International Journal of Academic and Applied Research (IJAAR)
ISSN: 2643-9603
Vol. 7 Issue 1, January - 2023, Pages: 32-38

Impact of Conservation Farming on Smallholder Farmers' Livelihood in Minsundu Camp, Ndola: Zambia

Gabriel Chipando[1*] & Chavula Petros[1]

[1]Department of Agroforestry, School of Natural Resources, Copperbelt University P.O. Box 21692, Kitwe, Copperbelt Province, Zambia. E-mail: chipandogabriel@gmail.com
[2]Department of Agroforestry, School of Natural Resources, Copperbelt University P.O. Box 21692, Kitwe, Copperbelt Province, Zambia. E-mail: chavulapetros@outlook.com ; ORCHID iD: https://orcid.org/0000-0002-7153-8233

Abstract: *Dramatic climate changes and variations that Zambia has been experiencing over the past few decades miffed ongoing crop production, and disrupt the livelihood of farmers, and the food supply chain, especially on smallholder farmers. This is a result of the overdependence of most crops on alternating rainfall patterns, however, there is a rising concern about climate change and climate variations' impacts on Zambia's national food security. Food security is a constant top issue because the annual production just meets the nation's food needs limiting food exports for agricultural produce. National food security has also been affected by food loss due to its perishable character after harvest. In addition, horticultural crops are among those whose yield and nutritional quality are degraded due to short life span on shelves of most smallholder farmers in Zambia. In Zambia, conservation farming is one of the interventions put in place to adapt to the changing climate. Conservation farming has been highly recommended as an effective agriculture system for improving yield and reducing inorganic fertilizers usage among smallholder farmers in Zambia. However, this study was conducted in Minsundu Camp in Ndola district, Zambia among non-adopter and adopters of conservation farming. The study assessed the impacts and contribution of conservation farming among smallholder farmers' households in the study area. Therefore, the study observed the potential benefits of conservation farming to top-end agriculture in Minsundu camp. It was observed that conservation farming provided maximum benefits among adopters in-terms of increased maize yield, soil fertility and productivity. In the long-run conservation, farming can aid to poverty alleviation through increased household income, crop yields, and climate change resilience to smallholder farmers in the study area. Results from this study are vital for policy makers and future research gaps on conservation farming in Zambia specially to improve agricultural Maize production among smallholder farmers.*

Keywords—Agriculture, Climate-Change, Farmers, Future, Food, Insecurity, Household

1. INTRODUCTION

The food insecurity problem has become more intensely pronounced in recent years with the threat posed by recent trends, such as water scarcity, ecosystem, and biodiversity degradation exacerbated by climate change. Additionally, pressure has also emanated from the rapid population growth which has increased the demand for food. And in 1994 the world population was projected to double from roughly 6 billion to more than 12 billion in less than 50 years. The increase in world population has contributed to food insecurity and environmental pressures. Food insecurity mostly affects 80% of the rural population in Sub-Sahara Africa(Konuma, 2018). In addition,70% of the rural population is directly dependent on agriculture for their livelihood. Zambia is one of Sub-Saharan African nations, most rural communities are languishing in abject poverty, yet despite this, the agricultural systems being promoted there have unacceptably high environmental, economic, and social costs(Chavula, 2022a).

The conservation farming system, first emerged in 1940s in Nebraska, USA where mulch was used to control wind erosion(Mohammed et al., 2020), represents a local variant of traditional minimum tillage technologies adopted in many parts of Sub-Sahara Africa including Zambia faced with food insecurity problems, rapid population increase and poverty(Nagothu, 2018). Similar hand-hoe planting basin systems have emerged across the Sahel as well as in Cameroon, Nigeria, Uganda, Malawi and Tanzania. Ox-drawn rippers have expanded recentlyin Tanzania, Kenya, Namibia, Zambia and Mozambique while early work with tractor-drawn minimum tillage systems in Zimbabwe and South Africa provided much of the inspiration for recent transfer to Ox and hand-hoe cultivation systems as used by smallholder farmers(Thierfelder et al., 2018; Nyathi et al., 2021).

