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Farmer's Knowledge and Information Support Towards Sustainable Agriculture Practices in Zimbabwe

BACHELOR'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled "Farmer's Knowledge and Information Support Towards Sustainable Agriculture Practices in Zimbabwe" independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 14 April 2023

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Abstract

Farmers' knowledge and information support systems are increasingly becoming critical in the practice of sustainable agriculture worldwide. The specific aims were to explore farmers' sources of knowledge, assess the quality of the information provided by trainers and the trainer's information delivery skills, and understand the barriers towards information transfer to farmers. In this study which focused on Goromonzi District in Mashonaland East Province in Zimbabwe, the researcher used a semi-structured questionnaire to gather data from 112 farmers to understand how knowledge and information support enhance the practice of sustainable agriculture practices. The researcher found that most farmers rely on social media, especially WhatsApp messenger, farmer-to-farmer and radio as the main sources of knowledge and less on extension officers, television and cooperatives. On the quality of knowledge received from trainers, the study found that the farmers were positively commending the knowledge though they had misgivings about the trainers, citing lack of frequency on training. The main barriers standing in the farmers' way of transferring information were the absence of information centers (91 percent), lack of technological devices (80 percent), lack of extension officers (77 percent), and late delivery of information (74 percent) of farmers agreed to these four aspects as barriers to information transferring. The researcher recommends that the government create policies that help rural farmers with information centers, which could be in schools or shopping centers to increase awareness and preparedness for agricultural activities.

Key words: Knowledge, information, extension officers, training, SAPS, barrier.

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List of the abbreviations

AEZ	-	Agro-Ecological Zones
AEZs	-	Agro-Ecological Zones
AGRITEX	-	Department of Agricultural, Technical and Extension Services
AIS	-	Agriculture Innovation Systems
AKIS	-	Agricultural Knowledge and Information System
CSA	-	Climate Smart Agriculture
FAO	-	Food and Agriculture Organization
FFs	-	Farmer Field School
FTLRP	-	Fast Track Land Reform Program
GISP	-	Government Input Support Schemes
GMB	-	Grain Marketing Board
IBM	-	International Business Machines
ICT	-	Information Communication and Technology
IPCC	-	Intergovernmental Panel on Climate Change
LEDC's	-	Less Economic Developing countries
SAPS	-	Sustainable Agricultural Practices
SDGs	-	Sustainable Development Goals
SMS	-	Short Message Services
SPSS	-	Social Package for Social Sciences
SSCF	-	Small Scale Commercial farmers
TCAP	-	Targeted Command Agriculture Program
UNFCCC	-	United Nations Framework Convention on Climate Change
USAID	-	United States Agency for International Development
ZIMASSET	-	Zimbabwe Agenda for Sustainable Socio-Economic Transformation

1. Introduction

Poor crop yields and soil fertility are the main causes of hunger in Southern African countries. The United Nations has established Sustainable Development Goals (SDGs), including SDG1 and SDG2, to eradicate poverty and hunger and SDG13 to address greenhouse gas emissions and climate change. These goals guide decision-makers in creating a sustainable environment (Alemayehu and Bewket, 2017; António Guterres 2022). Therefore, in this era of gradual climatic changes, farmers' knowledge and support systems are increasingly becoming necessary as they facilitate adopting sustainable agricultural practices (SAPS)(Ahikiriza et al. 2022). Research on the relationship between farmers' knowledge and support systems has been of significant priority. A study by Food and Agriculture Organization FAO (2022) discovered that households from eight provinces in Zimbabwe had unfavourable knowledge and support systems not suitable for farmers' success to be realized. With more than half of the population in Zimbabwe being smallholder farmers, there is a need to consider the adoption of SAPS to curb the effects of climate change (FAO 2022).

The absence of knowledge makes it difficult for farmers to adopt SAPS. Hence it is essential to find appropriate channels to support the farmers with information to increase their knowledge base of SAPS (Istriningsih et al. 2022). Therefore, it is important to note that as much as information transfer to farmers is the centre of focus, small scale farmers have the experience they gain through repeated planting styles on their local lands (Chuma et al. 2022). According to Sanni et al. (2022), it is essential to support farmers by not taking away their ways of farming but by supplementing their knowledge through appropriate channels.

The agricultural sector faces numerous challenges, not only limited to climatic variability, resource depletion, and lack of financial support (Heo et al. 2020). The smallholder farmers are also limited with knowledge and information support, valuable resources that can promote sustainability. Farmers' knowledge of agriculture problems can help improve agriculture productivity (dos Santos et al. 2021).

The effects of climate change have had a detrimental impact on small scale farmers. Therefore, it is important to educate farmers on how to adapt to rainfall and seasonal changes through SAPS (Istriningsih et al. 2022). Hence the introduction of sustainable agriculture practices compatible with local farming practices. Inconsistency in rainfall distribution and climate change results in low yields as farmers depend on rain-fed crops and irrigation systems (Huang et al. 2015). The interconnectedness between SAPS, climate change, lower yields, and low soil fertility should be curbed by introducing knowledge and information support systems to small scale farmers. The need for farmers to adapt to these changes is paramount because of the high dependency on rainfed crops, which eventually results in lower yields. Monoculture practices like planting the same crops yearly result in poor soil fertility. Therefore, farmers must adopt SAPS (Schilling et al. 2012; Zhang and Peng 2021). Climate changes depend on geographical location; consequently, it is important to consider precise information about the specific geographic farm. Research done by Zinyengere et al. (2014) in Southern Africa showed that crop yields for maize would decline, averaging below 20 percent compared to previous years. The decline in staple crops poses a danger for hunger because most small-scale farmers practice subsistence farming and sell only if they have higher yields (Belesova et al. 2019).

The immediate channels for transferring information to small scale farmers are government institutions through government extension officers (Ragasa and Mazunda 2018). The government of Zimbabwe created programs for farmers' knowledge and Information Support systems, deploying extension officers, organizing workshops, and researching sustainable seeds that can adapt to climate change (Paul Noumba et al. 2019).

As much as much research is available on farmers’ knowledge and support systems, there is less research on such in Goromonzi hence this research. The objectives of this research were to explore the farmers sources of knowledge that enhance the adoption of SAPS, focusing on four SAPS: legume intercropping, crop rotation, mulching and agroforestry, and finding out the barriers that prevent information transfers to farmers.

2. Literature Review

2.1. Agriculture in Zimbabwe

mbabwe has four major commercial crops: tobacco, soya beans, cotton, maize (Mbanyele et al. 2021; Mpepereki et al. 2005; Ngarava 2020). Tobacco, the country's most important export crop to China, South Africa, Mozambique and Poland, is said to have made USD 863 million in 2021 (OEC 2021). Soyabean is another important crop with high demand in Zimbabwe, and its demand is likely to increase due to the reduction of exports by countries producing soyabean (USDA 2023). The other crop is cotton, Zimbabwe's second most important cash crop. The country is said to be capable of producing 89,000 metric tonnes per annum and produces cotton contractually (USDA 2010). The fourth crop is maize, and according to Foreign Agriculture Services Report of USDA (2022), there was a drop in the metric tonnes produced in 2021/2022 compared to the prior season, which had 2,7 million metric tonnes, and this drop was a result of changes in weather patterns.

Coming down to the household level, FAO (2022) conducted a survey and found out that the major crop was maize (79 percent of the households), followed by sorghum (6 percent) and groundnuts (4 percent). **Figure 1** below illustrates the data.

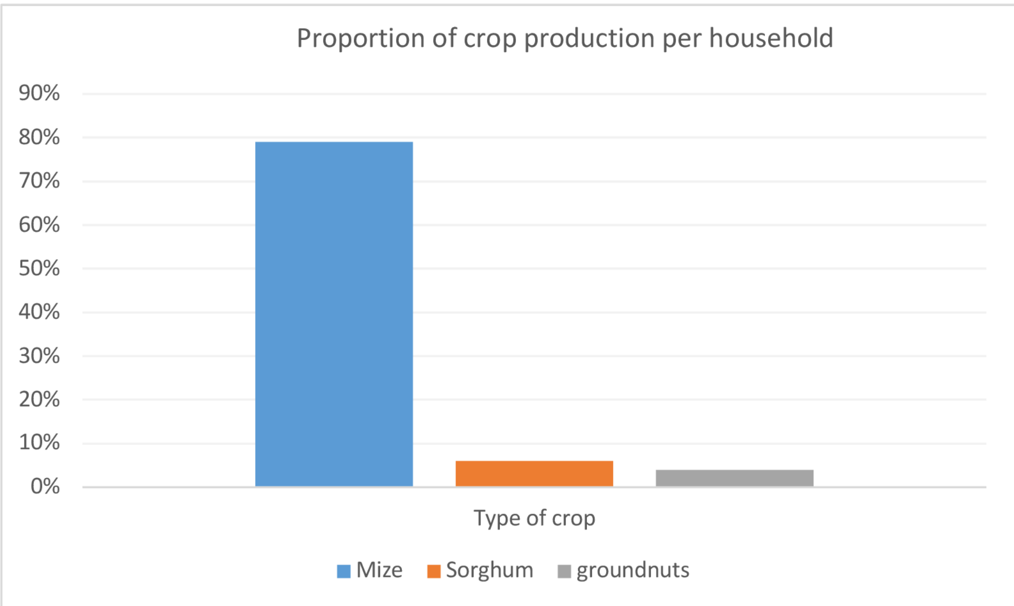

Figure 1. Proportion of crop production per household (FAO 2022).

