CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

FACULTY OF TROPICAL AGRISCIENCES

Land Tenure Systems and its Impact on Food Security in Zambia

Dissertation

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Declaration

I hereby declare that this dissertation thesis titled: Land Tenure Systems and its Impact on Food security in Zambia is solely my own investigation and authorship. The work of other researchers used to support this study is duly acknowledged. I am responsible for any limitations, errors and short comings in interpretation of literature.

In Prague 08.08.2018 _____

Ing.et Ing. William Nkomoki

Dedication

I dedicate this Dissertation to our beloved “Queen”, **Mary Banda Nkomoki** who graduated into glory land on 21st May 2018. Your works, time, belief, support, encouragements, and prayers are immeasurable and second to none. May your beautiful soul continue to rest in eternal peace our hero!!! With Lots of Love!!!

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Abstract

Food insecurity is a global challenge that is commonly debated, and secure land tenure systems and property rights to lands for smallholder farmers are imperative to achieving food security. The research aims to investigate the relationship between land property rights and food security situation of smallholder farmers in southern province of Zambia.The first specific aims of the study are to quantify the prevalence of food insecurity among the households and to determine the effect of land tenure, along with other chosen factors as determinants, on food security. Among environmental challenges, sustainable agricultural practices (SAPs) are vital for smallholder farms in Sub-Saharan Africa, including Zambia, to attain better agricultural productivity and food security status. The second specific aim of the study is to determine the factors that influence the adoption probability of SAPs, the effect of land tenure in particular. Furthermore, the study tests the association between smallholder households' SAP use and their food security. The data collection process employed a structured questionnaire survey consisting of 400 households that was conducted in Southern Zambia in 2016. The findings of the ordered probit regression analysis reveal that land tenure is a determinant on food security status. The probit regression analysis results indicate that land tenure influences the adoption of SAPs. Implementing crop diversification and agroforestry is associated with the food security status of smallholder households.

Key words: agricultural practices, food security, property rights, sustainability, smallholder farmers

Abbreviations

CFU - Conservation Farming Unit

CSO - Central statistics Office

FAO - Food and Agriculture Organisation

FCS - Food Consumption Score

GHI - Global hunger index

GDP - Gross Domestic Product

HHS - Household Hunger Scale

IFAD - International Fund for Agriculture Development

IFPRI - International Food Policy Research Institute

SAPs - Sustainable Agricultural Practices

UNICEF - United Nations Children's Fund

WFP - World Food Program

WHO - World Health Organisation

ZNFU - Zambia National Farmers Union

ZVAC - Zambia Vulnerability Assessment Committee

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PREFACE

Sustained production in terms of agricultural growth is fundamental to feeding the rural population (Sitko and Chamberlin, 2016). Given the vital role of land for rural populations, food security can only be attained if issues of land access, tenure security, and land use rights are addressed in a sustainable manner. The predominant livelihood activity in Zambia is smallholder farming mainly cultivating maize. Agriculture employs 72% of the country's labour force, with more than 60% residing in rural areas (FAO, 2015). The 2017 global hunger index (GHI) report ranks Zambia among the countries with hunger levels above Sierra Leone, Madagascar, Chad, and the Central African Republic, indicating alarming levels of hunger (IFPRI, 2018). The complexity of defining food insecurity indicates that delivering food security within the agriculture sector is challenging, and it requires multiple contributions from political will and social participation to create an enabling environment (Qureshi et al., 2015). In this regard, agricultural development is viewed as a necessary measure to combat the food insecurity that many agricultural households face (Goshu et al., 2013). Furthermore, studies indicate that land property rights are part of a one strategy to answer the challenges of food insecurity among the smallholder farmers.

According to Mulolwa et al. (2016), two main land tenure systems are used in Zambia, namely, the customary and statutory systems. Customary land authority is vested in traditional rulers (chiefs) as the custodians. Despite customary land being informally recognised, no formal consent is adhered to; therefore, there is no land tenure security or user rights. In contrast, a statutory land tenure can be leased for 99 years and is renewable. It is provided with exclusive ownership and protection from eviction, since land title deed documents, which indicate full property rights to the land, are issued. Food security is threatened as the majority of smallholder farmers lack any formal users' rights to agricultural land in developing nations (Robertson and Pinstrup-Andersen, 2010).

However, one alternative solution with regard to addressing food security issues involves the promotion of land tenure security (Holden and Ghebru, 2016). Second, to increase food security, maintaining soil fertility and higher food productivity with respect to environmental challenges are the key points to be kept in mind (Wagstaff and Harty, 2010). Lovo (2016) stressed the critical role of adopting environmentally friendly, sustainable agricultural practices (SAPs) in order to maintain soil fertility. Numerous practices such as the use of cover crops, intercropping and agroforestry were discussed to promote agricultural yields and soil conservation (Mensah, 2015).

This study analyses the adoption and food security effects of several SAPs that are relevant to the Zambian condition, such as crop diversification, intercropping, agroforestry, and the use of planting basins. The challenges in agricultural productivity are related not only to a decline in soil fertility due to a low adoption rate of SAPs, but also insecure property rights to agricultural land.

Regarding the relevance of this topic, Holden and Ghebru (2016) indicated that a research gap exists in relation to studies addressing the evident relationship between land tenure security and food security. For Zambia, less research has been carried out to explore the systems of land tenure (Jain et al., 2016). Mbow et al. (2014) highlighted the fact that despite the potential positive effects of SAPs, adopting them in practice is low in Africa. Furthermore, some researchers indicate positive relations between land tenure security, agricultural growth, and SAPs, but little research has quantified the food security aspect.

The study contributes to understanding the effects of land tenure security on food security. The study will help policy-makers in relation to land-related issues by developing plans to ensure that smallholder farmers benefit from land ownership with regard to their welfare. With respect to adoption of SAPs, the study contributes to providing information guidelines to policy-makers, so that they can gain an understanding of a range of socio-economic, farm and ecological, and institutional factors that potentially promote adoption of the practices. Broadly, the thesis can be used for understanding the implications for other countries, which are of similar condition and provide a channel for researchers to further study different attributes concerning land tenure, SAP adoption, to promote welfare of smallholder farmers (food security). The study is in line with the national policy objectives to inform policy-makers on the importance of developing land and food policies, so that they could aid farmers in Zambia to attain their full potential.

1. INTRODUCTION

1.1. Concepts of Property Rights to Land

Land is an asset of the utmost importance in different parts of many developing countries. A large proportion of the population derives their livelihood from numerous activities involving land. It encompasses the economic, social, cultural, and political endeavours of mankind (Kidido et al., 2017). Some of the challenges surrounding land are land tenure insecurity and land property rights. Sjaastad and Bromley (2000) defined property rights as "a social convention that allows individuals or groups to claim a benefit in a community or at any level, with protection enforced by the state". Land tenure security encompasses the rights that an individual or group has on land (Place, 2009). Furthermore, they defined tenure security under three dimensions, namely, type, duration, and certainty of the rights**.** According to Holden et al. (2013), land security concerning property rights to land is defined under three main rights: i) a users' rights, ii) collateral rights, and iii) transfer rights. For smallholder farmers, collateral rights are related to access to credits for the purchasing of inputs; however, this is not a major channel for smallholders with attached risks of land. Transfer rights describe the change or conversion of land from one state of tenure to another. Deininger et al. (2014) outlined the core of land tenure systems in advancing productivity based on three approaches, namely, i) the probability of land owners improving land-related investments, ii) the transfer of land to productive users, and iii) collateral for financial institutions. Holden and Ghebru (2016) contended that for smallholder farmers, whose ultimate goal is to achieve food security, strengthening users' rights is a way to achieve this goal. Figure 1 below describes land tenure security and expected outcome.

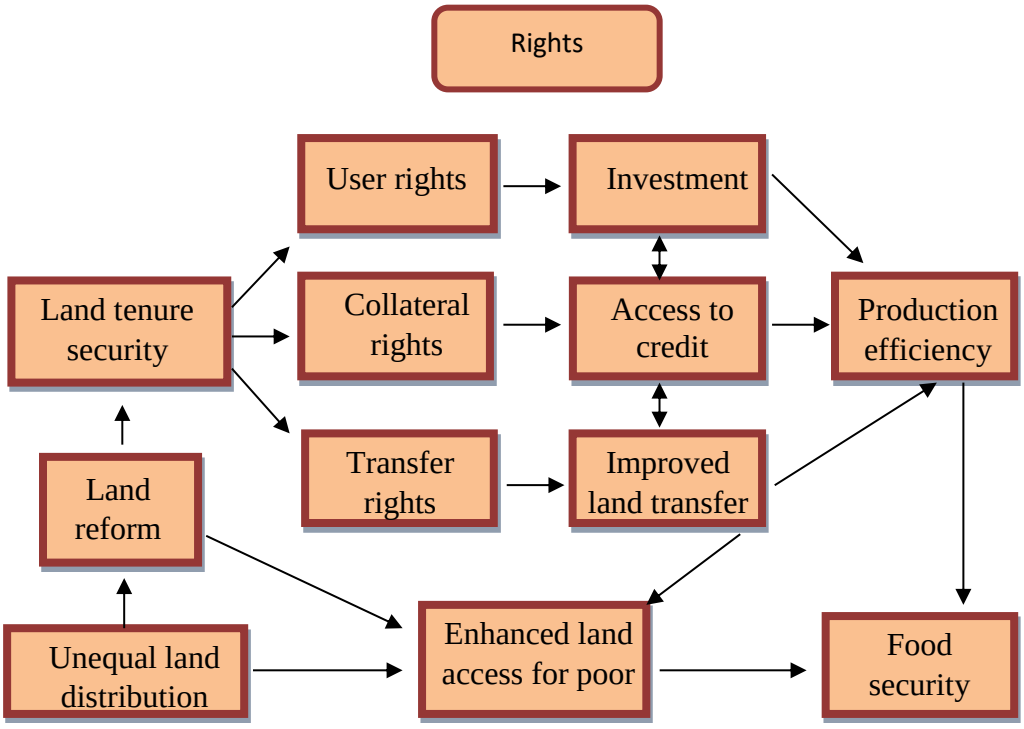

Figure 1. Land tenure security, user rights, and food security

Source: Holden et al. (2013)

Some studies have indicated the importance of land property rights. Borras et al. (2015) argued that the goal of property rights to land, especially for the poor, involves increasing their liberty with respect to land use. Powers et al. (2012) indicated that this liberty affords individuals the freedom to address issues of food insecurity without worries of domination from others in society. The individuals or groups are provided with choices to explore the social and institutional capital in order to consider valuable options. Similarly, Pena et al. (2017) examined smallholder farmers, who are land title holders (secure tenure with property rights) as well as non-title holders (insecure tenure without property rights), and they asserted that property rights provide individuals with planning and decision making for land utilisation over a longer period.