Who is a smallholder farmer? A smallholder farmer is regarded as a producer and a consumer(Reyes et al., 2020). This necessitates that a smallholder farmers take into consideration current consumption needs and production ends(Hanjra & Williams, 2020). As a result, a smallholder farmer will therefore react in various ways toward declining food production among them being the adoption of technologies brought to his or her attention such as conservation farming(Makate et al., 2019).It is not against this background that conservation farming has been promoted to sustain and improve crop production among smallholder farmers in Zambia and other developing countries(Jena, 2019). Even though local development and

promotion efforts date back scarcely a decade, many local observers consider conservation farming an emerging success story in Zambia(Tetzlaff, 2019). Its promoters note that conservation farming holds the potential to restore soil fertility to land degraded by years of excessive plowing and heavy application of chemical fertilizer, and improve on-farm yields and incomes with moderate input use(Chavula, 2022b).

In Zambia smallholder maize producers housed in Ndola despite them practicing conservation farming are faced with the problem of lack of inputs (e.g. fertilizer and improved maize varieties). The fact to note is that the impact of conservation farming on the maize smallholder farmers in Ndola(Munsaka, 2018), that if the farmers can produce adequate maize output and sustain themselves have received little attention either from the government or relief officials(Nkrumah, 2019). They have done very little to address the problem of theNdola smallholder maize farmers (Siankwilimba, 2019). It is because of this assertion that this research, therefore, seeks to establish the impact of conservation farming on smallholder maize farmers in Minsundu camp Ndola district, Zambia.

2. Results and Discussion

2.1 Description of Study Area

Minsundu Camp is located in the Ndola district, Copperbelt province of Zambia. The districts lies 320km north of Lusaka the capital city, with a population of 455,194 (CSO,2010) (. It lies in the agroecological zone III wherethe soils are generally highly weathered and leached and has a mean annual rainfall of about 1000m, (OGURA, 1991; Muliokela, 1995). The population of the district depends on mining activity and a small proportion on agriculture.

2.2 Sample size and data collection

Minsundu is divided in four zones; 1, 2, 3 and 4, each with approximately 20 smallholder farmers, giving a total population of about 87 farmers. The sample size was purposive (*i.e.* 48%) of the total population of smallholder farmers households in Minsundu camp farmers. A total of 40 households were interviewed in this study. The study used both primary and secondary data, with supplementary information from focus group discussion.

2.3 Data analysis

The statistical package for social sciences (SPSS)version 16.0. was used for data analysis. The "analyses"function was used to obtain percentages and frequencies, expressed in tables, graphs, and charts. Therefore, each farmer in the study was defined as a single case, and each case is defined as a set of values assigned to the collected of variables. The results were then interpreted as follows:

2.3.1 Sex of respondent and household head

Of the total, 40 participants, 55% were female and while 45% were male. Head of the households represented by male 52% and 48% female (see figure 1 and figure 2). The majority of male headed household characteristics were given by wives due to them been active in farming activities. Women took much part in farming activities as a way of sustaining themselves and the household. Most of women reported to belonging to one or two associations and farming groups. During the study, women were found to be very active inhousehold farming activities (*i.e.* maize production and small ruminants). Women showed keen interest in learning more about other conservation farming technologies. There is a need to continue empowering women so that they don't lose interest in farming and feel that they are not supported by the government.

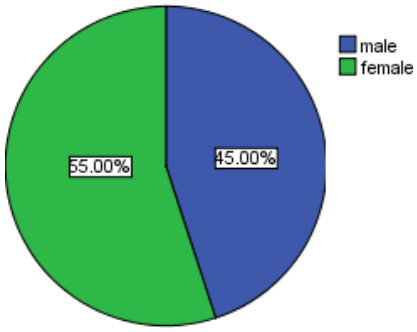

Figure 1: Sex of participants

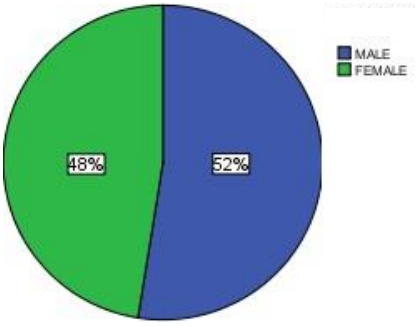

Figure 2: Household head

2.3.2 Age range of respondent

The participants' age ranged from 36-45 accounting for 18%, 46-55for 30%, and 56 above 52%. Therefore, the farmers of Minsundu camp were generally considered to be above 56 years of age.