The farmers also supplement by keeping a small number of livestock, and from the same report FAO (2022), poultry has a share of 48 percent, cattle 26 percent and goats 20 percent, as shown in **Figure 2** below:

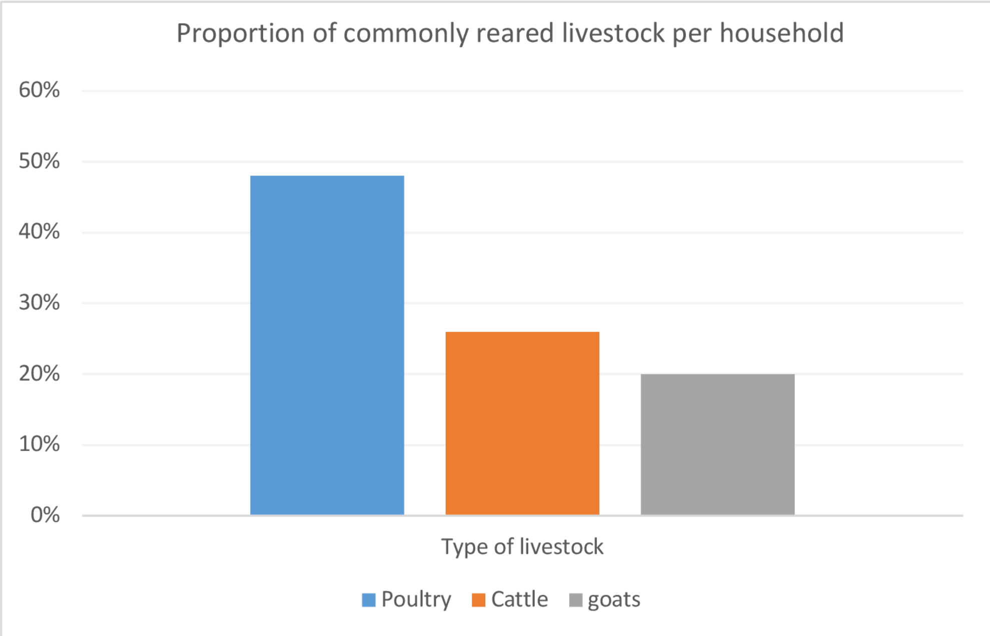

Figure 2. The proportion of commonly reared livestock per household (FAO 2022).

The government of Zimbabwe -supported smallholder farmers and resettled them to land with good soil properties, and there was a sharp increase in yield for maize and cotton (Rukuni et al. 2006). The fast-track land reform program began its initiative of buying and sometimes taking land from large-scale commercial farmers (non-Zimbabwean) and giving the land to the landless; the war veterans and those in high government ranks got more land (Makate et al. 2019). Indigenous people benefited from the Fast Track Land reform programs, and farmers were resettled and occupied the A1 farming category. Although they managed to get the land from the program, they were not equipped with financial or technical resources to support their farming system. Over 110 000 square kilometres of farming land was taken from large scale commercial farmers and distributed to over 150 000 families (Svubure et al. 2015). Since the debated Fast Track Land Reform Program (FTLRP), Zimbabwe's agriculture system has had no guidelines on allocating financial resources to support Agriculture.

The government revised the error and implemented financial programs in 2009 to support Agriculture. The government started to support farmers after the country faced great hunger and economic challenges caused by inflation in 2009 (World Bank 2019).

Zimbabwe's Agriculture is into four categories: large-scale commercial farms, small-scale commercial farms, A1 and A2 farms, and the last class are communal lands.

2.1.1. Large scale commercial farmers

Large scale commercial farmers are farms the colonialists previously owned before Zimbabwe gained its Independence in 1980. The owners have access to title deeds and large amounts of crops in considerable quantities and highly mechanized machinery (ZIMSTATS 2019). These farms focus on the export market, cultivating crops such as wheat and tobacco.

2.1.2. Small scale commercial farmers

During the post-colonial period, the farms were allocated for native Zimbabweans, These farmers own 4 per cent of the total land area in the country, and they have access to title deeds in the form of a lease granted by the government (ZIMSTATS 2019).

2.1.3. A1 and A2 farms

According to ZIMSTATS (2019), the government acquired land from large-scale farmers in the year 2000 and redistributed the land to communal land and urban areas. The government categorized the communal area into two groups, namely the group A1 farmers and the group A2 farmers (Tatsvarei et al. 2018).

2.1.3.1. A1 farms

The total land ownership is limited to six hectares and allocated to a family or an individual. These farmers are given access to ownership rights through an offer letter and resettled across all the agroecological farming regions (Scoones et al. 2018). The leading agriculture practices for these farmers are mixed farming systems for livestock and crops, and the type of crops depends on the farming region (ZIMSTATS 2019).

2.1.3.2. A2 farms

These farms have a design to support the middle class, and each farmer owns an offer letter that gives them the legal right to farm on the land. In this farming model, they practice cropping, livestock production, and the farms' size depending on the Agroecological region (Shonhe et al. 2021; Shonhe and Scoones 2021).

2.1.4. Communal lands

In this farming system, farmers have access to farming land. However, a chief or headman manages it, and the community has grazing land for pastoral activities like livestock and goats. These families in communal lands practice subsistence farming, and the farmers sell extra produce to the market. These communal lands constitute approximately 42% of agriculture production in Zimbabwe (ZIMSTATS 2019). These communal lands have the same characteristics as rural areas, comprising about 51 per cent of the total population (Weiner et al. 2016).

2.2. Agriculture programs in Zimbabwe

The Targeted Command Agriculture Program (TCAP) implementation created farming opportunities for people in rural areas and increased the productivity of small to medium commercial farmers. However, it has been encountering challenges since its introduction in the year 2016 up to 2019. Farmers are not participating in the decision-making for the program's implementation, which results in a poor distribution of resources to farmers. The program has helped farmers improve their yields and living standards because they get government support for farming inputs necessary to improve food security in Zimbabwe (Obi and Chisango 2011).

The government of Zimbabwe 2022 implemented the Pfumvudza presidential input programme targeting which benefits an estimated 3.5 million farmers in Zimbabwe through the Agro-Ecological Zones (AEZ), these consist communal A1, small scale commercial farmers (SSCF), and peri-urban farmers. The initiative is to support households in the different Agro-Ecological Zones (AEZs) to protect against food insecurity. The programme focuses on biodiversity instead of planting one type of crop, which increases the risk of failure in dry spell seasons.

The major type of plants distributed among the farmers in the agroecological zones (AEZs) includes maize (*Zea maize*), sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), soyabeans (*Glycine max*), sunflower (*Helianthus annus L*), groundnuts (*Arachis hypogaea*), dry beans (*Phaseolus vulgaris*), African peas (*Vigna unguiculata*), vegetables (Gumbo 2022).

The Pfumvudza input distribution is according to crops under the 1984 AGRITEX agro ecological zones. Famers are supported with inputs for a specific land area plot area of 0.6 hectares. In Agro- Ecological Zone 1, 2, 3, farmers get the following crops and inputs:sunflower, sorghum, pearl millet, ground nuts, African peas, sugar beans, and maize. These measures increase biodiversity and reduce land degradation through monoculture practices. Government projects were not successful. This resulted from distributing maize to all the AEZ, which led to lower yields as some regions are not suitable for planting maize or no crops at all, including drought resistant crops like sorghum and millet. This measure is part of the sustainable development goals agenda of 2030, which focuses on ending hunger and zero poverty among the 17 sustainable development goals (SNDG's) (Gumbo 2022).

The government initiates farming projects to boost the agriculture sector. The Targeted Command Agriculture Program (TCAP) supports farmers with farming inputs, and after harvest, the farmers will sell their crops to the main Grain Marketing Board (GMB) at government maize price. The targeted Command Agriculture Program(TCAP) has helped farmers increase their productivity and has employed people in communal lands (World Bank 2017).

2016 to 2020 is the beginning of effective agricultural support programs like the Targeted Command Agriculture Program (TCAP) Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET). These programs are aimed at improving the agriculture sector. According to World Bank (2003), the main contributing factors to Zimbabwe's food insecurity are low rainfalls or droughts and poor government policies. Famines affect the production of maize negatively, whereas government policies can either positively or negatively affect access to maize and tobacco. In 2000, the government implemented the negatively debated Fast Track Land reform program (FTLFR). According to Ngarava (2020), the FTLRP significantly produced essential commodities like maize and tobacco in the next decade.

Although the government took the land from the former landowners, they did not plan what to do with the land; they took the former colonialists. The government's actions caused food insecurity because it reduced the production of the primary commodities in the country, and the land resources like arable land were not used effectively and efficiently for more than ten years.

2.3. Climate of Zimbabwe

2.3.1. Agroecological zones in Zimbabwe

Table 1. Agroecological zones in Zimbabwe (FAO 2006; Manatsa et al. 2020)

Region	Area (km squared)	Annual rainfall/mm	Farming systems
I	7,000	Above 1,050mm. Rainfall throughout the year with mean temperatures	Dairy farming, specialisation, and diversification. Crops: coffee, maize, fruits, tea
II	58,600	700-1,50mm Limited rainfall in the summer season.	Intensive farming, livestock, maize
III	72,900	500-700mm. Flash rains are followed by dry seasons and drought.	Semi-intensive: livestock. Crops: Maize, tobacco, sunflower,
IV	147,800	450-600mm. Poor rainfall and repeated droughts.	Semi-extensive; livestock, sugarcane, fodder crops.
V	104,400	Less than 500mm. Poor soils and poor rainfall throughout the year	Extensive farming, cattle ranching, sugarcane

2.3.2. Temperature

In region one, the mean minimum and mean maximum temperature is between 10 degrees to 23 degrees Celsius. Region two has the same temperature characteristics as those in region one. Agro-ecological region three has a moderately high mean minimum and mean maximum temperature, ranging between 11 and 26 degrees Celsius and yearly temperatures between 18 and 22 degrees Celsius. The temperature characteristics in region four are the same as in region three. The final region is region five, with higher temperatures than any other four regions, with mean minimum and maximum temperatures between 21 and 32 degrees Celsius (Mugandani et al. 2012).

2.4. The effects of climate change on agriculture

Climate change significantly reduces soil fertility, and elevated temperature increases future evapotranspiration projections to a study done by (Raes et al. 2021). In countries like the Gambia, Mali, Niger, and Côte d'Ivoire, it will be challenging to cultivate drought-resistant crops like sorghum and maize as a staple food could become impossible to plant because of a decrease in soil fertility in the future years of 2030 and 2050 with an increase in the evapotranspiration rate of 3 and 7 percent, respectively. Shifting seasons, increased heat for plants and change in rainfall distribution patterns are among the factors that will lead to high food insecurity in Cambodia (Alvar-Beltrán et al. 2022). Research in India and Bangladesh looked at adjusting the farming calendar to cope with the changes in the rainfall patterns; this was seen to save water, improve agriculture productivity, and reduce the loss of yields due to poor timing for planting rice and wheat because of climate change (Wang et al. 2022).