Links between land tenure security and economic performance are an important outcome. One way in which property rights impact economic output is through investments, since risks of land loss are minimal on account of secure land tenure (Besley and Ghatak, 2010). This results in less resources being devoted to pursuing the protection of rights to land, and the focus shifts to obtaining more productivity from it. From an economic perspective, the idea is to have rights to property, which do not affect or disrupt the efforts of the land owners to meet their expectations (Lipton and Saghai, 2017).

1.2. Land Access in Zambia

Zambia has a total land mass of 752,621 square kilometres (Central Statistics Office, 2012). As in many African countries, agricultural activities play a leading role in Zambia's economic, social, and environmental needs for the majority of the population. Despite the abundance of land, the possibility of agricultural growth is becoming increasingly challenging due to smallholder farmers' limitations to land access (Jayne et al., 2014). The policies on land in Zambia have remained stagnant for decades, as the policy-makers often do not consider the smallholder farmers' land constraints (Nolte, 2014). Strategies for and assessments of land distribution and governance will play an important role in reducing the challenges that smallholder farmers face in accessing land (Jayne et al., 2014). The national development plan report 2017–2021 bemoans the low access to land in Zambia, since land is a vital resource for investment, the creation of wealth, and its ultimate contribution to poverty reduction.

The understanding of the term land tenure systems in Zambia roots from the British colonial times and it was classified as crown land and customary land. The crown land was considered with private property rights to attract European farmers in the regions while the customary lands where kept for preserving African culture and created in smaller contingents of colonial administrators. Since Zambia's independence in 1964, crown land become known as statutory land and the terminologies have remained unchanged. However, agricultural settlements schemes were developed in statutory land for individual African farmers (Smith, 2004).

In Zambia, land is governed under the Land Acts of 1995 (Honig and Mulenga, 2015; Mulolwa et al., 2016). Land ownership is two-fold, namely, customary tenure and statutory tenure. Recent proportions demonstrate that 60% of agricultural land is under the purview of customary land tenure, while 40% is under the purview of statutory land tenure (Honig and Mulenga, 2015). Customary land is vested in traditional rulers (chiefs) as the custodians. Despite customary land being informally recognised, no formal consent is adhered to; thus, not only there is no land tenure security, but there is also restricted land users' rights. This raises concerns, given that many rural populations reside in customary land tenure (Mulolwa et al., 2016). In contrast, statutory land tenure can be leased for 99 years, and it is renewable. It is provided with exclusive ownership and protection from eviction, since land title deed documents, which indicate full property rights to the land, are issued (Mulolwa et al., 2016).

Farmers obtain land access in customary tenure either through inheritance or allocation by the traditional authorities; this is classified under non-market access. For an individual residing in traditional area, the chances of acquiring access to land from traditional authorities for cultivation purposes is higher. The other approach to gain access to land is through purchases classified under market access (Sitko and Chamberlin, 2016). Chamberlin and Ricker-Gilbert (2015) indicated that land rental markets in Zambia are aimed at transferring land from less productive to more productive farmers in order to enhance farm efficiency. The Land Acts provide customary land conversion formalisation, with approval from the traditional chief in charge of the area and the commissioner of lands, who is a government representative (Mulolwa et al., 2016). Sitko and Jayne (2014) asserted that a weak land administration system in Zambia has paved the way for local elites to attain large pieces of land in the customary tenure at the expense of smallholder farmers. The chiefs or traditional leaders in customary tenure are required to consult their subordinates; however, no one questions a chief's decision, due to the social status and power that they possess, (Nolte, 2014). Moreover, the chiefs are reluctant to agree to the transformation of customary land to statutory land, because their subordinates may be deprived of land access and the government is involved in the conversion process. Another attribute is the fear of losing traditional powers once land is converted to statutory tenure; the reason being that the conversion may benefit people coming from outside the chiefdom and country (Chamberlin et al., 2015; Nolte, 2014).

Land security is constrained by the lack of information, complexity, and prolonged procedures associated with obtaining land title (Ministry of National Development and Planning, 2017). Furthermore, Sitko and Chamberlin (2016) reported that the knowledge concerning the availability of land for smallholder farmers and land institutions in Zambia is outdated and inadequate. Figure 2 below highlights the mode or procedure of land acquisition in Zambia.

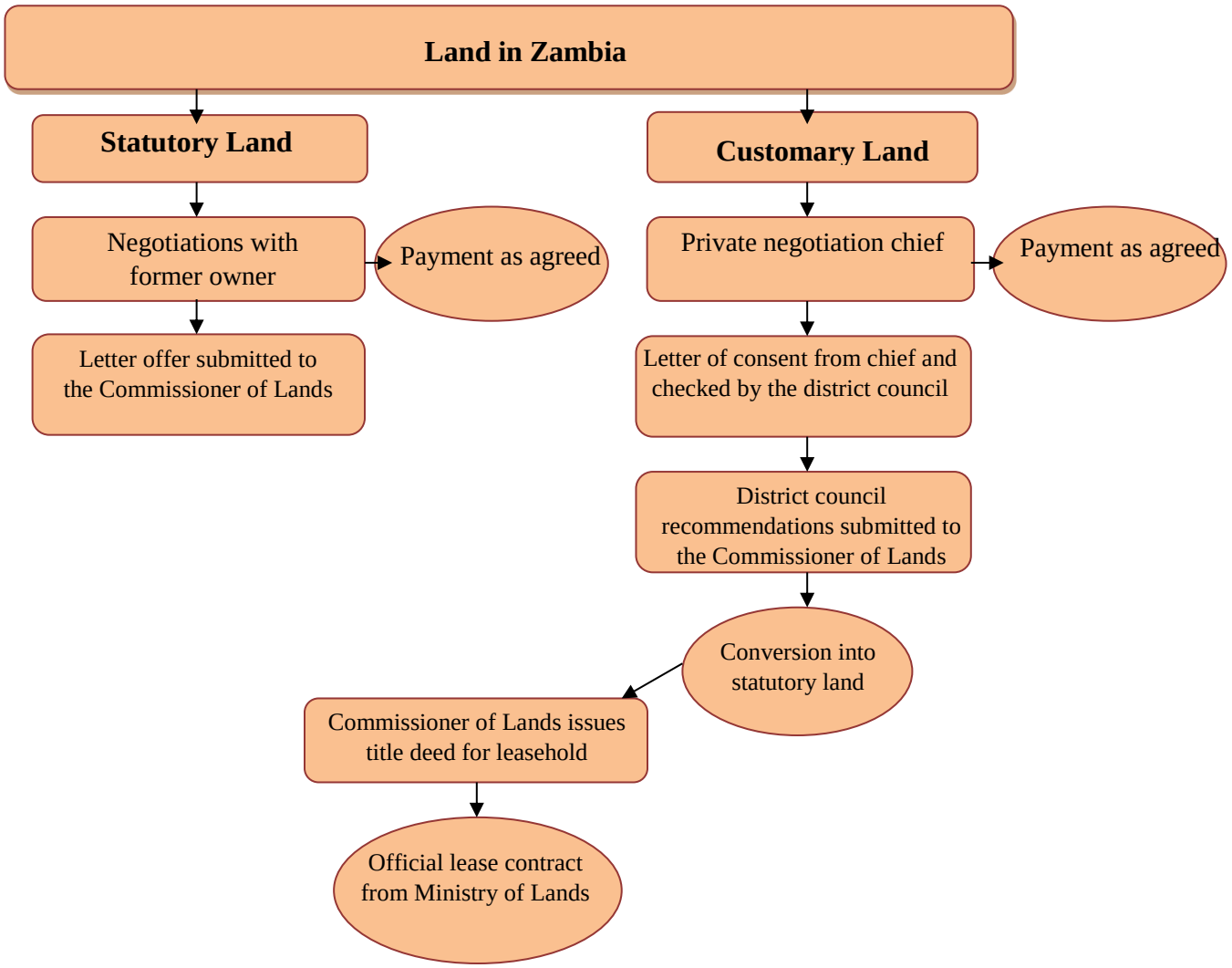

Figure 2. Process of land acquisition in Zambia

Source: Nolte (2014)

1.3. Implication of Large Scale Land Acquisition in Sub Saharan Africa

Following the food price crisis of 2007–2008, the demand for land acquisition in Africa was on the rise and a major concern arose for rural communities with regard to the loss of their lands. Anseeuw et al. (2012) indicated that Zambia is one of the countries targeted for land investments and agriculture productivity along with Sudan, Ethiopia, DR Congo, Tanzania, and Mozambique. Further, their study demonstrated that the majority of land acquirers are from the US, countries of the European Union, China, Brazil, and Gulf countries such as Qatar, Saudi Arabia, and United Arab Emirates. In their support, Schoneveld (2014) highlighted that over 22.7 million ha of land have been acquired from Sub Saharan Africa. He further said that about 52% of the total area acquired for foreign investments cover six countries, namely, Ethiopia, Zambia, South Sudan, Mozambique, Ghana, and Madagascar. The researcher elaborated that the acquired land was used for cultivating oilseed, accounting for 60%, timber (15%), sugar crops (13%), food crops (7%), and others focusing on traditional crops for export.

The debate of the impacts of large-scale land acquisition on small-scale farmers has been raised in some studies. This is a concern that majority of the farming communities in developing countries are smallholders. von Braun and Meinzen-Dick (2009) stated that the negative impacts, related to large acquisition, on smallholder farmers have been the land displacements and water constraints, which have resulted in exacerbated threats of food security in already prone regions. Matenga and Hichaambwa (2017) conducted research on the effects of agricultural commercialisation on livelihoods in Zambia. They not only highlighted the fact that the search by foreign investors in the African farmland poses a challenge to the output of African agriculture, but also came up with suggestions concerning which direction it should take to counter the threat. In addition, they stressed that this situation has resulted in the emergence of challenges to the right of land for smallholder farmers. The large-scale land acquisition has given rise to negative options or paths for smallholder farmers, such as out grower schemes and contract farming with commercial farmers. In Zambia, acquisition by the urban elites, and local and foreign investors, has resulted in the size of farm sizes for these groups to rise, accessing between 5 and 100 hectares of land, while affecting the smallholder farmers, who experienced a reduction (Sitko and Jayne, 2014).