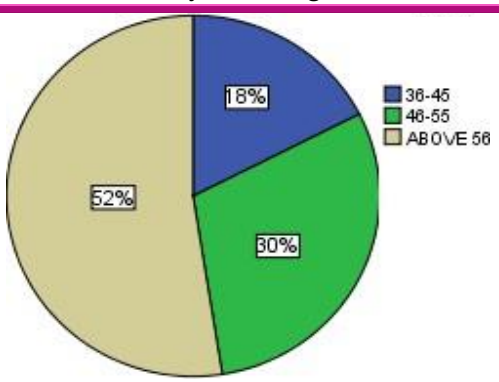

Figure 3: Age range of participants

Therefore, it was observed that no youths within the study area were actively involved in farming. Youths are able-bodied young men and women who need to spearhead all developments in the agriculture sector, particularly crop production. Youth need enlightened and/or empowerment to actively participate in agricultural activities. That has the potential to contribute to rural community growth and development.

2.3.3. Marital status of participants

The marital status of the participants were found married at 48%, single at 10%, widow 32%, and divorced 10% as shown in figure 4 below.

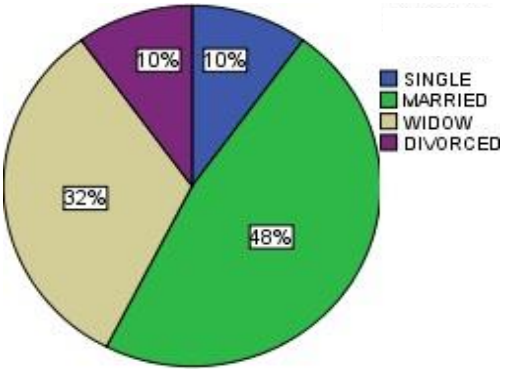

Figure 4: Marital status of the participants

Most of the participants were married with family responsibilities. However, it came to light that either husband or wife are involved in farming. Widows reported been the most vulnerable in the study area with numerous dependents to take care of. The study recorded less adoption of conservation farming by marital of status single, widowed and divorced participants.

2.3.4. Education level of participants

Of the 40 participants 38% attained primary and 52% secondary school education level shown in figure 5 below. The level of education had a contribution on the uptake of conservation farming among participants. It was observed that participants with higher level of education easily participated in conservation farming practices training conducted by agriculture extension officers. It was observed that when presented with a situation, the participants could identify the opportunities within their challenges, lobby for or gather the necessary solutions, including physical, financial and human resources. This showed the importance of formal education versus crop farming in the study area.

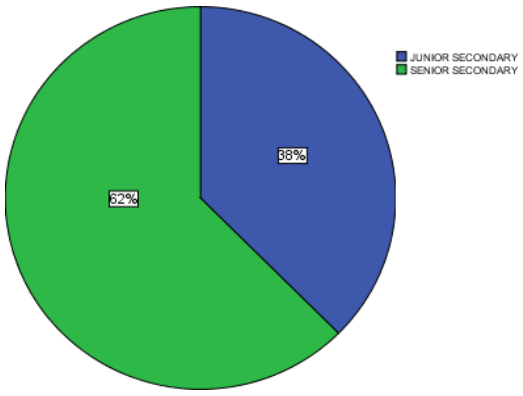

Figure 5: levels of formal education attained by the participants

2.3.5. Household type and size

It was observed that 12 % participants were from nuclear families and 88% from extended families as shown in figure 6 below. The household size of the participants was found to be in the range of 3 to 9 people see figure 7 below the average household size was found to be 6.

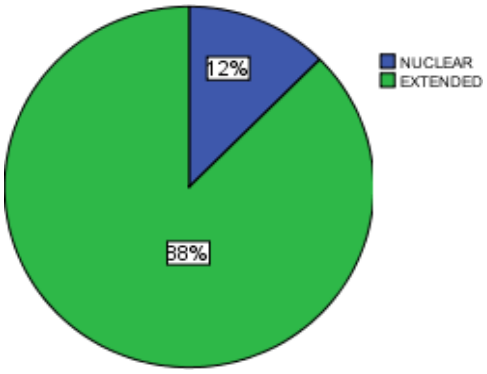

Figure 6: Household type of participants

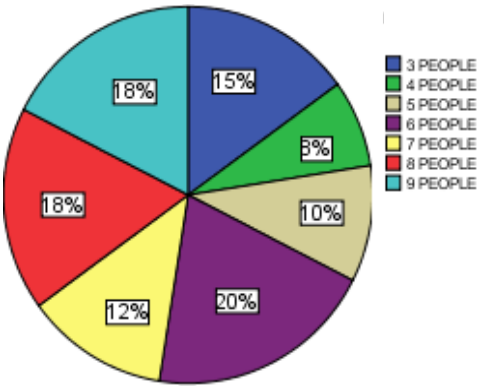

Figure 7: Household size of participants

A few households were found to be nuclear, consisting of a husband, wife and 4 children. Households with big numbers meant more labour for agriculture activities and reduced expenses of hired labour. Less expense and availability of labour results into easy adoption of conservation farming with increased productivity per hectare.