Climate change is a phenomenon that has been widely studied. Several scholars have attempted to define climate change, noting its causes, characteristics, impacts, and the appropriate responses to mitigate those impacts. The United Nations' Framework Convention on Climate Change (UNFCCC 2006) defines climate change as "a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable periods".

Also, the Intergovernmental Panel on Climate Change (Shukla et al. 2019) defines climate change as "any change in climate over time whether due to natural variability or as a result of human activity".

Farmers in developing countries usually make short term decisions. However, with the help of information technology, farmer applications such as weather forecast applications can help farmers plan and reduce the elevated risk of failure when implementing long-term projects in the wake of climate change (Lundström and Lindblom, 2018). Using local resources effectively is a great tool for transforming farming in developing countries (Zeweld et al. 2017). According to Guo et al. (2021), climate change affects crops with reduced crop production because of temperature variations and erratic rainfall. Khan et al. (2020) also argued that climate change increases diseases and pests.

2.5. Adopting sustainable agriculture practices

Sustainable agricultural practices warrant efficient use of natural resources while ensuring people have enough to eat (Mgomezulu et al. 2023). These practices include mulching, crop rotation, and drought-resistant crops. According to Shukla et al. (2019), through the Intergovernmental Panel on Climate Change (IPCC) report, sustainable agriculture practices meet the needs of different agroecological aspects and where human intervention does not lead to waste of resources.

2.5.1. Sustainable soil management practices

Sustainable soil management practices have occupied the centre stage in modern agricultural and environmental management. As noted by the Food and Agricultural Organization FAO (2017), the soil is the world's largest pool of carbon, and 95% of the world's food is produced in the soil. The topic of SAPS has increasingly become inevitable for governments across the globe to adopt sustainable soil management practices (FAO 2017). In a study by Makate et al. (2019) in Southern Africa, Climate Smart Agriculture (CSA) is a major influential aspect towards creating a sustainable agro-ecological environment. For instance, numerous use of drought resistant crops, improved legume varieties and conservation agriculture are important in reducing the effects of climate change.

2.5.1.1. Legume intercropping

Another practice targets the increase and maintenance of biomass in the soil. This can be done by managing crop residues, planting nitrogen fixing plants like legumes and balancing the soil fertility (Taylor and Bhasme 2018). Cereal crops and legumes are combined with high crop output in the next planting season. The combination of cereals and legumes is helpful in light, acidic soils with poor nutrient content and high-water drainage properties (Księżak et al. 2023). Mixing different family crops increases yield rate for instance, the combination of grain crops like maize (*Zea maize L*) with soybean (*Glycine max L*), besides acting as a nitrogen fixing component in the soil, also serves as a protein supplier for households (Chimonyo et al. 2019).

2.5.1.2. Mulching

Mulching refers to any organic or inorganic covering material placed on the soil to reduce soil moisture loss. Mulching as a cultural practice has been touted for several benefits: soil moisture retention, heat trapping, runoff reduction, increase in germination percentage, improvement of soil structure, weed prevention and control and helping to control soil erosion (Telkar et al. 2017). Organic mulching is the soil covering using material that occurs naturally in that environment, like grass, straw, dry leaves, bark, saw dust and compost (Mohiuddin et al. 2020). Compost is considered one of the best means of mulching, although due to being refined, it fails to suppress the growth of weeds (Telkar et al. 2017).

2.5.1.3. Crop rotation

2000 years ago, crop rotations were defined as cycling crops on the same land to improve fertility and soil status and control pests and weeds (Rana 2019). Rana (2019) observed that while there is no binding crop rotation structure, an ideal crop rotation would involve cycling cash crops like vegetables, cover crops like grasses and cereals and green manures like legumes. Rana (2019) outlines ten principles of crop rotation: i. follow a legume with a high nitrogen demanding crop; ii. grow a less nitrogen demanding crop in the third stage; iii. avoid growing a particular crop more than once a year in the same location; iv. follow a crop with one from a different crop family; v. use crop sequences that promote health crops, vi. use crop sequences that control weeds; vii. use longer sequences of perennial crops on sloping land; viii. grow deep rooted crops within the rotation; ix. grow crops that leave significant residues behind, and x. grow crops into blocks based on family.

Crop rotation reduces weed growth, pests, and diseases, enhances soil fertility and structure, and boosts soil organic matter and biodiversity, thereby preventing soil erosion, raising crop yields, and minimising risk (Albert 2015; Nkomoki et al. 2018; Rana 2019).

2.5.1.4. Agroforestry

Planting different plant species on the same piece of land, mixing trees and perennial woody species with crops, instead of monocropping, agroforestry promotes full utilization of resources to increase biodiversity at a specific piece land. Agroforestry systems increase the organic matter in soils containing either dead or living organisms, which helps to improve soil fertility and structure (Sobola et al. 2016). This increases the species richness of crops, and wood perennials act as an impediment against diseases, and pests, reducing water runoff and soil erosion (Fahad et al. 2022).

2.6. Factors influencing the adoption of sustainable agriculture practices

Moreover, for instance, knowledge is the main capital towards adopting smart climate agriculture to understand the factors that affect the adoption of smart climate agriculture (Westermann et al. 2018). The adoption of SAPS is a pillar in creating food security for rural farmers. However, they are attributing factors that influence the adoption of SAPS. These factors are classified into two main aspects, namely the (1) producer characteristics, those related to the farmers background and (2) institutional factors. A summary of the main contributing factors includes gender, age, level of education, family size, farm size, experience, and institutional support (Melesse 2018).

2.6.1. Producers characteristics

2.6.1.1. Gender

Gender is a main factor affecting adoption of sustainable agriculture practices in African countries. Research studies done in Kenya, Malawi, and Uganda by Fadeyi et al. (2022) found that adapt quicker to SAPS adoption than women.

According to Khan et al. (2022) there is no relationship between gender and the adoption of information SAP delivered through mobile phones; males and females adopt sustainable agriculture practices regardless of gender differences. The type of gender, which is the household head influences the adoption of SAP (Andati et al. 2022).

2.6.1.2. Age

According to Fadeyi et al. (2022), when people grow old, they fear changing to new ways of farming, and there is resistance to change. The farmer's age is vital in the crop type when to plant or any decision-making regarding expanding knowledge (Ai et al. 2023).

2.6.1.3. Education level

The ability to understand delivered information depends on the ability to interpret the information with little or more background of educational level. Therefore education plays a vital role in adopting sustainable agriculture practices (Fadeyi et al. 2022). Education was identified as a major factor in adopting SAPS in African countries.

2.6.1.4. Farm size

A study in Ethiopia reviewed that farmers who grow different crop varieties often require big farmland. Therefore if farmers have huge farmland sizes, they will be less adoption towards the adoption of sustainable agriculture practice. Also, farmers who practise mixed farming, like crop and animal production, require more land to adapt to new sustainable agriculture practises (Melesse 2018). Farmers with small pieces of land quickly adapt to SAP because there are no high investment costs (Hu et al. 2022). However, according to Ngaiwi et al. (2023) farmers with big land are eager to set aside some of their lands for investigation, whereas small scale farmers are not ready to use their small portions of land for new agriculture practices.

2.6.1.5. Family size

The family size is important in determining the constructive adaptability of SAPS farmers, with few household members easily adapting to SAP and whereas large households use family labour to implement high labour SAP methods (Ngaiwi et al. 2023).

2.6.1.6. Experience

Farmers with many years of implementing agriculture practices in rural areas were seen to be knowledgeable and could adapt to recent technologies because of the awareness acquired over more years of land preparation, planting, weed control, harvesting process and storage. These farmers understand the importance of improving and adapting to sustainable agriculture compared to farmers without understanding. Therefore, sustainable agriculture practices have a high adoption rate among farmers, with experience gained over many years (Fadeyi et al. 2022).

2.6.2. Institutional characteristics

According to Melesse (2018), a farmer may abscond from adopting sustainable agriculture due to bad institutional policies. If farmers get support in the form of credit, education centres, and the availability of land title deeds to increase land tenure security, farmers adopt sustainable agriculture practices. The favourable outcome of adopting agroforestry in Africa depends on how institutions and the system in each country operate to achieve the benefits of agroforestry, even at the rural level for small scale farmers (Ndlovu and Borrass 2021).

2.7. Effects of land ownership

In Zimbabwe, a number of scholars have echoed the sentiments that land ownership has indeed an impact on seeking knowledge on sustainable agricultural practices and implementing them. Maguranyanga and Moyo (2006) argue that most rural farmers in Zimbabwe have land insecurity, which demotivates them from seeking knowledge on sustainable agricultural practices and implementing them. The two scholars argue that the current land ownership patterns were insufficient for anyone to care about soil conservation or other sustainable agricultural practices. This echoes Zeweld et al. (2017), who argued that the impacts of no control over land could not be undermined in empowering farmers with knowledge and training towards the adoption and implementation of sustainable agricultural practices.

On the contrary, research shows that farmers with proper documentation of land ownership showed concern about the fate of their land.

These enlist both smallholder and large-scale commercial farmers, although most are commercial farmers. This echoes Nkomoki et al. (2018), who support that farmers who are legally registered and have farm ownership show a positive adoption attitude towards SAPS.

2.8. Barriers to adopting SAPS

2.8.1. Level of literacy

Literacy cannot be undermined in any given set up where communication is the foundation of progress. Basic reading skills are crucial in creating, accessing, and disseminating agricultural information. Language barrier towards information dissemination is problematic because farmers should have basic reading skills in Zimbabwe and major newspapers like the Herald and Newsday in English. As noted by FAO (2017), there comes the point in agriculture when one must read instructions on chemical labels, on adverts and when one has to compose marketing material for themselves. The EIP-AGRI (2020) argues that within the European Union, where numerous workshops among farmers are held occasionally to discuss farming issues, the participants have no option but to be literate because much material is shared for reading. It can be seen, therefore, that the level of literacy is somehow hinged on the farmers' ability to access, create, share, and interpret sustainable agriculture-related information. The researcher in this study will also want to understand how much of a factor literacy level in Goromonzi.

2.8.2. Lack of financial resources

Many government organizations organize events to support knowledge transfer for sustainable agriculture practices. However, a lack of financial support for farmers and the government to implement the SAPS is always a limiting factor (Molnar 2014). Research programs by Lipper et al. (2011) pointed out how important it is to financially support rural farmers as they depend solely on agriculture for crops. The FAO pointed out how poor women and children are left out of financial programs in rural areas. This, in turn, increases rural farmers' negative attitude toward developing and adopting (Bekuma et al. 2023; Hernández 2017; Mutyasira et al. 2018).