However, on a positive side, von Braun and Meinzen-Dick (2009) pointed out some benefits of foreign land acquisition, such as technological spillover, creation of waged employment, and

infrastructure development. In addition to the benefits, Kleemann et al. (2013) argued that the smallholder farmers have benefited in foreign land investments via knowledge transfer through training, extension services, and advanced agricultural technologies. Nevertheless, De schutter (2011) asserted that the benefits are undesirable, as host countries fail to govern the foreign investments in relation to achieving poverty reduction. Nolte's (2014) study in Zambia added that despite the investors being required to develop the properties at a defined time through infrastructure development, the enforcement from the lawmakers on land governance is weak. Kleemen et al. (2013) asserted that weak legal processes and the uncertainty of the acquisition process of large lands has resulted in smallholder farmers losing their land without compensation. They suggested strong consideration be given to local population and respect be shown for their rights. Figure 3 below illustrates the area of foreign land investments in Sub Saharan Africa in hectares.

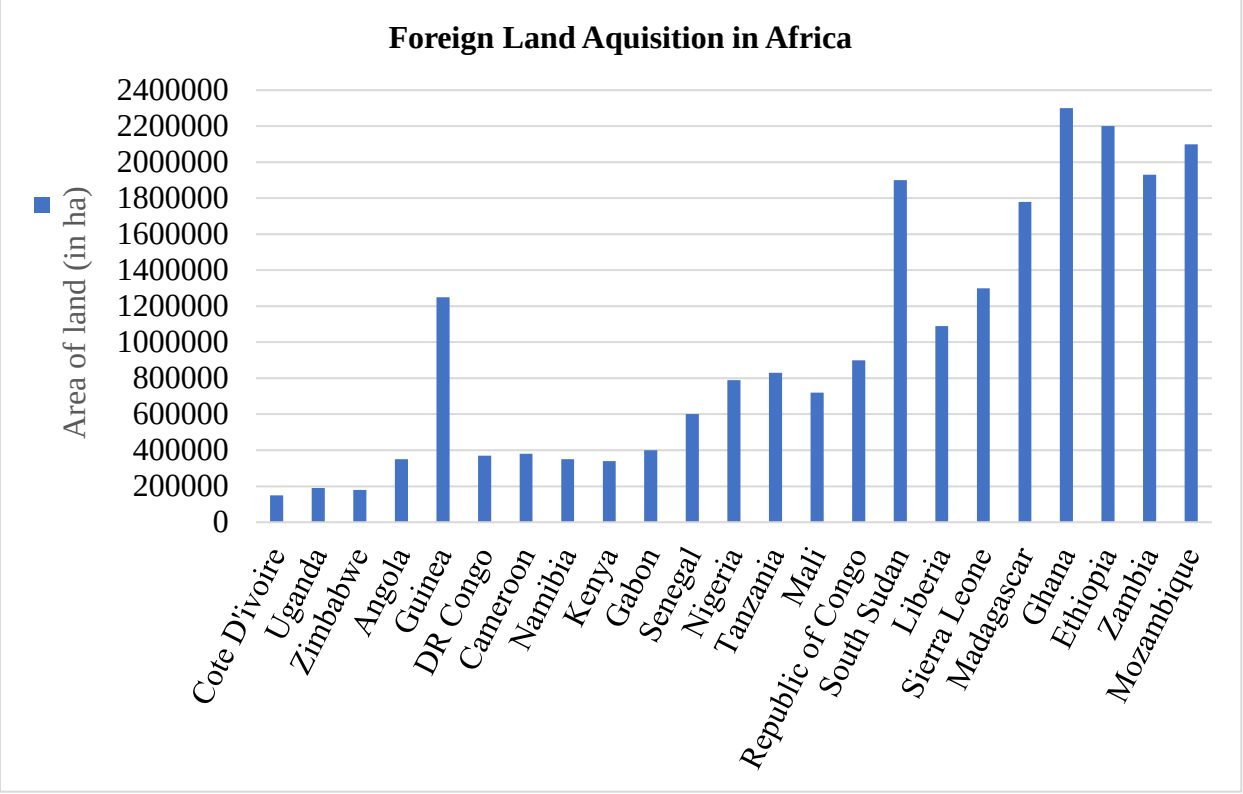

Figure 3. Foreign land acquisitions in Africa

Source: Schoneveld (2014)

Figure 4 below shows the origin of the countries and the amount of land that has been acquired in Sub Saharan Africa.

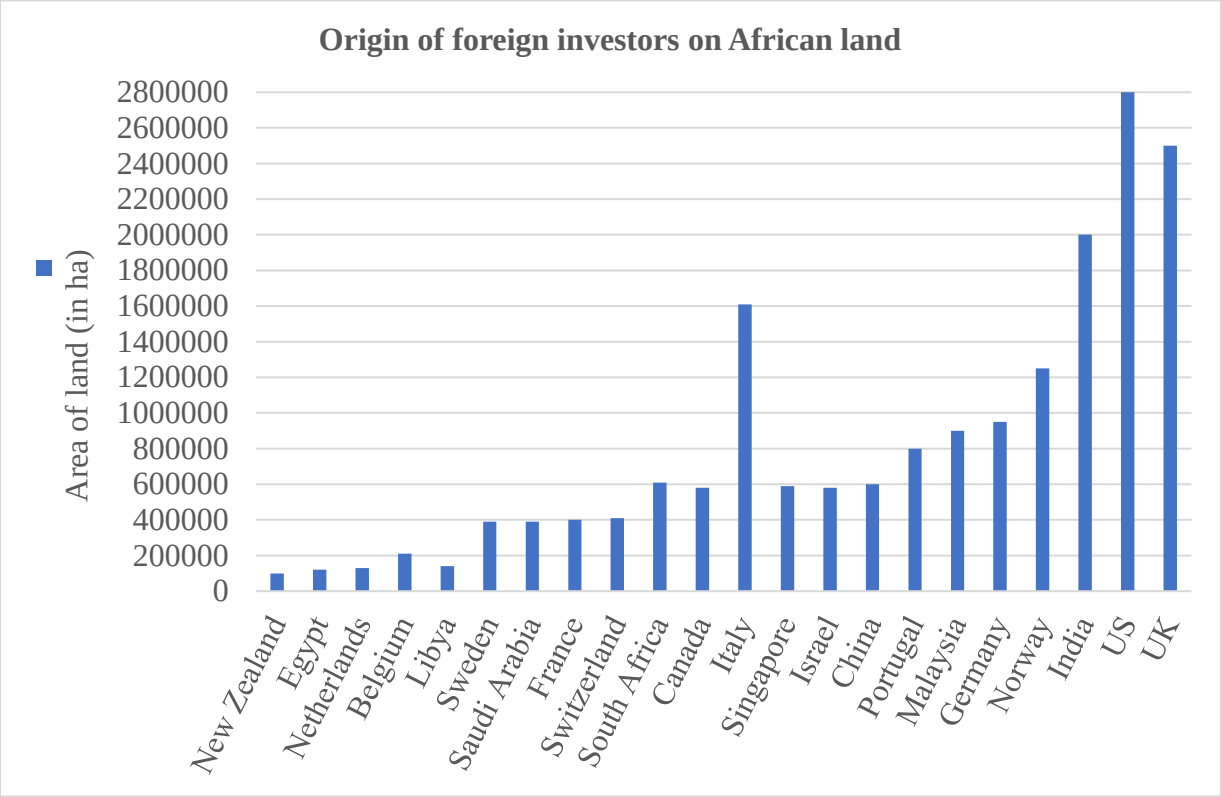

Figure 4. Country of origin for land investors

Source: Schoneveld (2014)

1.4. Strengthening Customary Tenure System: Tenure Security and Limitation

Tenure security is described as the both the level of protection of land rights and the duration that one holds onto these rights (Holden et al., 2013). The whole set-up of land is a highly compelling issue, with the economic interest in land posing a challenge to customary tenure systems, due to the lack of clear property rights. Studies have employed and adopted different indicators to measure land tenure security, for example, the duration of land ownership and possession of land title (Place, 2009). Deininger et al. (2008) identified three indicators to measure land tenure security, which are as follows: i) the perception of land owner on the risk of losing land, ii) inheritance (the likelihood of transferring land to others and not offspring), and iii) a measure of land that is acceptable as collateral. Furthermore, Deininger et al. (2012) highlighted a measure of land security as land certification, perception of land conflicts, and the portion of land with agricultural investment. In many African countries, customary land tenure is characterised by

restricted land rights, and it is the major tenure, compared to statutory land tenure, which is provided with comprehensive land property rights (Alden, 2011). In attaining social justice regarding land holdings, Boris et al. (2015) revealed that land reforms were, and will continue to be, a crucial policy approach. Furthermore, Boris et al. (2015) indicated that the strengthening of land rights is critical for customary land tenure systems in Africa with regard to enhancing food sovereignty.

Alden (2011) suggested that the formal recognition of customary land is inevitable as a source of land rights, especially for smallholder farmers. This can be brought about through the provision of land certificates to strengthen customary tenure, as has been seen in Malawi, Tanzania and Uganda. In support, Van Leeuwen (2014) indicated that formal land recognition in customary tenure may be employed through policies of land titling to landholders. However, the constitutional land rights of poor rural populations are impeded by a lack of education and awareness, which limit their claims to land. If this issue of land is not handled well, it raises social relation issues in the form of undemocratic classes benefiting at the expense of the targeted group that the reforms are meant to benefit, gender discrimination, and ethical divisions, leading to a high potential for conflicts. Similarly, interventions to strengthen land rights in customary tenure include recognising the provision of documents to formalise rights to use land through land right policies (Lawry et al., 2016).

Furthermore, Lawry et al. (2016) revealed that the conversion of customary land is a common approach to providing property rights. However, the challenge in converting a customary tenure system to a statutory system is attributed to the high costs of the titles and registration processes. This is in line with earlier studies; Deininger et al. (2008) argued that land titling may not always provide property rights (security) to women in joint ownership, thereby creating inequality. Besides, the cost of registration for titles may exclude many smallholders in the communities in Africa. In other African countries, smallholder farmers on customary land depend on the transfer of land to statutory status for improved productivity in agriculture (Deininger et al., 2017). Similarly, Sitko and Chamberlin (2016) suggested policies focused towards user rights as an approach for smallholder farmers in customary land to be protected against local elites in Zambia. This will promote equal land access for the smallholder farmers and enhance viable agriculture production in Zambia. More importantly, these policies should be legal, with a clear recognition of the fact that they benefit the locals in land title acquisition and market transactions. One of the

assertations is that once more land is acquired by elite at the expense of locals, the income inequality in rural areas will increase. Meinzen-Dick and Mwangi (2008) indicated that caution must be observed when dealing with issues of land property rights, citing Kenya, where the aim of strengthening private users' land rights in communities resulted in the marginalisation of the local people. Holden and Ghebru (2016) highlighted that customary and statutory tenure rights usually create conflicts among the groups involved.

