done using demo plots method.

With regards to CA/CSA investment in the district that were surveyed, it was mentioned that the investment was mostly through CFU who provided a few equipment to some farmers such as rippers, sprayers and other farming inputs and trained the farmers in CA. Follower farmers bemoaned that this support was not enough as most of these services are given to only lead farmers. "They are not

adequate because only a small percentage of farmers are reached". To add on, farmers through such investment are unable to access rippers, tractors and oxen to enhance CA on their own fields". The other investment or support that was mentioned was the government supported Farmers Inputs Support Program (FISP). There was limited, if not nonprivate sector support provision to farmers for CA. Farmers are proposing that agroforestry should receive more investment/ support.

3.2.5 Policy measures that support conservation agriculture/climate smart agriculture in Zambia

FAO's support to countries in creating the required policy, financial and enabling environment provides farmers, foresters and fishers with the knowledge and access to resources and services to move towards more sustainable, climate change resilient and economically viable production systems. (FAO, 2019). Respondents were asked if they were aware of any existing CSA policies in Zambian and the results shown in the figure below are that majority of them (64.7%) are not aware about the existence of these policies while 35.3% indicated that they were aware.

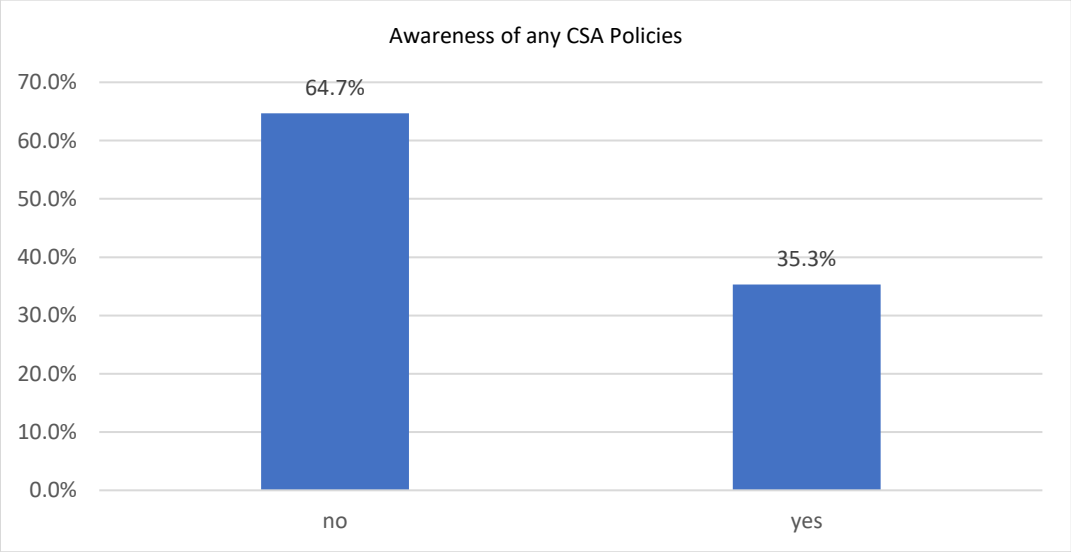

Figure 34: Distribution of respondents by awareness of CSA policies. Source; Field data, 2021

3.2.5.1 Sources of information on CSA policies

Respondents who reported that they were aware of CSA policies (n = 1264) were further asked to state their main source of information on CSA policies, the result in the Table 9 below shows that

majority (79%) of respondents got information on CSA policies through agriculture extension officers, this was followed by radio stations 11%, NGOs (7%) and Television (2%).