2.8.3. Lack of agriculture inputs

The existence of the value chains in the urban markets makes it difficult for rural farmers to enter these markets because of big cooperations with access to inputs for sustainable production. Thus, a publication by FAO (2017) supported the importance of supporting rural small-scale farmers with inputs, input suppliers and tools that support the easy adoption of sustainable agriculture practices. Consultation is one of the best input mentioned by the FAO, as big commercial farmers have access to these inputs before making decisions. However, small scale farmers are very reliant on external support for inputs mainly the government; therefore, in the absence of these input support systems, adoption becomes out of reach and impossible (Bekuma et al. 2023; FAO 2017).

2.8.4. Lack of knowledge

Farmers get their knowledge through training and collaboration through extension officers and demonstration farms; therefore, the absence of information support systems that promote the adoption of SAP, becomes a barrier towards adopting SAPS (Bekuma et al. 2023). Training empowers small scale farmers with the specific knowledge towards adoption is crucial. If they do not get the knowledge both in the short term and log run, adoption will be difficult in the short and long-run periods of their practical traditional farming styles (Serote et al. 2023).

2.8.5. Shortage of land

As farmers increase their land sizes, they adopt strategies to diversify their land for different farming practices; research by Alemayehu and Bewket (2017) confirmed the importance of farmers who have many plots and how they adapt easily to SAPS.

2.8.6. Land tenure insecurity

In Zambia, women were seen to be overlooked over land ownership rights, therefore the adoption of SAPS will become a hindrance when they are not seen as important stakeholders towards the ownership of land for agriculture practices (Anibaldi et al. 2021).

Ability to adapt to SAP which is seen to have both short- and long-term attributing positive results is dependent on farmers having ownership rights to the land they are planting; this increases farmers positive attitude towards adopting sustainable agriculture practices and can curb the effects of climate change (Alemayehu and Bewket 2017).

2.9. Farmers information support services

The FAO (2017) noted that farmers need to learn their climates and plan their farming activities in correspondence with their climates. For example, their planting, ploughing, harvesting, and the crop varieties they plant should favour those climates. With the advent of both climate change and the rise and then the continuous change and technology the world over, farmers' information support services have continuously become critical. These support services, alternatively known as Agricultural Knowledge and Information System (AKIS), are the links and sources of information that link and integrate farmers, researchers, agricultural educationists, and extensionists and encourage them to exploit and promote reciprocated learning and to create, share and make use of agriculture-related technology, knowledge, and information. Farmers are at the centre of the knowledge created and argue that AKIS believes that research is not the only means of generating or accessing agricultural knowledge, but even the informal ways do the job. AKIS is a guiding principle or some theoretical framework guiding the creation, access, and circulation of agricultural knowledge among farmers (Alaie 2023; Giagnocavo et al. 2022; Paveley and Roger 2023).

In particular, agricultural information refers to data sets and messages essential to agricultural activities like crop protection and production, animal husbandry and natural resource conservation and management (Tadesse 2008). Farmers' knowledge is the local skills and practical experience that farmers need to have to enable them to do farming in their local environments (Šūmane et al. 2018). Farmers' knowledge is required to exploit sustainably the natural and cultural resources involved in agriculture. The EIP-AGRI (2018) talks about applications that foster farmer-to-farmer cooperation based on AKIS 2.0. They also talk about agricultural support media and social media for farmers, added to the technical and other soft skills that enable farmers to practice sustainable agriculture.

According to Bernet et al. (2001, training extension officers unfamiliar with software-related decision support applications is important. An important aspect towards sustainable development is understanding the problems which cause farmers not to adopt modern technologies or the latest information (Bavorová et al. 2020).

Using technology in planting can help reduce the negative effects of soil erosion during the growth of crops (Bavorová et al. 2020). Social media applications like Twitter, Facebook, WhatsApp messenger have become successful tools in sharing information for farmers who stay in various parts of the world and practicing the same agriculture activities (Šūmane et al. 2018). A study by (Lundström and Lindblom (2018) indicated that agriculture could reach maximum production if integrated with information communication technology software to help farmers implement projects without human errors. However, Aubert et al. (2012) emphasize the importance of simplicity of precision agriculture: complex software's difficult to adopt; therefore, there is a need for simplicity among farmers of all expertise to increase the adoption of precision agriculture among farmers.

A study in Malawi and Indonesia by Berg et al. (2020) indicated that farmers in developing countries must learn how to accommodate environment and economic shifts every season because it directly affects a farmer's input and output towards sustainability. The farmer field school (FFs) is an important pillar at the field level because it tackles all the problems farmers face during agriculture practices. According to Taylor and Bhasme (2018), demonstration farms function as a network connector for private sectors, extension officers, non-governmental organizations, and donors to meet with farmers. Farmers prefer information provided by private institutions because it is more dynamic and easier to understand and implement (Bavorová et al. 2020). It is important to understand the problems that affect farmers adoption of current information before bringing the latest information because culture has an influence on farmers decision making in the initial stages of the adoption of innovative technology and information (Šūmane et al. 2018). There is immense importance towards building demonstration farms from all perspectives, including informal and formal knowledge of the demonstration farms, to maximize information sources. Mixing formal and informal information sources is essential to create good farming practices. Research done in Australia concluded that the information provided to farmers has either a negative or positive impact on adopting sustainable agriculture practices (Taylor and Bhasme, 2018).

Another study by Šūmane et al. (2018) in two separate places: Latvia and Austria, discovered the absence of extension officers and formal institutions which offer consultation services for famers. Farmers got help from other farmers through networking applications like WhatsApp messenger. The use of digital systems has a higher chance to increase productivity and reduce labour intensive methods bringing digital technology to the agriculture sector and using networking software's is an ultimate tool towards achieving sustainable development goals set by the United Nations (Fielke et al. 2020). Agriculture innovation systems (AIS) are of paramount importance in state and privately led agriculture organizations as they reduce incompetence and human error towards adopting sustainable agriculture practices by farmers in rural developing countries and towards alleviating poverty (Kamara et al. 2019).

Marketing, financial aid, meteorological information, and sustainable agriculture practices are the most important drivers that support farmers agriculture activity. However, research done in Kenya by Omulo and Kumeh (2020) mentioned the implementation of Information Communication and Technology (ICT) through mobile telephones and mobile networking applications. Social networking platforms like WhatsApp messenger, Telegram, Facebook and Twitter help farmers connect and share information and experiences and connect with other private stakeholders to increase sustainable agricultural practice knowledge (Kenny and Regan 2021).

2.10. Factors affecting the transfer of agriculture knowledge

The way knowledge is transferred increases adoption by the recipient, in this case, farmers. According to Taylor and Bhasme (2018, how information is transferred influences the effectiveness and equitableness of the transferred knowledge on the farmer. The researcher emphasizes the linkages between the farmer and the mode of transfer, which is either horizontal or vertical to farmers, and the mode of knowledge transfer, respectively. Training farmers increase agriculture productivity but affects effective training (Nakano et al. 2018).

2.10.1. Training

Research conducted by Nakano et al. (2018) in Tanzania pointed out the importance of training farmers and noticed how farmers trained to adopt sustainable farming technology quickly adapted after the training, and the yield per hectare increased from 3.1 to 5.3 tons per hectare. Farmers who had not received training benefited from their relatives because of family linkages, and the farmer-to-farmer mode of transfer was used for farmers who did not attend the main training program. The farmer-to-farmer yield rate increased from 2.6 to 3.7 tons per hectare.

2.10.2. Number of contacts with extension services

Contact with extension services is among the factors that affect the transfer of knowledge (Musafiri et al. 2022). In Nigeria, over 50 percent of farmers had contact with extension services, which led to the high adoption of SAPS, farmers who were in frequent communication with extension services increased their yields and reduced farm losses (Onyeneke et al. 2022).

2.10.3. Trainers

Research by Hutchins (2009) mentioned that the importance of the trainer's voice affects effective knowledge transfer. Among other factors, the design of the training schedule and the environment the trainer chooses to train in impact the transfer of knowledge. A trainer with experience tends to provide the correct information applicable to the specific problem. According to Burke and Saks (2009), trainers who are accountable for the training they offer do their best to deliver information to the trainee effectively and efficiently. The ability of the trainer to draw full attention during the training process is a vital aspect of obtaining satisfactory results for the transfer of knowledge (Burke and Hutchins 2007).

2.10.4. Time of delivery

According to Szulanski (2000), the transfer of knowledge is not a single act, but the transfer of knowledge is a procedure in stages. Therefore timing is important to achieve success in the transfer of knowledge.

2.11. Sources and channels of information

In the age of high transition in the channels of ICT, farmers need to use information sources that help them understand the knowledge and changing climatic situations easily. The best way to combat climate changes affecting rural farmers is to transfer knowledge relating to climate change and SAPS at a local rural household level and increase the adoption of SAPS (Alvar-Beltrán et al. 2022; Ayim et al. 2022; Shen et al. 2022)

2.11.1. Extension officers

The extension officers should equally give information to small farmers and help them with ways to increase production and yields per hectare (Bernet et al. 2001). According to Šūmane et al. (2018) farmers adjust to diverse sources of information from different extension offices to create new farming styles. Collecting data on the problems farmers face before deploying extension officers is essential as this helps to increase efficiency in solving poor communication methods towards adopting SAPS. Agriculture extension services function as a key role towards helping government systems creates good schemes that allow farmers to increase their efficiency towards sustainable agriculture practices and poverty alleviation. Governments need to strengthen the relationship between farmers and extension officers because extension officers solve farmers' challenges. Major extension services in Zimbabwe are organized by the Department of Agricultural, Technical and Extension Services (AGRITEX) and work with other private and non-government-owned organizations practices (Taylor and Bhasme 2018).

In their study, Makate et al. (2019) found that combining financial support schemes and using agriculture extension officers for farmers is essential for effective, sustainable agricultural practices among A1 and A2 farmers in Zimbabwe. According to Kassem et al. (2021), a lack of financial support services and few extension field agents reduce the effectiveness of information sharing to farmers willing to adopt new farming technologies and improve their informal knowledge of agriculture. Agriculture extension services have functioned as a pillar in enhancing productivity, and income for farmers, mostly in developing countries, and has helped transfer technological knowledge from developed countries to Less Economic Developing countries (LEDCs) (Cook et al. 2021).