2.3.6. Source of farm labour

The source of farm labour, 55% of the households interviewed was family. Those who had the financial capacity supplemented this with hired human labour that is 45% of participants illustrated in figure 8. The participants indicated the labour intensiveness of tillage operations or land preparations. Those with bigger family sizes alluded that atleast they were able to save on energy and time compared to those with smaller families sizes.

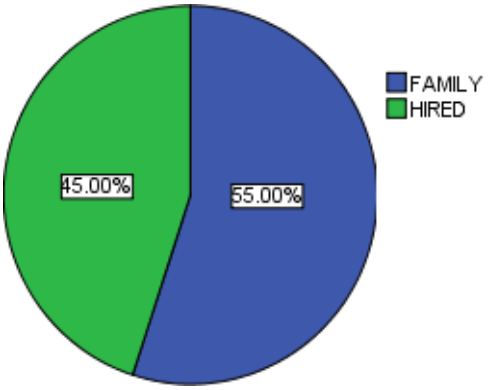

Figure 8: Source of farm labour

From the survey data, conservation farming showed an increase in labour demand as shown by the difference in standard deviations 276.952 and 212.151 (see figure 9 and 10 below). Conservation farming adopted had farmland size of 1 to 3 hectares of land of which required more labour as compared to conventional agriculture. Labour demand of conservation farming serves as a limitation to increased hectarage of the practice. Some labour-demanding components such as weeding can be reduced through the introduction of herbicides. Higher labour requirements emerge clearly among fields managed under conservation farming basins (*i.e.* wedding and land preparation).

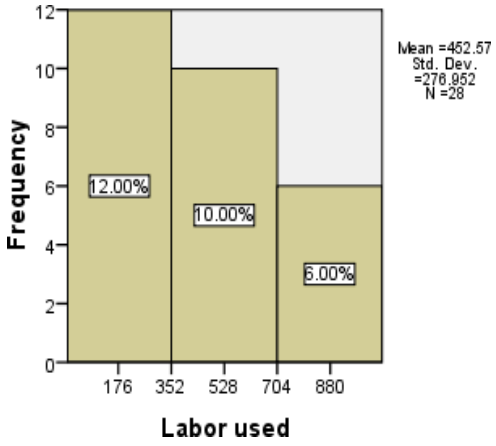

Figure 9: Labour used by conventional system

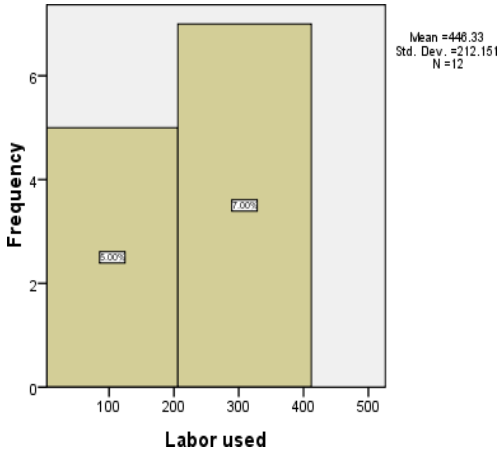

Figure 10: Labour used by conservation system

2.3.7. Land tenure

The 48% of the participants claimed to own the land while 30% stated that they were squatting on state land for free, and 22% mentioned that they were renting the land as shown. Smallholder farmers who owned land with title deeds easily practiced conservation farming. Those squatting on communal land had no proper title deeds and those who were renting paid a fee to the land owner according to the number of hectares.

2.3.8. Land preparation

The study found that 65% of the participants were cultivating land by use of simple conventional hand tools while 35% used conservation farming minimum tillage shown in figure 12. Preparing land by traditional means; using simple hand tools. In the study area smallholder farmers cultivating by conservation farming means were fewer to smallholder farmers who practiced conventional agriculture.