Table 9:Distribution of respondents who were aware of CSA policies by source of information. Source; Field, 2021

Sources of Information on CSA policies				
Source of information	**Frequency**	**%**	**Valid %**	**Cumulative %**
Agriculture extensional officers	1002	79%	79%	79%
NGOs	85	7%	7%	86%
Other	13	1%	1%	87%
Radio	138	11%	11%	98%
TV	26	2%	2%	100%
Total	1264	100%	100%	

The respondents mentioned that the policies/plans/strategies that support CA/CSA include the National Agricultural Policy and the 7th National Development Plan. Other strategies included the promotion and strengthening agricultural production, resilient to climate change, promotion of environmentally friendly and climate smart farming systems, promoting wealth-based insurance schemes especially among small holder farmers and strengthening capacity at camp, district, and provincial levels to regulate and process and transmit of early warning information

Respondents described the effectiveness of these policies as moderately effective. Most Ministry of Agriculture/ Livestock and Fisheries staff at district level indicated that they have not been actively involved in policy reviews on climate change related policies/ strategies. The district staff also indicated that they do not know how these policies/plans/strategies are being implemented However, with availability of these policies, the district staff mentioned that the policies/strategies/plans on CSA/CA are available as online documents and sometimes they are obtained as hard copies.

At community level, it appears that community members have not been involved in policy discussions and advocacy on climate change. Additionally, farming communities have no source of information on CA/CSA policies, plans and strategies. The communities are suggesting that the information be obtained from Camp Extension Officers, TV, and other radio programmes and through holding meetings and workshops for farmers.

Suggested improvement to policy implementation included roll out projects to all farmers in the district, increase budget allocation and funding to districts so as to carry out awareness throughout the district. There is need to give insurance to all farmers as opposed to FISIP beneficiaries only as effect of climate change such as drought affects all farmers.

Chapter four: Conclusion and Recommendations

4.1 Conclusion

1. *To identify the Conservation Agriculture/Climate Smart Agriculture practices that farmers are using*

Some farmers were found to be using CSA/CA practices on their farms, common among them was permanent planting basins, ripping, permanent ridges, maintaining crop cover/ residue retention and crop rotation. Farmers using CSA/CA accounted for 40% of all respondents

2. *To Identify the impact of climate change on Small Holder Farmers in Zambia*

Farmers clearly have been negatively affected by climate change as evidenced by reduction in crop yields and loss of livestock among others. While farmers have adopted some strategies such as crop rotation, use of drought tolerant varieties, organic farming to mention but a few in mitigating the impact of climate change, the uptake of other government promoted strategies such as aquaculture and agroforestry remains very low.

3. *To determine the level of conservation agriculture/climate smart agriculture adoption among smallholder farmers in Zambia*

Most farmers prefer using conventional farming especially when it comes tillage methods, meaning the adoption levels of CA is s still low, though majority of farmers are aware and were trained on CSA/CA.

4. *To determine levels of investment into conservation agriculture/climate Smart agriculture practices in Zambia*

Levels of investment in CSA/CA remains quite low as almost half of the interviewed farmers only use a quarter of their farms on CSA/CA. Interestingly, almost half of the surveyed farmers reported using three quarters of their budgets on CSA/CA. External financial support to farmers to support CSA/CA remains low as only 10% of farmers practicing CSA/CA reportedly received external finical support.

5. *To Identify policy measures that support convention agriculture/climate smart agriculture in Zambia*

Awareness on policy provisions supporting CSA/CA implementation remain largely unknown to small holder farmers and among a few that did know the policies, agriculture extension officers were a key source of that information. Farmers are seldom engaged in CSA policy formulations.

4.2 Recommendations

1. Improve on and increase the numbers of smallholder farmers trained in CSA/CA – this will require support to implementing agencies on climate smart agriculture to scale up trainings and awareness raising on CSA among small holder farmers.
2. Promote and support small holder farmers to adopt and scale up the use of aquaculture and agroforestry among the CSA/CA practices as they have potential to improve their livelihoods as well as reduce greenhouse gas emissions
3. Given that conventional farming especially on tillage practices, remains the practice of choice among many smallholder farmers, more effort ought to be made in sensitizing and equipping farmers to easily adopt and practice CA practices.
4. Investment in CSA/CA need to be improved both at individual farmer level and from agencies that support farmers. Farmers should be encouraged to increase both the hectarage and financial outlays reserved for CSA/CA. this can be accomplished if government and other stakeholders can increase CSA/CA related financial and technological support to farmers.
5. Improve policy awareness among farmers. Policy implementation on CSA/CA will remain a challenge if those on whom the policies are meant to impact remain unaware of the promoted policies. Government and other key stakeholders in the agriculture sectors should invest more in raising awareness on CSA/CA in general and on the policies and strategies propagated by the government.

References

Appendices