1.4.1. Land Inequalities

Achieving equity in land access is key for smallholder farmers. Gender inequality is exhibited in many forms, such as tenure security, access to productive assets, and the negative perception of females as potential farmers (Githinji et al., 2011). Land inequality is divided into the following two forms: i) the ascribed form (through inheritance), which in some cases deprives one of fair opportunities, and ii) the well-being of individuals (the relevant outcome), wherein the powerful individuals in society own more. This highlights the need to enforce land rights across the board. However, in customary tenure, the powers of land ownership usually favour males rather than females (Deininger et al., 2014). With regard to land inequality, Lipton and Saghai (2017) reported that reducing land inequalities in developing countries is required to attain the overall better gini coefficient. The assumption is that more land will be shared among a broader group, comprising the powerful (elite) people in the society and poor groups, who are usually the women and youth. According to Sitko et al. (2014), 89.3% of the smallholder farmers on customary land do not have titles to the land, while those on statutory land account for 96.1% of farmers with land titles in Zambia. As earlier studies have demonstrated, the land title acquisition is bounded by a complex, bureaucratic process and high transaction costs, which eventually constrain smallholder farmers, who end up been evicted from their farming land. Figure 5 shows the national distribution of smallholder farmers with land titles.

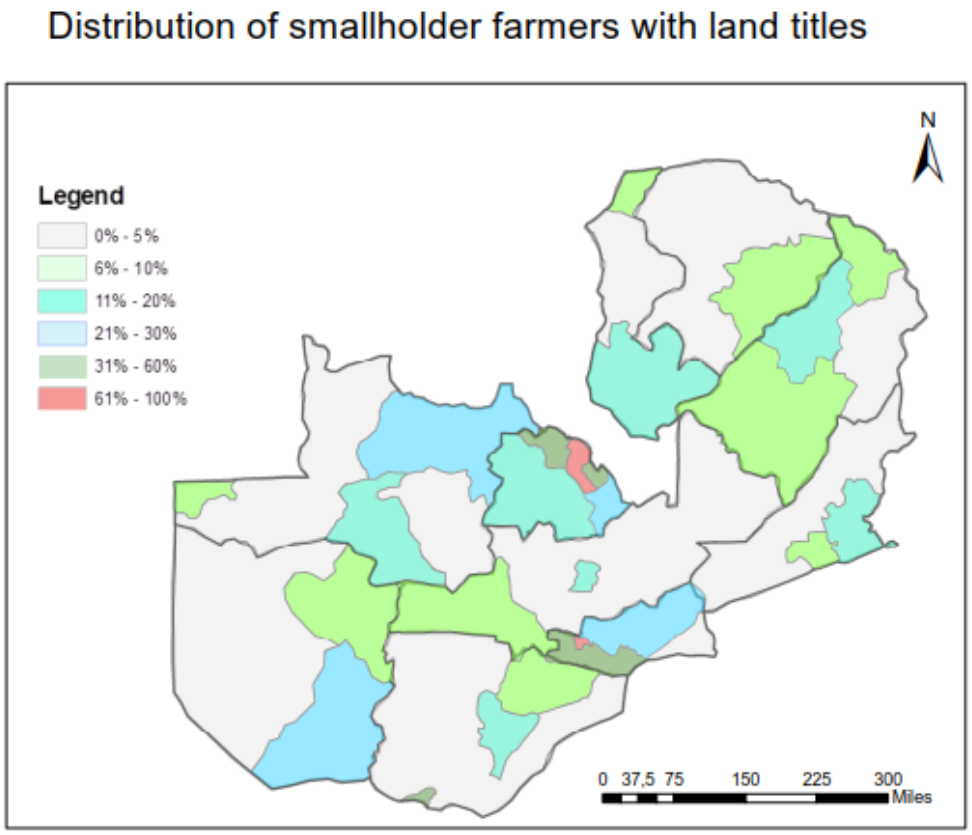

Figure 5. Distribution of smallholder farmers with land titles in Zambia

Source: Adapted from Sitko et al. (2014)

1.5. Climate and Agroecological Regions in Zambia

Zambia is a landlocked country located in the central parts of Southern Africa and bordered by eight countries. To the south bordered by Botswana and Zimbabwe; to the east by Malawi; Mozambique to the south east; to the north Tanzania and the Democratic Republic of Congo; and to the west by Angola and Namibia to the south west. The climate of Zambia is generally moderate that is divided into three seasons namely rain season (November to April), cold season (May to August) and hot season from September to October. The summer temperatures go up to maximum of about 35˚Celsius with variations in the annual distribution in temperatures and precipitation (Thurlow et al., 2009).

Zambia's land mass of 752,620 square kilometres is divided in three agroecological regions, namely, I, II and III. Figure 6 below illustrates the division of Zambia's agroecological regions.

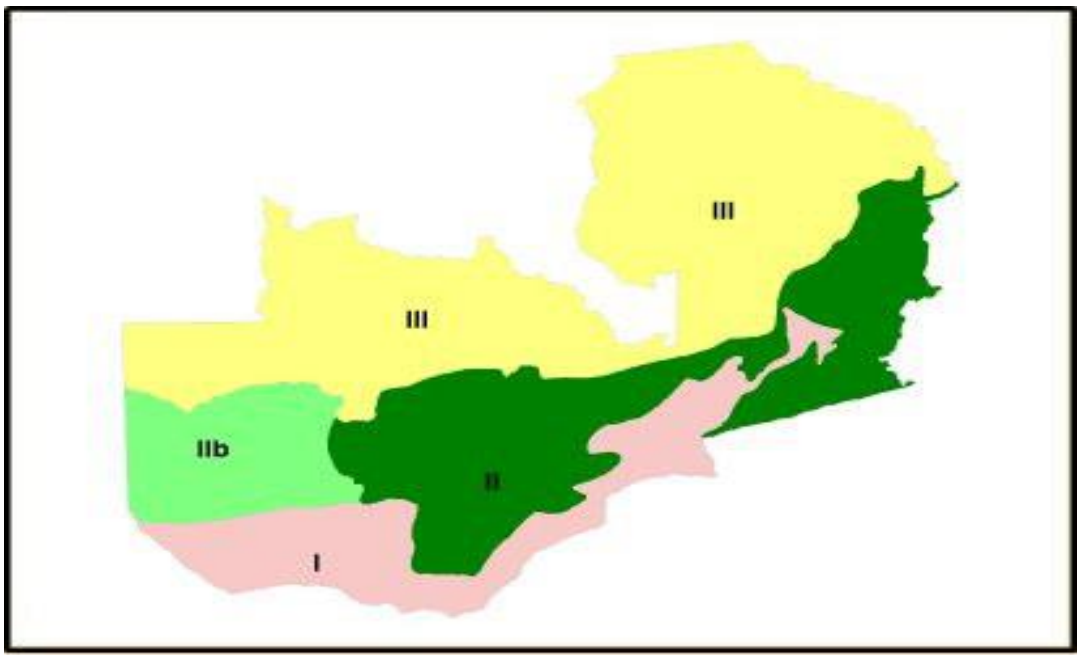

Figure 6. Zambia agroecological regions

Source: MACO (2011)

The areas that are covered in region 1 include the Eastern, Western, and Southern part of Zambia, with a mean annual rainfall below 800 mm. The land area covered is about 12% of the country's total land. The main agriculture activities include cattle rearing and cultivating crops resistant to drought such as sorghum and millet. The pedological aspect consists of fine and shallow soils on escarpment and loamy to clay soils in the valley. In region two, the land accounts for 42% of the country, receiving a mean annual rainfall range of 800 mm to 1000 mm. This zone mainly produces crops such as maize and groundnuts. The provinces included are Lusaka, Southern, Central, and Eastern fertile plateau. It is further divided into IIa and IIb. The third region is the largest in terms of land area (46%). The annual mean rainfall goes up to 1500 mm. It comprises the Northern, North-Western, and Luapula provinces (MACO, 2004).

1.6. The Agricultural Sector in Zambia

Agriculture contributes 10% of the gross domestic product (GDP). It declined from 21% in the 1990s to 18% in the 2000s (FAO, 2015). The dominant livelihood activity in Zambia is smallholder farming, mainly the cultivation of maize, which is the staple food. The Government of the Republic of Zambia classifies the farmers under three different levels with respect to advancement in technology and size of the farm. These classes of farmers are small scale, medium and commercial farmers. The small-scale farmers are characterised with farm size of less than 5 hectare, they apply the indigenous way of farming, lacking in technology and focus on subsistence production for home consumption and cultivate the land manually using hand hoes or hired oxen. The largest producers are small scale farmers, however, they are also categorised as the most vulnerable to and affected by food insecurity, producing on an average land size of 1.5 hectares, mainly in customary land. The second level consists of medium scale farmers who cultivate farm sizes of about 5 to 20 hectares. They are a bit advanced in technology with a combination of draught power and tractors. The highest level constitutes the large farmers who utilise advanced technology and mechanisations in production. Their production is market oriented and concentrate on growing for the export markets (Sitko et al., 2011: Sipangule and Lay, 2015)

Maize production accounts for a larger proportion with 89% of the households cultivating it, groundnuts accounting for 51% and 34% cultivating cassava. The average national maize production is in the range of 1.4 tons/ha 2.6 tons/ha which is lower than the 5 tons/ha target set by the Comprehensive Africa Agricultural Development programme (CAADP) (Chapoto, 2016). Food and nutritional security is usually based on the availability of the staple crop maize in Zambia. Maize has annual per capita consumption of about 133 kilograms and it provides more than half of the caloric requirements in the households. Mason et al. (2015) highlighted the fact that despite more than 80% of smallholder farmers growing maize, only 30% of the rural population could produce surplus. Smallholder farming is categorised by low productivity, which is mainly oriented towards meeting household needs, the lack of markets, and high levels of poverty (Chapoto, 2011). Chamberlin et al. (2014) studied maize yields in different agroecological districts in Zambia and their findings revealed that smallholder farmers attained about 40% of estimated yields for low-management levels. The potential for attaining an increase in cultivated land and agricultural production volumes is high, given that Zambia utilises only about 14% of approximately 58% of its arable land (Ministry of Agriculture and Co-operatives, 2011). With

respect to crop production for smallholder farmers at household level, who are largely dependent on rainfed agriculture, the potential contribution from an agricultural point of view to reduce poverty is contexualised towards agricultural incomes, rural livelihood strategies, and gain in yields due to agricultural innovations (Harris and Orr, 2014). They further suggest that careful consideration of farm sizes, which are affected by lower agricultural productivity, aids in adopting a specific technology to improve crop production. They said that for small land sizes, the returns obtained from crop productivity were lowered to raise the farming households out of poverty in Africa and India.