Model farmers can function as information banks and help agriculture extension workers to understand how farmers in the specific region react. This helps to find ways to improve sustainable farming methods (Ragasa 2020). In developing countries where the road infrastructure hinders the movement of extension officers, the extension officers need to look for ways to improve communication and help the community to eliminate the road networking challenge, for example, through cooperatives schemes which can raise capital for the development of roads (Bernet et al. 2001).

2.11.2. Radio

This study by Ayim et al. (2022) mentions the importance of voice messages to farmers in rural areas and that radios are still an important channel for sending agricultural information to farmers in rural areas. Therefore, using radios acts as a bridge to connect rural farmers to extension officers, credit access, and government input support schemes to improve farmer's knowledge (Awuor and Rambim 2022).

2.11.3. Social media

The importance of using ICT advancements like Facebook has become a trending option among farmers in Africa. This is supported by a study by Takahashi et al. (2023), who mentioned Ethiopian wheat farmers receiving wheat prices through Facebook posts and increased wheat sales by 14 percent compared to information on Facebook by foreigners. Research in Kenya by Księżak et al. (2023) sought to find out how social media platforms affect the adoption of agriculture practices and found the use of WhatsApp messenger as a promoter towards the adoption of agriculture practices. The application allows farmers to interact by exchanging videos, voice audio, portable document formats and text messages of agriculture-related information with extension officers and formal organizational providers of agriculture information (Nain et al. 2019).

2.11.4. Television

The use of television entertainment to break gender stereotypes in agriculture practices as women are seen as less important in decision making in African culture.

A field experiment in Kenya identified a positive influence of how education through dramas broadcasted on national channels managed to break stereotypes for women participating in agriculture activities (Aju et al. 2022). In the rural areas of Bangladesh, a study by Mazumdar et al. (2023) mentioned how farmers received information about weather forecasts. Although the information was inaccurate, it helped farmers decide when to plant their crops.

2.11.5. Farmer field school and farmer-to-farmer

The farmer field school is defined as a stretched planting season, whereby farmers attend a school and learn farming practices in the ecological setup with practical examples of sustainable agriculture. This can be a demonstration farm where they practically absorb the information from a theoretical and practical point of view and interact with other farmers and share information (Bhuiyan and Maharjan 2022). The learning model was identified in East Africa and seen as the most suitable way to enhance farmers' knowledge of sustainable agriculture practices, particularly small-scale rural farmers, and increases income by approximately 60 percent (Davis et al. 2012).

2.11.6. Cooperatives

A cooperative is defined as a body of people who mutually agree to solve their problems by coming together and joining resources to solve their economic, social, and political issues towards the greater good of the community or the cooperative members (Ziegler et al. 2023).

3. Aims of the Thesis

The aim is to investigate how knowledge and information support promote implementing sustainable practices in Zimbabwe.

3.1. Specific objectives

1. To explore farmers' sources of knowledge to enhance sustainable agriculture practices.
2. To assess the quality of the information provided by the trainer and the information delivery skills of the trainer.
3. To identify the barriers towards information transferring

3.2. Research questions

1. Which sources of information do farmers use to enhance sustainable agriculture practices in Zimbabwe?
2. How is the information provided by the trainer and the quality of the information delivery skills of the trainer?
3. What are the major barriers to information transferring?

4. Methodology

4.1. The study area

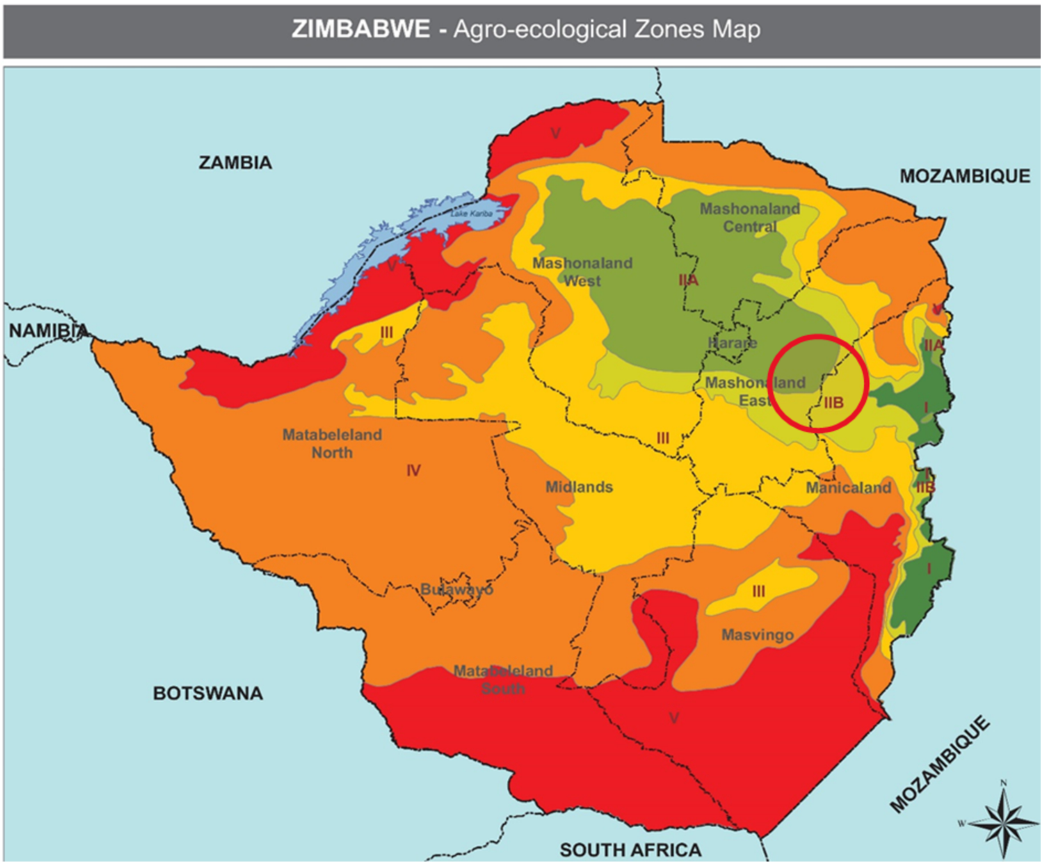

Figure 3. A map of Zimbabwe - Study site highlighted by a red circle
Source: Adapted from (OCHA 2009).

Mashonaland East is a province with an area of 32 230 square kilometres, consisting of the following constituencies or districts: Chikomba, Goromonzi, Marondera, Mudzi, Murehwa, Mutoko, Seke, Uzumba-Maramba-Pfungwe and Hwedza. Mashonaland East province is spread over AEZ IIA, IIB, III and IV. The research area is in Chikwakwa Goromonzi, located in the natural farming region IIA and IIB according to modified Agro-ecological Zones (AEZ). Most agriculture production occurs in Mashonaland East, and the area has good climatic conditions for intensive crops and animal production. The annual rainfall distribution ranges between 650 mm to 1,050 mm.

4.2. Sampling procedure

A mixture of multistage and random sampling techniques was used to select the area. The agro-ecological zone IIA has good rainfall distribution; however, shifts in rainfall distribution patterns have affected the agriculture production for farmers in this area. Two (2) villages were purposely sampled in Goromonzi, namely Chikwakwa and Chirivhi. The respondents were selected using the convenience and snow bow sampling technique with the help of the village Headman, the secretary for the Women's support for both villages and an experienced enumerator who took charge of the data entry. 112 respondents were interviewed, fifty-six (56) in Chikwakwa and fifty-six (56) in the Chirivhi village in agro-ecological zone IIA.

4.3. Data collection process

The data was collected from the period December 2022 to January 2023. The survey was conducted using a semi-structured questionnaire. During the survey, the heads of households or an adult present were interviewed. The google form for the survey was used and structured according to the original handwritten template. As a result of low internet access in the region of Chikwakwa in Goromonzi, data collected was manually written down and later uploaded to the google cloud. The researcher supervised and conducted the survey, and face-to-face interviews were used with the assistance of the Chikwakwa ruling heard man, the secretary for the women support in the villages as a numerator and another experienced researcher as a numerator. The questionnaire had 22 questions which were divided into the following section. Section A was about the farmer’s background. Section B was about sustainable agriculture practices, and Section C was about information sources and barriers towards adopting sustainable agriculture practices (SAPS). The study group had a total of 112 respondents.

4.4. Data analysis

The collected data were categorized, coded, and redefined using Microsoft Excel sheets. The analysis used IBM (International Business Machines) SPSS (Social Package for Social Sciences) statistics software version 29.0.

5. Results and Discussion

5.1. Descriptive analysis

The study sample group had 112 farmers from different households. From the sample, 39.3 percent were males, 60.7 percent were females, and the highest percentage of marital status were married people, with 71.4 percent. As illustrated in Table 1 below, the results found that a small percentage of 1.8 percent are two people without education. The other primary, secondary, high and tertiary education categories had 40.2, 42.9 and 15 percent, respectively. The institutional characteristics showed that only 21.4 percent of farmers had access to credit support.

Most importantly, the study found out that of the 112 farmers, 92 percent were farmers who were dependent on government input support schemes, and of the 112, only 13.4 percent confirmed the use of government extension services regularly for gaining knowledge. The results also found that 92 percent of the farmers knew SAP. Furthermore, the results showed that 99.1 percent grow maize, 75.6 percent grow beans, 19.6 percent grow sorghum, and 92 percent grow vegetables. The study results also showed that 91.6 percent of the farmers were under the communal land system, and 8.4 percent were renting the farms.