2.3.9. Seed type used

Of the total 40 participants, 65% reported to use improved see varieties and 35% local varieties. Smallholder farmers in the study area preferred improved seed varieties to local varieties due better yields and disease resistance. Other seed varieties were not preferred due to low hybrid vigor.

2.3.10. See used in kilograms

From the collected data more seeds were sown in conservation farming as compared to conventional agriculture. The standard deviations (28.305) and (13.903). In conservation farming, farmers didn't cultivate more than 3 hectares of land and used more than 60 kilograms of seed, whilst farmers practicing had more than 3 hectares and used less kilograms of seed.

2.3.11. Conservation farming and conventional output rating

Of the total 40 participants, 62% responded that conservation farming is a good practice and 38% responded that it's fairly good as shown in figure 11 below. And Of the total research participants conventional farming, 32% responded that it is very good, 2% responded that it is good, 28% responded that it is fairly good and 38% responded that it is poor as shown in figure 12. From the participants it was highly shown that conservation farming is a very good practiced in Minsundu camp. Output differences between conservation farming and conventional tillage systems, as measured by this survey, are broadly consistent with earlier studies. The results indicated that conservation farming is more efficient as compared to conventional agriculture and the potential to increase maize yield.

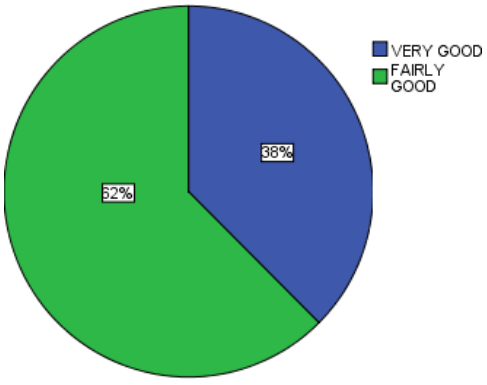

Figure11: Conservation farming output rating

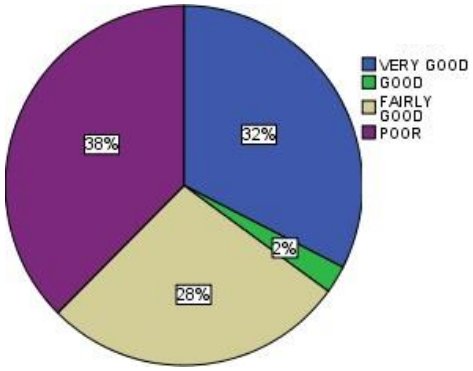

Figure 12: Conventional tillage system output rating

2.3.12. Land nature effect

Of the total 40 participants, 58% reported land nature not to affect their farming output while 42% reported the land nature to affect the output between conservation farming and another farming practices. However, from the observations the nature of the land in the study area is the same. The contributing factor was the type of the farming system up-taken by the household. Participants further alluded that land had no effect on output and/or with no proper explaining on positive or negative effects.

2.3.13. Farmers' union effort rating

Of the total 40 participants, 30% responded very good to the rating of the farmers' union effort in serving the farmers know the maize productivity. And 70% responded good to the rating of the union to helping farmers. The participants highly rated the union to be good in doing their job regardless of the farming practice they were doing. Those who were practicing conservation farming acknowledged the fact that without the unions under the ministry of agriculture they could not have known about conservation farming. With the union's effort farmers appreciate conservation farming and those who do traditional farming (conventional) acknowledged the fact that as a result of belonging to the union they can keep a good record of how they do their farming and how best they can improve their way of farming.

2.3.14. Challenges faced by smallholder farmers

Of the 12 Participants practicing conservation farming, 20% face water scarcity. And so 15% face a problem of lack of manpower (labour), 20% face a challenges with maize shelling, 15% face challenges of lack of transport, 12% lack of a tractor and 18% lack of electricity. Of the 28 participants in conventional farming, 18% face lack of water, 15% lack

of electricity, 18% responded lack of manpower. Whilst 18% face a challenges in shelling, 10% lack transport means and 22% lack of tractors.The results, indicate that conservation farming challenges are more less the same to conventional agriculture challenges. Therefore, it was established that the farmers in the Minsundu camp depended on seasonal rainfall for meeting their agricultural maize crop water needs. The farmers stated that if only they had irrigation facilities to enable them to produce maize crops all year round, they would earn more income from agriculture growing maize. Improved income will definitely improve the welfare of smallholder farmers. The study found-out also that if smallholder farmer had transport to ferry produce and inputs could have enhanced production. It was also concluded that farming implements contribute to uptake of conservation farming for easy labour and excess income favors the hiring of labor to meet the deficit.