1.7. Governmental Support to Agriculture

Zambia is a member of the 2003 Maputo declaration on Agriculture and Food Security and the Comprehensive Africa Agricultural Development programme (CAADP), which has resolutions from signatory countries to attain a 6% annual agricultural growth by allocating at least 10% of budget allocation to the agriculture sector. In support to this, the Zambian government launched the National Agricultural investment plan (Chapota and Chisanga, 2016).

The government of Zambia provides support to agricultural sector at different levels through different institutions, with the ministry of agriculture and livestock undertaking a leading role. In case of research, some of the institutions include Zambia Agriculture Research Institute, Golden Valley Agricultural Research Trust, University of Zambia, and the National Institute for Scientific and Industrial Research (PARI, 2015).

To the farmers, one of the notable programmes is the Farmer input support programme (FISP) that aims to provide subsidised fertilizers and seed. The programme is implemented through cooperatives and farmers groups, with conditions for beneficiaries to be able to grow maize on an area of 1 to 5 hectares and pay input costs, which go as high as 50% (Mason et al., 2013). The major challenge with FISP is late delivery of farmers inputs and poor targeting of beneficiaries. According to Saenz and Thompson (2017), subsidy programs in Zambia were introduced in the year 2000 to support farmers with agricultural input at lower prices. They documented that in order to enhance agricultural productivity in poor income countries and food insecurity-stricken countries, many African governments had developed subsidy programs.

Good market accesses are more visible in regions that are along the line of rail as these areas have good infrastructure development in Zambia (Sitko and Chamberlin, 2016). The farmers main crop

market is divided between the Food Reserve Agency (FRA) and the private sector. From the year 2002 the government mandated the FRA institution to purchase agricultural produce from farmers on its behalf. The purchased crop is stored and later sold to millers via a tender process, sometimes sells the maize on a below market price to consumers and for relief aids in times of need.

1.8. Agricultural Knowledge Acquisition in Zambia

In this survey area, the sampled farmers learnt the different aspects of agriculture mainly by sharing their knowledge through networking in farming groups and/or information dissemination by extension services. Agriculture extension support is further coordinated by the Ministry of Agriculture and cooperatives through extension workers. It provides agriculture-related information on television and radio, and organises agriculture shows, at the district, provincial, and national level. Agriculture extension is important as it helps farmers to decide on whether to choose new technologies and increase production.

1.9. Effects of population density on farm sizes

Zambia has a population of about 14.6 million people and is regarded among the most land abundant countries in Sub Saharan Africa (Sitko and Chamberlin, 2016). The issue of population densities is profound for agricultural dependent economies. This affects farming systems and impacts on farm size cultivation, land constraints, and farmers' livelihood strategies. Much of the population in Sub Saharan Africa resides in rural areas and the challenge has been in relation to population growth, and how it affects farm sizes and agricultural output. Despite the importance of population densities regarding African agriculture, Josephson et al. (2014) bemoans the lack of studies. The way smallholder farmers react to the population densities eventually impacts their food security status.

A study by Muyanga and Jayne (2014) focused on the impact of population densities on land pressure in Kenya. They indicated that with an increase in population density by 100 persons per square kilometer, land size holdings reduced by 16% and area under cultivation declined by 17%. The interpretation shows that an increase in population density is associated with small land sizes, which forces intensive use of available land. In their study, they suggested that policy-makers should consider smallholder-led agricultural strategies by increasing their access to land through land redistribution in order to promote equality in landholdings. Similarly, Ricker-Gilbert et al. (2014) conducted a study in Malawi, looking at the effects of population densities on agricultural

intensification and household welfare. They demonstrated that an increase by 100 persons per square kilometer reduced farm size by 10%. The implication is that the densely populated areas shifted to high dependence on off farm incomes as a source of livelihood. On the other hand, Jayne et al. (2014) looked at land pressure and farming systems in Africa; they indicated that the rise in population densities has resulted in smallholder farmers continuously cropping their farms without any fallowing, which has led to unsustainable practices and a rise in degradation of soil quality. In Zambia, Jayne et al. (2104) indicated that about 68% of total arable land was available for cropping expansion.

Josephson et al. (2014) studied the impacts of population density on agricultural intensification productivity among smallholder farmers in Ethiopia. They found that population density is associated with smaller farm size, indicating that the farmers in high density populations are restricted to the same places and unable to sustainably intensify with declining land sizes. One of the factors attributed to decline in farm sizes is that as population increases, the parents tend to divide land amongst their children. This situation is worsened by the land tenure insecurity, which does not allow many farmers to invest more in the lands they cultivate.

Some negatives are attributed to population growth and land size; Josephson et al. (2014) argued that an increase in population and a reduction in farm size has resulted in a decline of household farm incomes per adult equivalent, as the members in the households are increased and divided into smaller amounts. However, they further argue that in cases where land rentals or share cropping is well established, despite the decrease in land sizes, the land cultivated may not decrease much and family area of cultivation may still be considered high.

The literature of Jayne et al. (2014) estimated a rural African population of 63% under 25 years of age by 2015, which resulted in the pressure of creating employment opportunities in the agricultural and non-farm sectors. They argued that for agriculture to be able to attain this youthful population, access to land, technology, and the profitability of the sector must be attractive.

1.10. Food Security Definitions and Dimensions

Food insecurity is a global challenge and an ongoing concern, with its dimensions of food availability, access, utilisation, and stability yet to be achieved (Rockson et al., 2013). Food insecurity and undernourishment are on the rise worldwide, from an estimated 777 million people in 2015 to 815 million people in 2016. This increase is a global concern with regard to achieving the second sustainable development goal, which calls for a commitment to end hunger, reduce food insecurity, and improve nutrition by 2030 (FAO, 2017). Food security is prioritised globally in the sustainable development goals (Conceição et al., 2016), and this challenge is more severe and dominant in Sub Saharan Africa (Ogundari, 2017). The majority of food-insecure populations reside in Africa, which is home to a larger number of the poorest and most poverty-stricken countries in the world (Nkegbe et al., 2017). The concept of food security has been raised at different levels, such as individual, household, regional, national, and global levels (Santos et al., 2014). Many international agencies, such as the World Bank, the Food and Agriculture Organisation, and the World Food Programme, have been influential in addressing this topic.

The World Food Summit has defined food security as a situation in which all people always have access to adequate, safe and healthy food to meet their dietary requirements for a productive and healthy life (FAO, 1996). The elements of food security include quantity (sufficiency), which highlights physical and economic access, and quality (diversity), which describes the nutrition aspects of food that meet dietary needs. The other elements cover acceptability, which deals with food preferences, and food safety and stability, which refer to the presence of food at all times (Coates, 2013). The work of Lovon and Mathiaseen (2013), which followed studies from Malawi, Nepal, Uganda and Guatemala, has demonstrated that poor households mainly consume the staple and vegetables.

The dimensions of food security are categorised into four core pillars, namely, availability, access, utilisation, and stability. Food availability is defined as having adequate food quantities of an appropriate quality (Carletto et al., 2013). Furthermore, it describes the physical presence of food in a household, if the quantities are sufficient and consistently available to all (Jones et al., 2013). Bashir and Schilizzi (2013) stressed that food availability can be achieved through different means, for example, from own production and food assistance. Food access refers to a household's or an individual's ability to acquire enough entitlements (resources) in order to obtain appropriate food

for nutritious diets (Carletto et al., 2013). The entitlements are defined as a set of commodity bundles that a person can have or establish command over in a community, with the support of the economic, political, social, legal, and traditional framework in which one lives (Jones et al., 2013; Santos et al., 2014). Food utilisation encompasses the nutritional aspects, including food safety, essential nutrients, and proper sanitation. Some important factors to ensure food utilisation include household food storage and food processing techniques (Thompson et al., 2010). Food stability connotes having adequate food all the time, regardless of the different shocks that may arise due to economic, social, or environmental conditions. This deals with issues of food seasonality to meet future needs, for example, the time before harvest and after harvest (Carletto et al., 2013). According to Leroy et al. (2015), food stability cuts across all three dimensions of food security, where food is available, accessible and adequately utilised across the season. The component of food availability has been widely studied, followed by food access, but less work has been carried out on food utilisation. This is according to the meta-analysis conducted by Bahir and Schilizzi (2013) on food security studies in Africa and Asia.

1.10.1. The Status of Food Security in Zambia

A study conducted by Sitko et al. (2011) revealed that only 36% of the households in Zambia were food secure. Chapota et al. (2011) indicated that the levels of rural poverty accounted for 80% of poverty in Zambia, and they have practically remained unchanged for the last 15 years. This was further emphasised by Nyanga (2012), who revealed that approximately 44% of Zambia's population was food insecure. The prevalence of undernutrition has continued to worsen from 32% in the 1990s to 42% in the 2000s, and it is currently at 48% (FAO, 2015). For Zambia, achieving the second sustainable development goal, which focuses on ending hunger, attaining food security, and enhancing nutrition by 2030, will be a challenge if no major timely policies are formulated. The 2016 global hunger index report (GHI) ranks Zambia third highest in relation to world hunger levels, after Chad and the Central African Republic, indicating alarming levels of hunger (IFPRI, 2017). According to Chapoto et al. (2016), the average national poverty levels range from 60 to 76% in Zambia. The highest poverty levels are reported in the Western province that account for about 83%.

1.11. Land Tenure Systems, Smallholder Agriculture and Food Security

In Sub Saharan Africa, access to farmland is a major determinant in defining the households as food insecure and vulnerability (Chamberlin and Ricker-Gilbert, 2015). Many Sub Saharan African economies are predominately dependent on smallholder agriculture. However, the sector has failed to achieve expectations in terms of production (Kassie et al., 2013). Persistent food insecurity has come about as a result, and it is exacerbated by land tenure systems that inhibit investments in agriculture (Kuusaana and Eledi, 2015).

With low production from smallholder farmers in Africa, some researchers have argued that no substantial contribution can be made to food security (Baiphethi and Jacobs, 2009). However, they indicated that land property rights are one strategy to answer the challenges of food insecurity among the smallholder farmers. Food security is threatened as the majority of smallholder farmers lack any formal users' rights to agricultural land in developing nations (Robertson and Pinstrup-Andersen, 2010). The literature of Holden and Ghebru (2016) has highlighted that higher numbers of landless people cause threats to food security in poor countries. However, one alternative to addressing this issue involves the promotion of land tenure security. Deininger et al. (2014) indicated that the concerns regarding land issues are prominent in most African countries due to lower agricultural productivity. This has led to issues of land rights gaining more attention, and land ownership being viewed as a major determinant in households to bargain for power. Headey and Jayne (2014) noted that issues of land constraints are of relevance in Africa, and the land tenure systems are part of that concern to ensure food security (Rockson et al., 2013).