Table 2. Descriptive statistics of categorical variables (n=112)

Variable	Description	Frequency	Percentage (%)
Producer's characteristics			
Gender	Male	44	39.3
	Female	68	60.7
Marital status	Single	15	13.4
	Married	80	71.4
	Divorced	1	0.9
	Widowed	16	14.3
Level of education	Non	2	1.8
	Primary	45	40.2
	Secondary/High	48	42.9
	Tertiary	17	15.2
Institutional characteristics			
Credit support	Farmer support	24	21.4
GISP to farmers	Government support	103	92
Extension services	Information support	112	112
SAPS			
Aware of SAPS	Knowledge of SAPS	103	92
Farm characteristics			
Types of crops	Maize	111	99.1
	Beans	93	75.6
	Sorghum	22	19.6
	Vegetables	103	92
Land tenure system	Communal	103	91.6

Variable	Description	Frequency	Percentage (%)
	Renting a farm	9	8.4

The results in Table 2 below show the statistics of continuous variables of household producer characteristics and farming characteristics of the interviewed farmers. The mean for the household size was 3.97, and the minimum and maximum household size was 1 and 15, respectively. The mean age of the study group was 45.21, and as in **Table 1,** the results showed that the farmers started practising farming upon finishing their primary or high school education. The minimum age of the farmers was 22 years, and the maximum was 80 years. The mean for the farming experience was 20.24, and the minimum and maximum years of farming experience were 2 and 63, respectively.

Regarding the farming characteristics, the mean land size was 2.85 hectares, and the minimum and maximum were 1 and 10, respectively.

Table 3. Description of continuous variables (n=112)

Variable	Description	Mean	Min	Max
Producers Characteristics				
Age	Years	45.21	22	80
Household size	Individuals in family	3.97	1	15
Farming experience	Years of farming	20.24	2	63
Farming characteristics				
Land size	Size in hectares	2.85	1	10

The study in **(Figure 3)** below showed that legume intercropping, with 92 percent, was the most implemented practice followed by crop rotation out of the four SAPS. This diversifies farmers during harvest as they can have maize and beans used for food security in main staple food meals.

The other reason is that farmers know nitrogen-fixing benefits through intercropping beans and maize, thereby improving soil fertility and reducing erosion.

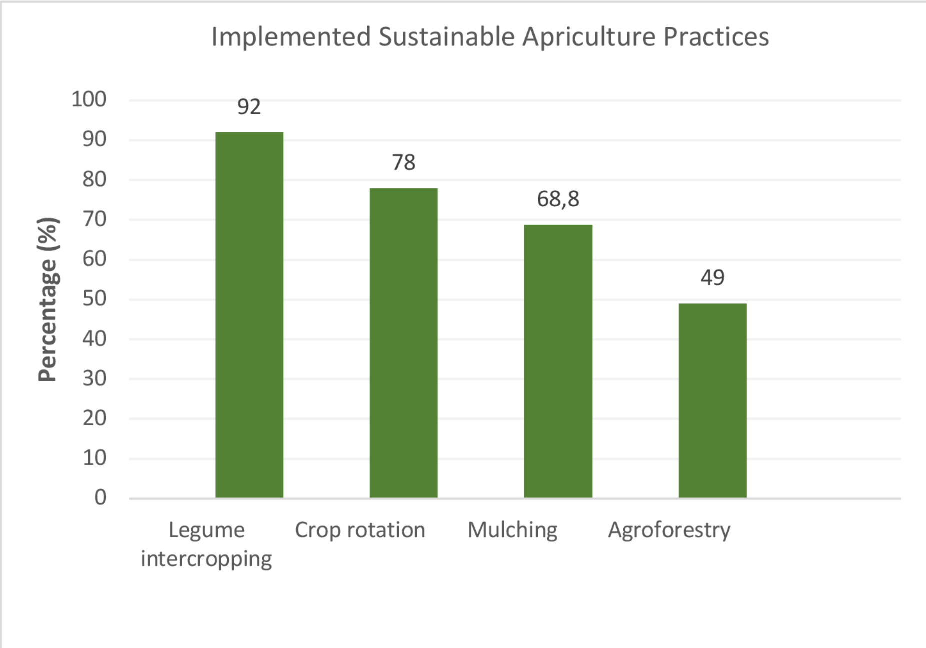

Figure 4. Implemented Sustainable Agriculture Practices

A report by the Food and Agriculture Organization (FAO) of the United Nations found that in Zambia, Mozambique, and Zimbabwe, crop diversification can increase resilience to climate change by reducing the risk of crop failure. The report cites numerous examples of diversified cropping systems that have successfully adapted to climate conditions, including African intercropping systems(FAO 2018).

In support of the positive attributes of legume intercropping, a study by Tittonell and Giller (2013) found that intercropping systems involving growing two or more crops together in the same field can improve soil fertility and increase yields in Sub-Sharan Africa. The study analysed data from 33 trials conducted across 13 countries and found that intercropping systems had 21 percent higher yields than monocultures on average.

However, intercropping can lead to water, nutrients, and sunlight competition. Research has shown that different nutrient crops have different requirements, and intercropping can lead to suboptimal nutrient availability for one or more crops.

A study by Bedoussac and Justes (2010) in France found that intercropping durum wheat with winter peas reduced wheat yield. This highlights the importance of proper crop selection and management to avoid nutrient competition and maximize crop productivity.

Crop rotation (78 percent) of the farmers interviewed confirmed crop rotation, with farmers changing the maize and beans crop positions and planting vegetables after harvest to avoid pest dominance over a single crop and increase soil fertility. However, crop rotation occurs when the farmers plant legume crops, for instance, cowpeas, lintels, and pumpkins, with maize. The crop rotation is usually complimented together with intercropping. Most importantly, crop rotation helps -scale farmers improve soil health, increase yields, reduce costs, and provide a more diverse and nutritious food supply. A study in China concerning cereal production by Li et al. (2023) supports the practice of rotating crops because it leads to better grain yield and soil fertility and achieves sustainable agriculture production.

Mulching was implemented mainly through women as they are the ones who plant vegetables after harvesting maize and are home most of the time doing house chores. The maize residues cover vegetables, reducing the evapotranspiration rate and increasing soil moisture content. On the other hand, farmers who use their maize residue for fire purposes do not prefer mulching, and it means they have to find firewood for heating water and perennial grasses to use for mulching; that process is labour-intensive. , 17.14 percent opted for adopting crop residue mulching to use resources efficiently. This is also supported by Tsige et al. (2020), who emphasized theta using crop residues as mulch makes women work harder because they will have to find other fuel sources like firewood research in Zambia.

Agroforestry was implemented by 49 percent of the total interviewed farmers. The farmers viewed agroforestry as a cultural practice rather than Sustainable agriculture practices. Pointing out that they plant trees around and on their farms to increase security and reduce gully erosion, destroying the natural landscape over time. Most of the group adopted practice of planting trees from their parents and used adopted the practice of planting trees from their parents and used trees for shade on hot days. They viewed those who did not plant trees as ignorant of culture.

5.2. Sources of knowledge to enhance sustainable agriculture practices

In **Figure 4** below, farmers were interviewed and asked about their significant sources of information. The ranking scale questions were classified into three sections rarely, moderately, and regularly with a classification of (0-2) times, (3-4) times and more than 5 times, respectively, for each category. ICT, among other benefits, enhances the accessibility and utilization of pertinent agriculture information for farmers, streamlines record-keeping and monitoring processes, facilitates effective farm management and has the potential to reduce production costs and boost productivity (Ahikiriza et al. 2022).

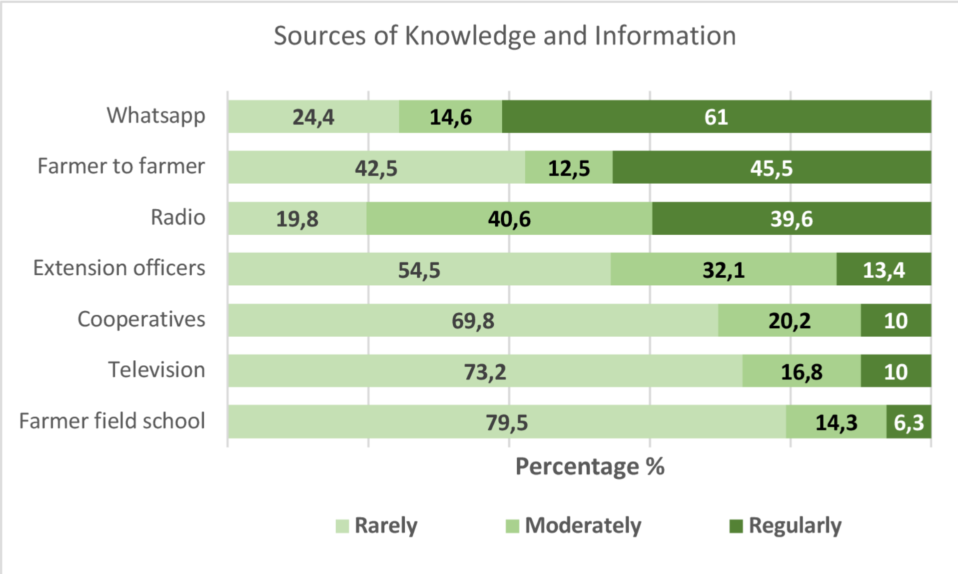

Figure 5. Sources of Knowledge to Enhance SAPS

Figure 5 represents 61 percent of the farmers who concurred that agriculture information is now easily accessible through WhatsApp messenger. Farmers get agriculture information for poultry and vegetable cash crops on WhatsApp messenger groups hosted by private companies. For instance, the Horizon Agriculture farming group was identified by 31 percent of the farmers as a reliable source of practical agriculture information. Takahashi et al. (2023) mentioned that efficient dissemination of agriculture information had garnered attention from academia and development agencies, focusing on utilizing information and technologies such as the internet, mobile phones, and short message services (SMS).

The farmer-to-farmer model of information sharing is the most common in the region as farmers invite each other to see the progress of each farmer, and if any challenge arises, farmers tend to ask farmers with more years in farming for solutions. Farmers in Sub-Saharan Africa attend training and gain hands-on experience but later share the information with their neighbouring farmers (Nakano et al. 2018). This is the same for radios, with 39.6 percent support as an important source of agriculture knowledge in rural areas.

The third most used source was radios, 39.6 percent of farmers were regular users of radios, 40.6 percent were moderate users, and 19.8 percent did not use radios to access agriculture information. The extension services 54.5 percent of farmers who knew of the presents of an extension officer in their farming region; however, they never had contact with the extension and the 13.4 who had contact regularly had financial resources to invite the extension officers who charged extra fees for knowledge transfer. The ranking of 54.5 percent was (0-5) times and 54.5 percent never met the extension officer. Whilst 32.1 percent encountered the extension on moderate bases of (3-4) times per year, only for consultations during the planting seasons. This discovery was supported by Cook et al. (2021). The extension approach focuses on increasing agriculture production through transferring knowledge from experts to farmers and its failure to consider social and political factors. Thus, the extension paradigm comprises the original part of knowledge transfer and the criticism, highlighting the importance of socio-political factors in agriculture development (Cook et al. 2021).