2.3.15. Use of the agriculture products

Of the total participants, 55% reported that they use the agricultural products for home consumption and sell to the government agency and 45% sell their surplus to local markets. In the study area, it's common for farmers to sell the maize produce through open market and used none for household consumption. The results show that conservational farming which has a good maize output has the potential to bring more income and profit to smallholder farmers households in Minsundu camp.

2.3.16. Environmental and economic factors

Of the total 40 participants, 65% alluded that rainfall patterns affect their farming activity and 12% mentioned other environmental factors to affect their productivity and 22% been affected by soil required nutrients for crop growth see figure 23. Of the total participants, 35% retorted that cost of inputs affected their crop production and 32% affected by cost of transport and 32% affected by the price of labour shown in. The study also compounded environmental and economic factors to affect smallholder farmers total yield per cultivated hectare. In the agriculture season of 2014/2015 drought and floods hampered most farming households' fields. However, the sampled participants barely depend on rainfall for agriculture and any delays affects planting time among other things. Economically inputs such as hybrid seeds and fertilizer are quite costly to average farming household. Hence the productivity is highly affected in short and long term. As shown by the research results the environmental and economic factors generallyaffected all the farmers' (*i.e.*, those doing conventional and conservational farming).

2.3.17. Cultivated land in hectares under conventional and conservation agriculture

Of the total 28 participants, among those doing conventional farming 21% cultivated 5 hectares of land whilst 36% cultivated 3 hectares, and 43% cultivated 1 hectare as shown in figure 13. Of the 12 participants practicing conservation farming, 42% cultivated on 1 hectare of land, and 58% cultivated on 3 hectares see figure 14. The results clearly tell that most of the land was under conventional agriculture farming typology in Minsundu camp since conservation farming is almost new to the area.

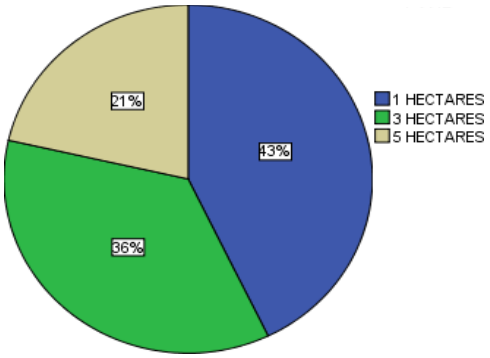

Figure 13: Land cultivated by conventional

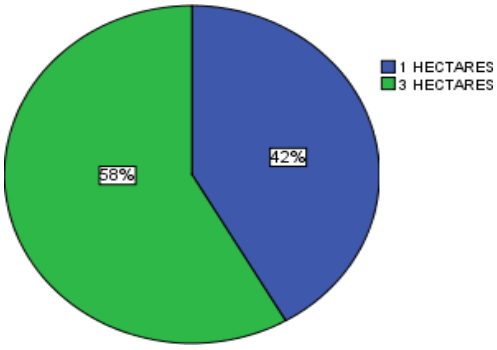

Figure 14: Land cultivated by conservational

2.3.18. Kilograms of fertilizer used

During the survey, it was established that Conventional tillage used slightly more inorganic fertilizer than conservational farming as shown by the difference in standard deviations 12.589 and 7.209 see figure 15 and figure 16. Inorganic fertilizer has consistently proved to be an important factor in yield improvement, even in low rainfall areas. Farmers applying fertilizer at an appropriate time significantly improve their yields, the availability and accessibility of fertilizer. The high use of inorganic fertilizer in convention farming is not good compared to conservational which uses less.