A study that Chirwa (2008) conducted in Malawi focused on land tenure systems and food production, and the results have indicated that households that had a change of land tenure systems from customary land reported high maize production and an increase in food security. Furthermore, Barrette et al. (2009) reported a positive contribution of land tenure to agricultural production and revealed its direct link to food security. Sambizi et al. (2013) investigated the role that tenure security plays in rural, poor Sub Saharan Africa, and their findings have indicated that land security is a major determinant of food security. In addition, Holden and Ghebru (2016) recognised that enhanced agriculture and productivity eventually lead to improved food security. Mwesigye et al. (2017) indicated that private ownership yielded higher outputs when compared to customary land tenure systems in Uganda. A private owner was considered to have secure land

rights in comparison to the customary land tenure with limited land use rights. Michler and Shively (2014) studied the relationship between land tenure and efficiency in farm productivity, and their findings have indicated that land tenure had an effect on farm productivity. Moreover, research by Mendola and Simtowe (2015) in Malawi indicated that access to a secure productive resource such as land enhances food security. A study by Santos et al. (2014) analysed the land allocation and registration programme in India's West Bengal to evaluate whether government-allocated land contributed to food security. Their findings revealed that no statistical significance was observed to impact food security on government land. With regard to the relevance of this topic, Holden and Ghebru (2016) indicated that a research gap exists regarding studies addressing the evident relationship between tenure security and food security.

For Zambia, less research has been carried out in exploring the land tenure systems (Jain et al., 2016). The study by Smith (2004) in Zambia demonstrated that formal land titles enhanced fixed investment and were more profitable, with positive and significant results for titling on agricultural productivity. Merten and Haller (2008) studied the effect of property rights on child growth and the food security of households in customary land tenure in Zambia, and they found that insecure property rights in that type of land tenure affected the food consumption pattern of the households. Sitko et al. (2014) analysed the effects of land titling among smallholder farmers with the objective of determining if it enhanced growth in agriculture. The results did not demonstrate any statistically significant differences between title and non-title holders.

1.12. Sustainable Agricultural Practices

Kristjanson et al. (2012) argued, based on a study in East Africa, that agricultural production is crucial to the enhancement of food security. In developing countries, food security is dependent on the sustainable use of natural resources, which is supported by secure land access. This demonstrates the significance of land tenure and property rights that allow households to use land and participate in agricultural activities (Richardson, 2010). Food production for smallholder farmers in Sub Saharan Africa is considered a major challenge and it is limited due to loss of soil fertility on farms. Kassie et al. (2013) identified adoption of SAPs as one of the ways to manage this challenge in the region. The challenge of dwindling natural resources and susceptible natural environment poses a significant challenge to the global food systems in providing food for people (Fan and Brzeska, 2016). They contended that to achieve a sustainable food security and nutrition,

approaches need to focus on agriculture research and development, reformed institutions, and infrastructure development to reduce trade-offs. Lopez et al. (2018) asserted that given the diversity of farming systems, proper understanding of the social ecological processes is imperative for interventions for livelihood strategies. They further argued that for farmers in high-cereal production, the efficiency use and management of resources must go hand-in-hand with the farmers' abilities and interest to invest in a variety of techniques for resource endowments. Natural resource use, food security, and small-scale farming are important topics in relation to Zambia's development strategies.

The government of Zambia seeks to achieve food security by promoting agricultural productivity through practices such as conservation agriculture. These practices are promoted through the Conservation Farming Unit (CFU) – a non-governmental organisation in Zambia – whose activities are conducted in collaboration with a national association called the Zambia National Farmers' Union (ZNFU) that represents the farmers and the agricultural industry. The focus of both organisations is on disseminating information to farmers regarding the major farming practices that result in reduced soil disturbances, permanent soil cover, crop rotation, nitrogen fixation, and ameliorating soil fertility (Andersson and D'Souza, 2014).

The decision-making process on adoption of an agriculture innovation is a complex process. It poses a challenge for many smallholder farmers as they have to decide on whether to adopt a practice that is being promoted or adapt to the already existing practices. Meijer et al., (2015) indicated the low adoption of agricultural innovations in Sub Saharan Africa, despite the huge potential and benefits, alluded to it. They furthermore asserted that factors such as knowledge, perception, and attitude of technology adopters can ensure sustainability, as they tend to capture the farmers preferences; however, few studies have focused on such factors. In support, Coulibaly et al. (2017) indicated that knowledge attained through training provides farmers with capabilities and skills to efficiently manage agroforestry in Malawi. The farmers' awareness about information on practices, and dissemination of better farming practices, is vital. Furthermore, they highlighted that the perception of farmers on farm problems positively influence the adoption of enhancing practices. With regard to relationships in gender and adoption of improved agricultural practices, Mutenje et al. (2016) suggested a simultaneous focus on male and female roles in agricultural activities will provide an opportunity to maximise available innovations.

To identify the most common SAP adopted by farmers in the selected areas, we included the question of "Which of these practices, if any, have you adopted in your farming?" into the questionnaire. The following choice possibilities: crop diversification, inter-cropping, fertilizer trees, green manures, mulching, animal manures, cover crop, and planting basins. Some of the common SAPs in Zambia and those adopted in this study include crop diversification, intercropping, agroforestry, and planting basins.

Crop diversification is defined as cultivating a range of crops on the same farmland. The typical arrangement is cereal, legumes, and tubers. The risks of complete crop failure in times of shock are reduced as crops are affected differently (Gebrehiwot and Van der Veen, 2013).

Intercropping describes the cultivation of two or more different crops at the same time and in the same planting space. A typical example in the study area is maize intercropped with legumes (groundnuts or beans); the ecological benefit is that the legumes supply nitrogen to the cereal. The expectation is that the farmer can harvest two crops in one season and hence improve income levels.

Agroforestry is a tree-based practice for the purposes of nitrogen fixing with fast-growing

shrubs or trees (Altieri et al., 2012). The assumption is that it contributes to higher crop yields, replenishes soil fertility, and protects against wind and soil erosion (Thangataa and Alavalapati, 2003). The CFU programme in Zambia promotes agroforestry as one of the SAPs to enhance nitrogen fixing in agricultural fields (Ngoma et al., 2015). Agrofestry is attributed to climate change adaption measures, nitrogen fixation of soils that improve their fertility, and eventually increasing nutrient supply for improved food production and food security (Coulibaly et al., 2017).

Different factors affect the adoption of agroforestry practices, which are widely classified as household factors, for example, (i) the perception of the farmer, the household size that is connected with the labor requirements, and access to input (ii) technological factors which include farmers and the management of the practice iii) policy and institutional factors which include input prices, land tenure, and property rights. (Ajayi et al., 2007). Akinnifesi et al. (2010) argued that agroforestry ensures sustainability in crop yields and delivers food security to households. However, they asserted that despite agroforestry being developed technically to suit smallholder farmers, the challenge lies in the fact that the adoption of this practice is not guaranteed. Furthermore, they highlighted some of the adoption challenges that farmers face in the form of

land constraints, land tenure rights, weak input support system, and unclear understanding of the benefits attached to the practice from the farmer's perspective. In line with the adoption hurdles, some approaches suggested establishment of a deliberate supportive policy environment that enables agroforestry to fit in the farmers' farming system and improve the intensity of knowledge dissemination, as the practice require skills to manage agroforestry trees. Akinnifesi et al. (2010) contented that the acceptability to adopt innovation (agroforestry) was also largely dependent on the management requirement of agroforestry, for example, farmers' household labor and ability to acquire additional labor outside the household. Furthermore, they indicated that farmers preferred adopting innovation with less operation and complexity and a reduction in labor requirements.

Some smallholder farmers in Sub Saharan Africa have indicated the risks and uncertainty as a limitation in adoption of agroforestry. In a study in Kenya, Jerneck and Olsson (2014), demonstrated that for the poor smallholder farmers, the adoption of agroforestry is considered a bigger risk, as it meant investing time and labor, while their priority is to have food to eat. However, households who reported to have higher food security status were more optimistic with regard to adopting agroforestry. Akinnifesi et al. (2010) suggested that national policies on agroforestry may be formulated to make the practice profitable and attractive for farmers to adopt.

Planting basins are holes dug in the farm at dimensions of approximately 15 cm wide, 30 cm long, and 15 cm deep, using hand hoes. The basins are usually prepared in the dry season, and with the onset of the rains, the crops are planted in the basins (Mazvimavi and Twomlow, 2009). Otim et al. (2015) indicated that planting basins are widely used in southern Africa, including Zambia. This practice promotes water retention and supports precise nutrient application. An analysis by Lalani et al. (2017) focused on the usefulness of conservation agriculture among the poor in Mozambique. They indicated that adoption of planting basins was more pronounced in the drier regions of Mozambique and southern Africa, as it was productive for water retention, in comparison to the wetter regions, where adoption of planting basins was less due to water logging problems. Hove and Gwene (2018) examined the effect of conservation farming, which is classified as planting basins, mulching and inorganic manure, on food security in Zimbabwe. Their findings showed that attainment in food security was achieved for farmers who correctly implemented the farming components. They ascertained that the farmers who adopted planting basins benefited from the first rains. However, they also revealed that smallholder farmers,

especially women farmers in Zimbabwe, confirmed that the task was demanding and the farmers who were interested in benefiting from the planting basins opted for the creation of groups for team work and rotated in member farms for preparation of planting basins in the months of August and September. Some impediments concerning planting basins were particularly in relation to female farmers' inability to prepare the planting basins due to labor requirements. This indicated why they quit this practice, which led to effectively not benefiting from the attainment of food security.

1.12.1. Land Ownership and the Adoption of SAPs

The farmers whose land rights are insecure are thus not motivated to invest in future improvements that they will not profit from. Furthermore, the benefits of land security in relation to land ownership extended to providing assurance of access to financial capital and the freedom to adopt innovation (Fenske, 2011). The study published by Borras et al. (2015) described property rights to land as a means of providing protection to land owners in order to exclusively utilise and maximise returns from their land's productivity. A positive effect of land certification on the adoption of conservation practices was observed in Ethiopia by Deininger et al. (2008). Mensah (2015) asserted that land rights regarding land ownership motivated people to adopt land conservation and SAPs for the attainment of better crop yields and food security practices. Research conducted on the effects of land ownership on the adoption of SAPs in Africa has demonstrated that secure land tenure is an important factor in the adoption of SAPs. A positive effect of this type of land tenure on the adoption of SAPs, for example, was observed by Holden et al. (2009) in Ethiopia. Kassie et al. (2013) focused on the adoption of innovative agricultural practices among rural smallholders in Tanzania, where intercropping and crop rotation were some of the SAPs considered. Their results have revealed that land size, land ownership, and extension services influenced the adoption of SAPs. Abdulai et al. (2011) conducted research on the relationship between land tenure and the use of mulching, tree planting, and manure and mineral fertilisers in Ghana. Land tenure was classified as secure for the households that owned land with full property rights, while insecure land tenure meant the owners of land had restricted property rights, fixed rent, and sharecropping contracts. The findings have indicated that secure land tenure positively influenced the likelihood of adopting tree-planting practices. Using data from West Africa, Fenske (2011) revealed that land tenure and land investment are interrelated.