The results found that of 112 farmers, only 12 were regular users of cooperatives, although the cooperatives were not in the local community. Although Horizon farming started a cooperative mainly focused on knowledge transfer without financial support. Television regular users were 10 percent (12 farmers), 16.8 percent moderately, and 73.2 percent did not have a television set. Although the majority of the farmers in Chikwakwa and Chirivhi in Goromonzi do not own a television set, according to research in Kenya by Areal et al. (2020), agricultural programs have the potential to motivate farmers in developing countries to adopt agricultural practices that address local and global challenges, such as climate change adaptation and mitigation, poverty reduction and increased productivity and income.

Only 6.3 percent of farmers who went for the farmer field school are those who had access to inputs from the organiser of the farm field school and those with financial credit assistance. Case studies were conducted in Malawi and Indonesia by Berg et al. (2020) to address current questions about the farmer field school (FFs) these questions pertain to the FFs significance in the field of rural areas and its place in the institutional environment. Regarding the cooperatives 69.8 percent of the 112 farmers confirmed not to be part of any cooperative. The researchers Berg et al. (2020) emphasize how farmer field schools (FFs) continue to be significant in the field, assisting farmers to adjust their agriculture practices and improve livelihood in changing conditions (Berg et al. 2020).

5.3. Training

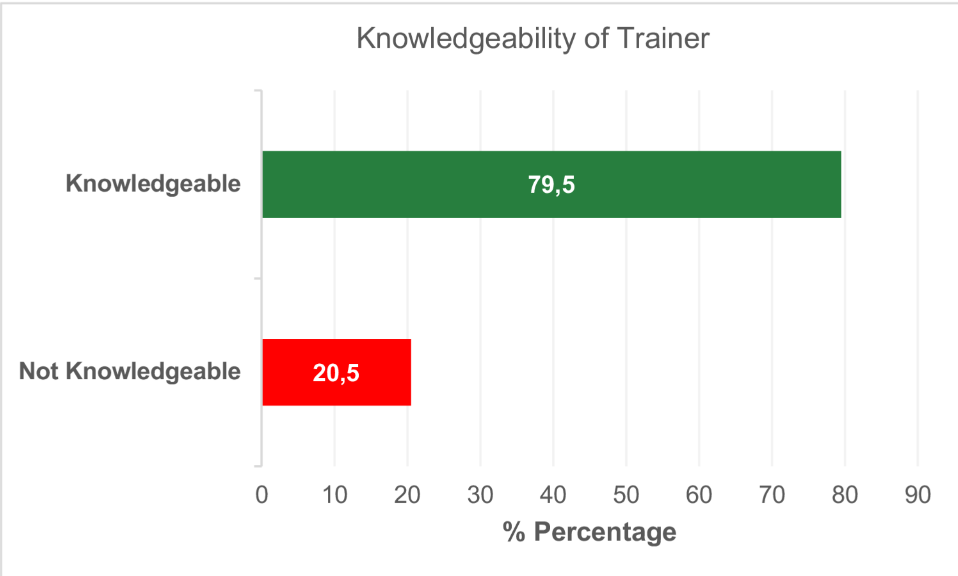

Figure 6. Qualities of the Trainer of Knowledge

The majority of the farmers confirmed the knowledgeability of the extension officers. According to **Figure 6,** 79.5 percent of the interviewed farmers positively rated the extension officers as experienced and well-informed about different agricultural practices. According to Kassem et al. (2021), evaluating the contentment of farmers regarding the standard of agricultural extension services is crucial to create extension plans that meet the requirements of farmers and suit the ecological conditions of agriculture.

However, 20.5 percent of the farmers cited that the extension officers were not experienced. Research done in Ghana on the effectiveness of extension agents by Antwi-

Agyei and Stringer (2021) on their results they found the importance of a requirement for capacity building that involves enhancing technical skills, improving communication skills, and enhancing knowledge to provide advice on climate change through extension services. The experienced farmers viewed the extension officers as not knowledgeable, citing a lack of practical knowledge of Goromonzi district.

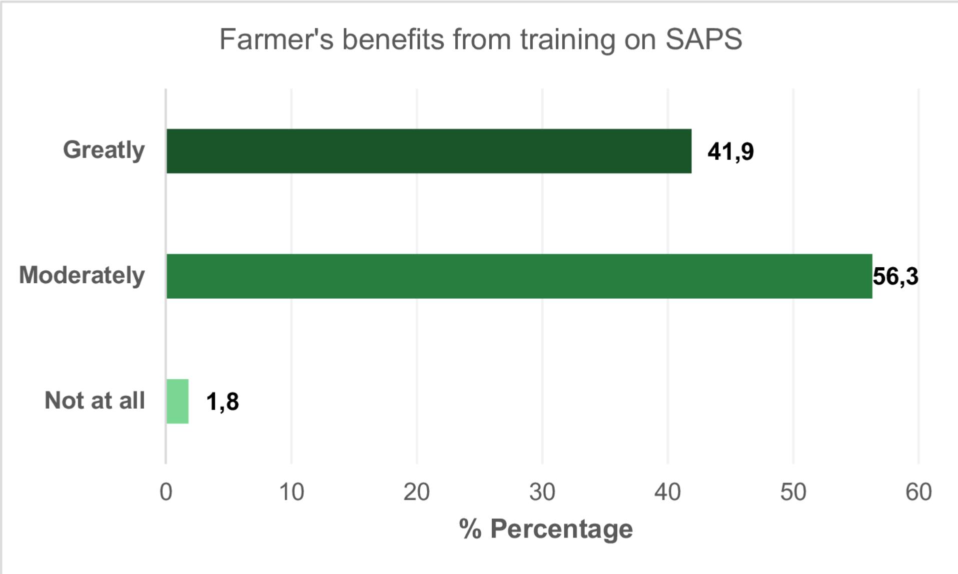

Figure 7. Farmers benefit from training on sustainable agriculture practices.

From the previous **Figure 5,** there was a positive review of 79.5 percent from farmers confirming that the trainers who did the extension services had experience and showed good practical knowledge, which motivated and led the farmers to adopt the knowledge they received on SAPS from the extension workers. **Figure** 7 illustrates the level at which farmers benefited from the training of the extension workers. This result in Goromonzi is supported by research done in Vietnam for small-scale farmers by Sattaka et al. (2017). They mention the active and comprehensive support of extension services playing a crucial role in ensuring local food and cultural security and fostering the sustainable production of glutinous rice.

Of most farmers, 56.3 percent noted a moderate benefit from the training, as benefits are limited to other variables like rainfall distribution and good timing during planting.

Farmers are affected by changing seasons of rainfall patterns; therefore, farmers are affected by climatic changes even when they possess the knowledge received from extension officers. In support of this finding, research was done by Talanow et al. (2021) in the neighbouring country of Zimbabwe in Western Cape South Africa farmers have observed long-term climate changes and their adaptive behaviour is influenced by prior experience and internal factors like risk perception and cognitive biases. However, Antwi-Agyei and Stringer (2021) saw the challenges of farmers not benefiting as much as they should due to the lack of transport facilities from extension services to increase knowledge for farmers and farmers' resistance to change as the main barrier to increasing their household food security situations. Farmers who greatly appreciated the benefits of the training they received are 41.9 percent and 1.8 percent mentioned not benefiting.

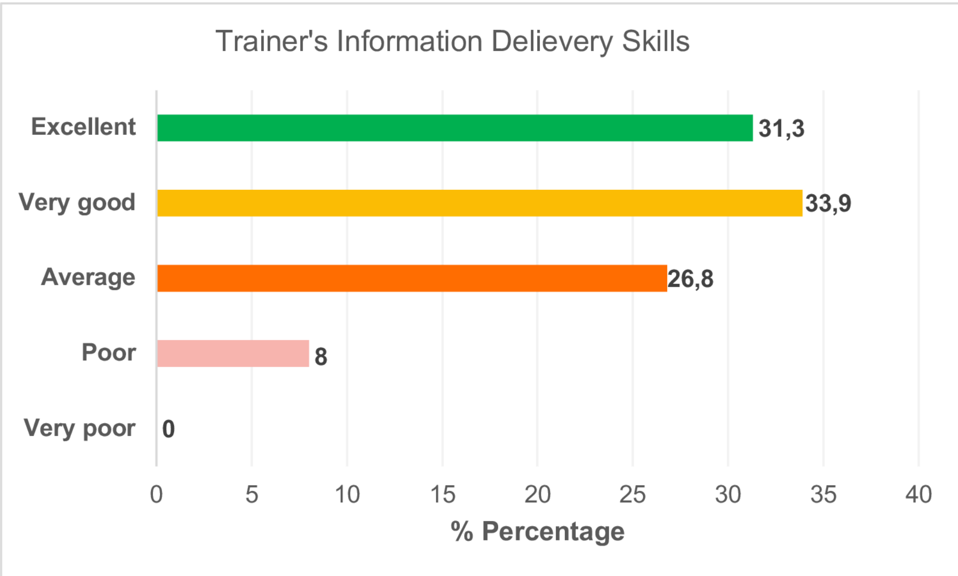

Figure 8. Trainer's Information delivery skills

Figure 8 above represents a part of the questionnaire which asked farmers to give a rating on the training they received, and of the 112 farmers, 31.3 percent confirmed the information delivery skills of the trainer as excellent and easy to understand. In Ghana, information delivery skills and field practical knowledge demonstration skills were identified as the major barrier to increasing the adoption of SAPS. The highest rating was 33.9 percent of farmers viewing the information delivery skills of farmers with a rating of very good.

Whereas 26.6 percent of the farmers rated the extension officers' trainers as average regarding information delivery skills, and 8 percent of farmers rated the information delivery skills the training they received as poor. No farmer rated very poor for SAPS (Antwi-

Agyei and Stringer 2021). In contrast a case study done in Malawi concerning lead farmers who work complementing the work of extension officers proved to be an efficient way of increasing communication and delivery of sustainable agriculture practices, noting that it becomes apparent that the quality of lead farmers (LFs), their adoption behaviour, and regular training have a substantial and consistent impact on promoting awareness and adoption of sustainable agriculture practices.