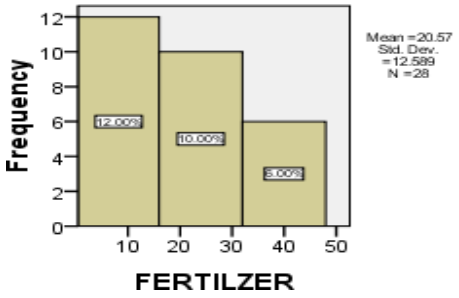

Figure 15: Fertilizer used by conventional agriculture

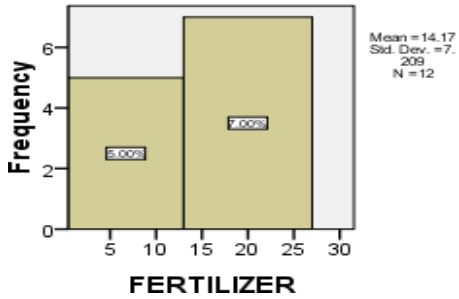

Figure 16: Fertilizer used by conservation agriculture

3. CONCLUSION

Conservation farming is highly recommended and influences crop yields among smallholder farmers in Minsundu area. However, it is important that smallholder farmers take keen interest in conservation farming practices. Therefore, the study results indicated that conservation farming sustainability is guaranteed. However, there is still a need for improvements in conservation farming technology transfer strategies, incorporating research and extension, and favorable policies to ensure the uptake. The performance of Conservation farming in Minsundu Camp has impacted good and contributed very positively to the livelihoods of maize smallholder farmers.

4. REFERENCES

[1] Chavula, P. (2022a). An Overview of Challenges that Negatively Affect Agriculture Performance in Sub-Sahara Africa : Synthesis Study. 6(11), 261–269.

[2] Chavula, P. (2022b). Inclusion of Agroforestry on Agricultural Farming Systems : Revisited. 6(11), 270–275.

[3] Hanjra, M. A., & Williams, T. O. (2020). Global change and investments in smallholder irrigation for food and nutrition security in Sub-Saharan Africa. In *The role of smallholder farms in food and nutrition security* (pp. 99–131). Springer, Cham.

[4] Jena, P. R. (2019). Can minimum tillage enhance productivity? Evidence from smallholder farmers in Kenya. *Journal of Cleaner Production*, *218*, 465–475.

[5] Konuma, H. (2018). Status and outlook of global food security and the role of underutilized food resources: Sago palm. *Sago Palm*, 3–16.

[6] Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of Environmental Management*, *231*, 858–868

[7] Mohammed, S., Al-Ebraheem, A., Holb, I. J., Alsafadi, K., Dikkeh, M., Pham, Q. B., Linh, N. T. T., & Szabo, S. (2020). Soil management effects on soil water erosion and runoff in central Syria—A comparative evaluation of general linear model and random forest regression. *Water*, *12*(9), 2529.

[8] Munsaka, E. (2018). The use of information sharing systems to address opportunistic behaviour between tomato farmers and brokers in Zambia. University of Pretoria.

[9] Nagothu, U. S. (2018). Agricultural Development and Sustainable Intensification: Technology and Policy Challenges in the Face of Climate Change. Routledge.

[10] Nkrumah, B. (2019). Africa's future: Demarginalizing urban agriculture in the era of climate change. *Future of Food: Journal on Food, Agriculture and Society*, *7*(1), 8–20.

[11] Nyathi, P., Stevens, J., Moyo, T., & Posthumus, H. (2021). Impact of Social and Institutional Factors on the Uptake of Conservation Agriculture: A Case of Zambia and Zimbabwe. *Sustainable Agriculture Research*, *9*(1), 1–67.

[12] OGURA, M. (1991). Rural-Urban Migration in Zambia and Migrant Ties To Home Villages. In *The Developing Economies* (Vol. 29, Issue 2, pp. 145–165). https://doi.org/10.1111/j.1746-1049.1991.tb00204.x

[13] Reyes, S. R. C., Miyazaki, A., Yiu, E., & Saito, O. (2020). Enhancing sustainability in traditional agriculture: Indicators for monitoring the conservation of globally important agricultural heritage systems (GIAHS) in Japan. *Sustainability*, *12*(14), 5656.

[14] Siankwilimba, E. (2019). Effects of Climate Change induced electricity load shedding on smallholder agricultural enterprises in Zambia: The Case of Five Southern Province Districts. Zambian Open University IJRDO-Journal of Agriculture and Research (ISSN: 2455-7668), 5(8), 01-151. https://doi.org/10.53555/ar.v5i8.3184

[15] Tetzlaff, N. (2019). Agricultural Agglomeration Infrastructure and Agricultural market integration for emergent farmers.

[16] Thierfelder, C., Baudron, F., Setimela, P., Nyagumbo, I., Mupangwa, W., Mhlanga, B., Lee, N., & Gérard, B. (2018). Complementary practices supporting

conservation agriculture in southern Africa. A review. *Agronomy for Sustainable Development*, *38*(2), 1–22.