Therefore, the aim is to close this gap and improve knowledge regarding the effect of land tenure and other factors on the adoption of the following four selected SAPs: crop diversification, intercropping, agroforestry, and planting basins.

1.12.2. Adoption of SAPs for Food Security

The effects of adopting innovative SAPs on food security have been studied in previous research. Mutenje et al. (2016) have studied the adoption of agricultural innovations such as maize diversification, and the effect of soil and water conserving practices on food security in Malawi. They highlighted that the adoption of better agricultural practices had the potential to contribute to food security, particularly in southern Africa. Lopez-Ridaura et al (2018) studied the food security status of farmer households and livelihood activities in India. They also examined the contribution of adoption of sustainable intensification practices and conservation agriculture on food security. Their findings indicated higher food security levels for small and medium-scale farmers, especially household farms were vulnerable to droughts, and mainly poor resource farmers.

Chibwana et al. (2012), in Malawi, highlighted the importance of crop diversification, indicating that lower adoption led to reduction in soil nutrients. Furthermore, they indicated that this resulted in a diversion from suitable tolerate crops, which negated and reduced food security among the farmers. A study by Makate et al. (2016), conducted in Zimbabwe, examined the effect of adopting crop diversification on livelihoods. The findings indicated that a higher adoption of crop diversification enhances the food security of households. Waha et al. (2018) conducted research on the importance of crop diversification in Africa. Their findings demonstrated that an increase in the number of crops grown per hectare positively contributes to a rise in household food security.

Arslan et al. (2015) analysed the effect of adopting intercropping and crop rotation on maize yield for smallholder farmers in Zambia. The results showed that maize yields increased in legume-maize intercropping. Surprisingly, for crop rotation, an increase in crop yields was observed in areas with variable rainfall pattern and a reduction in yields for areas with stable rainfall pattern.

Quinion et al. (2010) studied the effects of adopting sustainable practices such as agroforestry on food security among smallholder farmers in Malawi. The findings demonstrated that the adoption of such practices contributes to a reduction in the number of hunger months. Garrity et al. (2010) focused on farming practices that smallholder farmers implemented in Zambia, Malawi, Burkina

Faso, and Niger for soil fertility and food security benefits. A particular focus in Zambia was on agroforestry cultivation in maize crops, and the findings demonstrated an increase in household food security. A study in Southern Africa (Ajayi et al., 2011) indicated that agroforestry contributes to promotion of sustainable, environmental agroecology systems, which lead to an increase in crop yields and raise food security. Kristjanson et al. (2012) considered the relationship between agricultural practices (agroforestry, cover crops, and crop rotation) and their contributions to household food security in east Africa. The analysis indicated that food-insecure households adopted a lower number of agricultural practices. The review by Coulibaly et al (2017) in Malawi focused on adoption of agroforestry and its effect of household food security among farmers. The findings showed that the adoption of agroforestry contributed to the value of crops by 35%, with a higher increase in cases where improved maize varieties were incorporated.

A study by Ngoma et al. (2015), which investigated the contribution of adopting planting basins for maize cultivation in Zambia, revealed that adopting of planting basins increases crop yields and thus contributes to hunger reduction in smallholder households. Manda et al. (2015) determined the effect of adoption of selected SAPs (crop rotation and crop residue retention) on maize yields and household income in Zambia. The findings demonstrated that farms that had adopted both SAPs reported an increase in their maize yields and household incomes.

Besides these studies, little attention has been paid to the effect of adopting SAPs on food security in Zambia. Therefore, to improve the understanding of this issue, the study analyses the effect of utilising selected SAPs (crop diversification, intercropping, agroforestry and planting basins) on food security.

2. OBJECTIVES AND CONCEPTUAL FRAMEWORK

Research Hypotheses

Based on literature reference review, the study seeks to test the following hypotheses:

a) *Hypothesis 1*: Land tenure insecurity under customary land is associated with higher food insecurity

b) *Hypothesis 2:* Land tenure security enhances the adoption of sustainable agricultural practices

c) *Hypothesis 3*: Adoption of sustainable agricultural practices positively contributes to increasing household food security

The results of these hypotheses if materialized should contribute to improving the situation of smallholder farmer in Zambia and other countries where land rights are in focus. This will provide substantial relevant land policies and enhance long term food security situation.

Conceptual Framework

The mechanism to examine food security situation are covered with interest and consideration of land tenure systems. The subject is explored and guided toward understanding the land security classified as secure and limited secure tenure among smallholder farmers.

The relationship between land tenure, adoption of sustainable agriculture practices and food security focus on achieving higher productivity and obtaining of more diversified output from agricultural production. Fenske (2011) has revealed that land tenure security provides farmers with freedom and motivates them to invest in the adoption of SAP that they can profit from in the future. In the long run, the adoption of SAPs contributes to improvements in soil fertility and thus productivity. Additionally, adoption of some SAP such as crop diversification increases product diversification (Waha et al., 2018). Holden and Ghebru (2016) have contended that for smallholder farmers, the ultimate goal is to achieve food security. As the expected outcome from SAPs adoption is enhanced yield and more diversified production, higher food security will be achieved.

The Figure 7 below depicts the expected effects of land tenure security on food security.

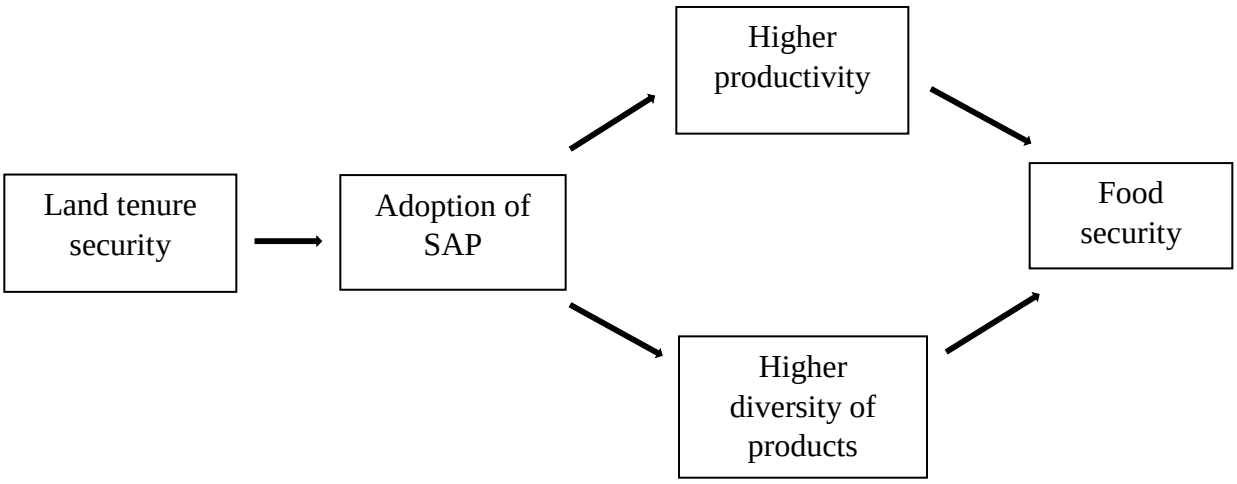

Figure 7. Conceptual framework: land tenure, SAPs and food security

Source: Author

Research Objectives

The overall objective of this research is to investigate the relationship between land property rights and food security situation of smallholder farmers in southern province of Zambia.

Specific objectives

a) To quantify the prevalence of food insecurity among households, and to determine the effect of land tenure, along with other chosen socioeconomic factors as determinants, on food security.

b) To determine the factors that influences the adoption probability of SAPs, considering the effect of land tenure, and to test the association between SAP use and food security.

3. METHODOLOGY

This section gives a description of the study site and its geographical location. It further, describes the research design indicating the sampling procedure, data collection and analysis of the data.

3.1. Study Site Description

The study was conducted in a southern province of Zambia, and four districts were covered: Kalomo, Choma and Mazabuka and Chikankata. The region was selected because even though the area is regarded as the food basket of the country, the population still faces food insecurity, which makes it more suitable for the study (Zambia Vulnerability Assessment Committee, 2015). Zambia is divided into three agro-ecological regions, namely Region I, II and III. The study districts are located in agro-ecological Region II, characterised by an annual precipitation of approximately 800-1,000 mm.

The soils in the region are characterized as sand loamy and clay loams Farming system integrates crop production and livestock raring mixed type of farming. Smallholder crop production include cereals, tubers and legumes. Cash crops such as sunflower, cotton, tobacco and soya beans are also cultivated. They also raring livestock mainly cattle, goats and poultry. The communal lands are open for livestock grazing usually after crop harvests while at the same time the land tenure rights are respected.

Regarding cultural characteristics, the study area is home to the Tonga people who are the main ethnic group. In Tonga culture, the number of cattle owned defines your social status. For household needs goats, pigs and poultry are sold to meet immediate needs such as for health bills and education. The traditional authority is vested into village headmen who represent the chiefs. Concerning marital issues, polygamy is a common practice in the southern province of Zambia. Similar to other regions country wide, the cases of HIV/AIDS and malaria pose as a big challenge on families who are dependent on agricultural practices as farm labour is massively affected which may distort their source of livelihood.

There are several open markets selling agricultural commodities located in each town and district. However, for the staple food that is mostly cultivated, two major markets exist i) through private buyers who are usually millers and ii) the food reserve agency buying on behalf of government at designated buying sheds. Most of the produce in this region are transport to Livingstone which is

Zambia's tourist capital via trucks and exported to neighbouring countries such as Botswana and Namibia.

Southern province is well connected to other regions of the country. Kalomo, Choma and Mazabuka lie on the line of rail. This makes better transportation to the capital city and to further link to the great north road towards the northern part of the country. However, the main roads in Mazabuka and Chikankanta are in dilapidated state which impend farmers to transport their produce. Similar, observation is noted for the road (Livingstone to Shesheke) connecting Southern province to Western province which is also in a bad state.