5.4. Barriers towards information transferring

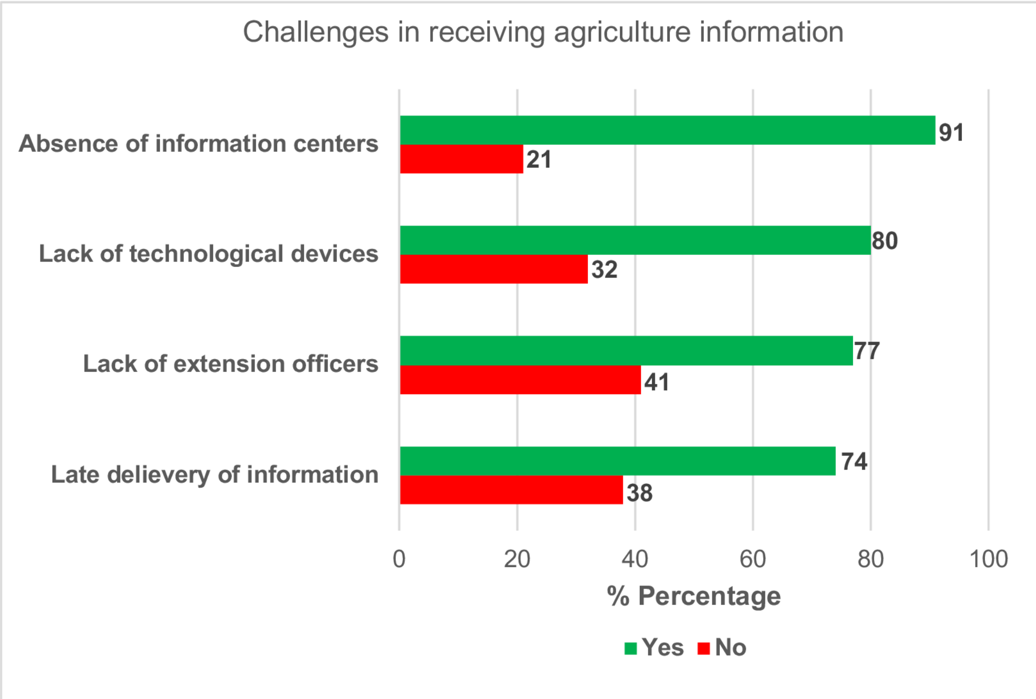

Figure 9. Challenges in receiving agriculture information

In Figure 9 above, farmers were asked to choose from a set of closed questions the options they viewed as barriers towards receiving agriculture information. Most (91 percent) of the farmers confirmed the absence of information centres when extension officers are not available to help with practical challenges in their fields, such as pests and disease outbreaks. Faulty Network boosters under technological devices (80 percent) were the major complaints about the farmers as majority of the farmers owned a smartphone to access information on WhatsApp messenger. However, because of inconsistency in the network coverage, this led to delays in receiving agriculture related information on WhatsApp Messenger.

In Tanzania, around 3.8 million text messages (SMS) were sent to more than 55,000 farmers during an agriculture maize support campaign. Of the total 73 percent were male, 19 percent had smartphones, and 86 percent cultivated maize on a maximum of 1.2 hectares of land (Karanja et al. 2020).

Farmers (77 percent) complained about no visits from extension officers. Extension officers in **Figure 5**, **Figure 6**, and **Figure 7 above** were seen as good sources of information for improving farmers' knowledge in Chikwakwa and Chirivhi. However, the farmers did not like the effectiveness and inconsistencies of training. Other farmers note that they must pay extra charges to get advice from government extension officers. Others confirmed that they only heard about the extension officer but never saw the training extension officer. For farmers access to extension services, especially in rural areas where public transportation is not readily accessible, it is important to modify policies that mandates farmers to visit extension agents. This is a review of the agriculture extension and services in Pakistan by (Baloch and Thapa 2019). Information support systems are a major influencer in enhancing sustainable agriculture practices. Farmers (74 percent) confirmed delay in information delivery in the case of outbreak of pests which destroys crops and in general farmers in the rural community in Chirivhi and Chikwakwa find it difficult to have valid on time agriculture information. This is supported by FAO (2022), farmers in Zimbabwe possessed inadequate knowledge and support systems that are unsuitable for the success of farmers to be achieved.

6. Conclusions and Recommendations

The first objective was to explore farmers’ sources of knowledge to enhance sustainable agriculture practices. The research found WhatsApp messenger as the most used source of knowledge; 61 percent of farmers concurred with the efficient use of WhatsApp messenger. Farmers were part of agriculture groups which sent practical knowledge in video format on how to practice rural related sustainable agriculture practices. Horizon Farming group was the main WhatsApp group known among the farmers. However, the farmers faced a challenge in effectively using WhatsApp messenger's benefits because of poor internet network services, to receive agriculture-related information on time according to the farmers’ calendar of activities. Therefore, governments, private sectors and network service providers should improve internet network services' quality and make it consistent mainly during the main farming activities. The effects of climate change heavily affect farmers. Therefore, improving information transfer information like specific planting dates will reduce poor crop yields and hunger.

The second objective was to assess the quality of the information the trainer provided and the trainer's information delivery skills. Government extension officers provided the most common training. The research found that 79.5 percent of farmers approved government extension officers as knowledgeable, and farmers with more years in farming regarded the extension officers as not knowledgeable, citing a lack of practical knowledge of the local environment. Most farmers benefited from the knowledge shared by the extension officers. The information delivery skills of extension trainers were ranked as excellent and very good, indicating good information delivery skills. It is therefore recommended that extension officers improve their knowledge and experience on specific agro-ecological zones to support farmers with knowledge related to their farming region.

The third objective was to identify the barriers towards information transfer. The research found that lack of information centres, technological devices, lack of extension officers and late delivery of information are major barriers affecting farmers access to agriculture information. Farmers also complained about the inconsistencies of training from extension officers and poor internet network challenges, leading to late information delivery.

It is therefore recommended that government should monitor the consistency of farmers' visits from extension officers and also to build information centres in the rural areas which saves as a foundation for transferring of information which leads to increase in farmers' knowledge.

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Appendix 1: Questionnaire

SECTION A: FARMER'S BACKGOUND

1. Please indicate your gender

Male ☐ Female ☐

2. Please indicate your age (years)

☐

3. Marital status

Single ☐ Married ☐ Divorced ☐ Widowed ☐

4. Level of Education

None ☐ Primary ☐ Secondary School or High School ☐ Tertiary ☐

5. Household size

☐

6. Please indicate your land size (ha)

☐

7. Which land tenure system are you under and do you have tittle deeds for the land:

Land Tenure Systems	Title Deeds YES	Title Deeds NO
Commercial Farmland		
Communal Land		

8. How many years have you been practicing farming?

☐

9. Are you renting the farm?

YES ☐ NO ☐

10. a) Do you belong to any farmer group or cooperative?

YES ☐ NO ☐

b) If YES, kindly write the name of the group/coopera-tive……………………………………………………………………

11. a) Which major types of crops do you grow?

Maize ☐ Beans ☐ Sorghum ☐ Vegetables ☐

b) State the reasons why you grow the crops you chose in 11(a) above…………………………………………………………………………………………

13a) Do you have access to farmer credit for your farming activities?

YES NO

b) If yes, please indicate your sources of finance from the list in the table below

Source of finance	**Tick**
Government	
Non-Governmental Organization (NGO)	
Bank Loan	
Cooperative	
Individual money lenders	

SECTION B: Part 1

1 a) Do you know or are you aware of what SAPS is?

b) If you know about SAPS, have you received training in SAPS?

c) **If yes can you rate the quality of the training that you received?**

SAPS	**Excellent**	**Average**	**Very Good ,**	**Poor**	**very poor**
Tick in box					

2 a) Which of the following sustainable agriculture practices have you heard about? (Tick where applicable)

Sustainable Agriculture practices methods	YES	NO
Legume intercropping		
Crop rotation		
Mulching		
Agroforestry		

b) Rate the level at which you have implemented the following sustainable practices in the past 3 years. (Tick where applicable)

Sustainable Agriculture practices	Best	Medium	Lowest	Not at all
Legume intercropping				
Crop rotation				
Mulching				
Agroforestry				

SECTION B: Part 2

1. How have you benefited from the application of the Sustainable Agricultural Practices?

Tick your most appropriate choice from below.

SAPS	Tick
a) Improves soil fertility	
c) Increase in yields	
d) Reduce soil erosion	

SECTION C

1. a) Please indicate your sources of information from the list below and rate how the source of your information:

Information Sources	Excellent	Very Good	Good	Fair	Poor
Extension officers					
Farmer Field School					
Television					
Radio					
Social media e.g., WhatsApp messenger, Facebook					
Agriculture cooperatives					
Farmer to farmer					

b) What are the challenges in receiving agriculture information? Tick the challenges either one or all of them!

Lack of technological devices	

Late delivery of Information	

Lack of extension officers	

Absence of Information center	

2a) Have you received information about farming in the past 3 years? (Tick the most appropriate choice from below)

YES NO ☐ ☐

b) Use the table below to tick and rank the most used tool for knowledge and information support. Use the following ranking (0-2 times) Rare, (3-4 times) Moderate and (more than 5 times) Regular.

Information Sources	**Rarely (0-2 times in 3 years)**	**Moderately (3-4 times in 3 years)**	**Regularly (more than 5 times in three years)**
Extension officers			
Farmer Field School			
Television			
Radio			
Newspaper			
Social media e.g., WhatsApp messenger, Facebook			
Agriculture cooperatives			
Farmer to farmer			

3 a) Have you received any training in the past three years towards practicing sustainable agriculture practices mentioned?

Yes No

b) Kindly indicate the provider of your training…………………………………………

c) How has the training you received benefited you in your agriculture practices?

Greatly Moderately Not at all

Can you please rate your trainer's ability to deliver information for sustainable agriculture practices?

Excellent Very good Average Poor very poor

4 What would you say about the qualities of the trainer? Strongly agree to strongly disagree:

Knowledgeable not knowledgeable

5 What are some of the barriers to the adoption of sustainable agriculture practices? Choose from the list below:

Barrier	**Tick**
Lack of financial resources	
Lack of best inputs (seeds, labor, equipment	
Lack of knowledge	
Shortage of land	
Land tenure insecurity	