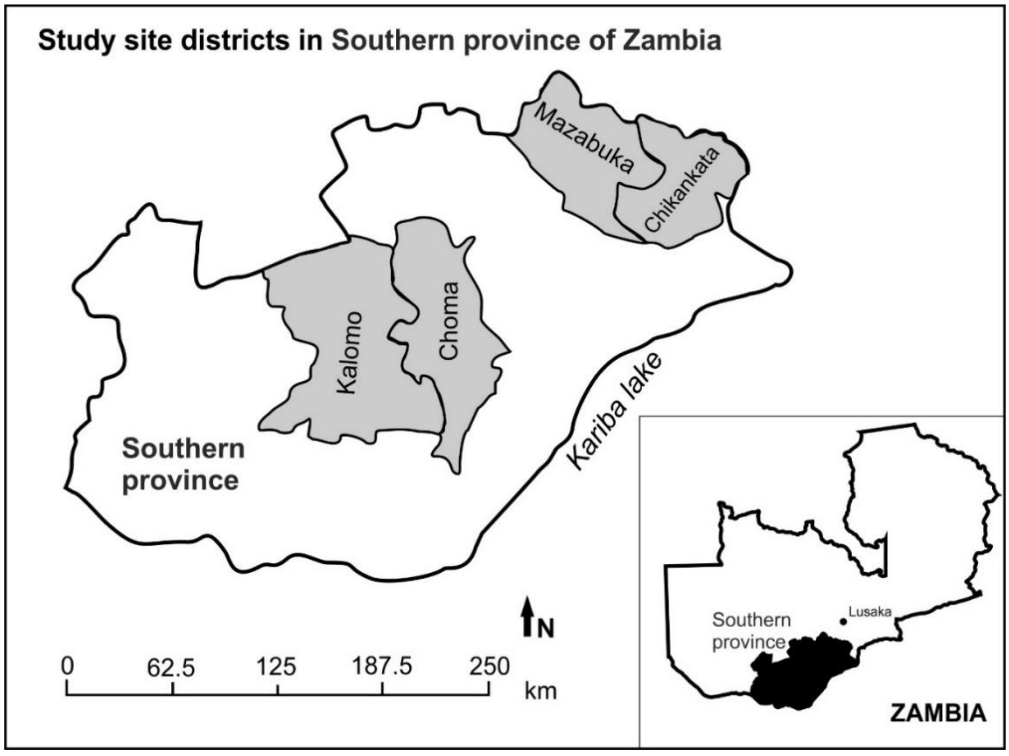

Figure 8. Study area

3.2. Data Collection

Data collection was conducted through a household survey in Southern Zambia in 2016. A semi-structured questionnaire in the form of face-to-face interviews was used for primary data collection. According to the central statistics office (2010), the southern province had 292,000 households. The province and districts were purposively selected, since they are high maize-cultivating areas that contribute largely to the national food stocks. One hundred respondents per district and 50 respondents per tenure system were interviewed. Three villages were selected per tenure system in each district, using a systematic approach that was guided by the following key features: i) villages in different locations and ii) villages with comparable tenure systems.

Insights from the review of previous literature on studies concerning SAPs, food security and land tenure systems enabled the formulation and drafting of the questionnaire. A pretest of the questionnaire was carried out in a pilot survey among 10 smallholder farmers. This allowed for the gathering of feedback to revise and finalise the questionnaire content with respect to suitable and smooth data collection. In total, 400 responses were gathered—200 under statutory and 200 in customary land tenure systems. Furthermore, before the quantitative questionnaire survey, an in-depth, qualitative interview of village headmen, district officers from both the Ministry of Agriculture and the Ministry of Community Development in Zambia was conducted in 2016 to gain a general understanding of the problems and the opportunities in the study area and to obtain consent to undertake the survey in each district. In total 8 qualitative in-depth interviews comprising of between 5 to 8 participants were conducted.

With regard to the questionnaire content, there are socioeconomic and demographic questions on consumption and hunger. Furthermore, the questions on the adoption of SAPs include farming characteristics and the adoption of agricultural practices such as crop diversification, intercropping, agroforestry and planting basins in the past 5 years.

3.3. Data Analysis

3.3.1. Food Security Indicators

Given the lack of consensus on indicators to measure food security, Carletto et al. (2013) suggested that a useful approach is to assess the food security situation of each dimension and specify the level — national, regional or household. In addition, the literature of Headey and Ecker (2013), in agreement, revealed that in measuring food security, a criterion to gauge the indicators is based on the demand of decision makers for a wide range of information. Vaitla et al. (2015) argue that, rather than focusing on one indicator, the best way to capture the food security measurement is to see the complementarity. For this reason, considering one indicator alone cannot necessarily reflect the food situation. Therefore, two indicators were incorporated to measure food security, namely the food consumption score (FCS) and the household hunger scale (HHS).

The FCS was developed by the World Food Programme as a frequency weighted dietary diversity score (Leroy et al., 2015). Different studies have validated and applied the FCS indicator: Weismann et al. (2009) in Haiti, Burundi and Sri Lanka; Mason et al. (2015) in Tanzania; Nsabuwera et al. (2015) in Rwanda and Goodman et al. (2016) in Kenya.

The FCS constitute of three components, namely the dietary diversity, the food frequency and nutritional value of the food groups (World Food Programme, 2012). The component of dietary diversity describes the food types a household consumes over a reference period. The food frequency indicates the number of times a household consumes a given food group in each recall period. The FCS uses eight food groups namely the staples, pulses, vegetables, sugar, oil, fruits, milk and meat/fish/egg. The food consumption information at household level is gathered from a country specific list of food items and food groups consumed. The nutritional value uses standard food group weights. The weights of nutritional values are as follows starting with lower values such as sugar and oils (0.5), vegetables and fruits (1), cereals (2), pulses (3) and meat, fish and milk (4) having the highest values (Leroy et al., 2015).

The food group score is calculated within each food group by summing up the consumption frequencies. Each group score that is obtained is multiplied by its weight. The results are then summed up to obtain and create the FCS (Carollete et al., 2013).

The FCS is calculated as follows using the formula below (Jones et al., 2013):

$$FCS = a_1 b_1 + a_2 b_2 + \ldots a_8 b_8 \quad (1)$$

where *a* = frequency (1-week recall period), 1-8 = food group, and *b* = weight (meat, milk and fish = 4; pulses = 3; staples = 2; vegetables and fruits = 1; and oil and sugar = 0.5).

The selection of the threshold intervals is standard and defined by the World Food Programme. |The FCS classify households into one of the following categories: poor (< 21.5), borderline (21.5-35) and acceptable (> 35).

The HHS was developed by the Food and Nutrition Technical Assistance. It is a cross-culturally validated food security indicator that captures elements of cultural experiences and severe food insecurity, and it was applied across studies conducted in Kenya, Zimbabwe, South Africa, Mozambique, Malawi, and Gaza Strip (Jones et al., 2013; Deitchler et al., 2011). A 4-week recall period is set as standard in data collection. The HHS questionnaire consists of the following three questions: i) was there ever no food at all in your household because there were not resources to get more? ii) did you or any household member go to sleep at night hungry because there was not enough food? iii) did you or any household member go a whole day and night without eating anything because there was not enough food? The responses to the questions were classified as "rarely" with the values 0 (twice a month), "sometimes" (3 to 10 times) with 1 and "often" (> 10 times) associated with 2. The values were added up for the three questions, and they ranged from 0 to 6. The standard threshold interval for the HHS categories are "little to no hunger" (scores 0-1), "moderate hunger" (scores 2-3) and "severe hunger" (scores 4-6) (Leroy et al., 2015).

3.3.2. Land tenure systems Statistical Analysis

i. To analyse the prevalence of food insecurity among the households. This was performed using descriptive statistics to quantify the percentages of food security under the statutory versus customary land tenure.

ii. To examine the effect of land tenure with the chosen factors as influencers on food security. This was done using the ordered probit regression model.

a) Ordered probit model

The dependent variables are categorical and ordinal, therefore, the ordered probit regression model is more suitable for the analysis than multinomial regression or probit regression model (Greene 2012).

The ordered probit model regression is calculated with the following equation:

$$y_i^* = x_i\beta + \varepsilon_i \quad (2)$$

where y_i^* is unobserved random variable, x is a vector of socioeconomic variables assuming normal distribution, ε_i = N (0,1) and *i*= 1, 2 …N.

y_i is the observable ordinal variable, y_i = j if $\mu_{j-1} < y_i^* \leq \mu_j$

where j= 0,1…n and μ_{-1} = -∞, and μ_n= +∞.

The probability is calculated with the following interval decision rule:

Prob [y_i= 1 if $y_i^* \leq \mu_1$, y_i = 2 if $\mu_1 < y_i^* \leq \mu_2$, y_i = 3 if $\mu_2 < y_i^* \leq \mu_3$

$$Prob\,[y_i = j] = \Phi\,(\mu_j - x_i\beta) - \Phi\,(\mu_{j-1} - x_i\beta) \quad (3)$$

where Φ denote the cumulative distribution function and j is the categories of dependent variable.

b) Dependent variables

The dependent variables are the FCS and the HHS food security indicators. FCS indicator is ordered into three categories, namely poor, borderline and acceptable categories. HHS is classified into categories: severe hunger, moderate hunger and little to no hunger.

c) Explanatory variables

The selection of explanatory variables is based on previous literature. The variables were classified into i) farm's head characteristics, ii) household characteristics, iii) farm characteristics and iv) institutional characteristics. The farm's head variables include gender, age, education level, marital status and farming experience; household characteristics include household size, self-employment, remittances, off farm, livestock income; farm characteristics include land ownership and land size; and institutional characteristics are access to credit and membership to farmer groups. The

variables were tested for multicollinearity. The variance inflation factors (VIF) values were in the range lower than 10 indicating no multicollinearity problems.

3.3.3. Sustainable Agricultural Practices Statistical Analysis

To investigate land ownership and other factors in the adoption of SAPs the probit regression analysis was used to determine the independent variables that have a statistically significant effect on the probability of adopting agricultural practices in the sample, and the average marginal effects were estimated to determine the contributions of independent variables to the probability of adopting agricultural practices. The independent variables were tested for multicollinearity using correlation, coefficients of tolerance and the variance inflation factor (VIF), all of which indicate that the variables are independent. The Durbin–Wu–Hausman test did not demonstrate any effect of potential endogeneity.

a) Dependent variables

The dependent variables are binary outcomes that indicate whether a farmer adopts a practice or not, taking values 0 and 1. Four adoption probit models - i) crop diversification, ii) intercropping, iii) agroforestry and iv) planting basins - were applied, and each model was specified as follows:

$$\Pr(y = 1|x) = \Phi(x\beta) \qquad (4)$$

where *y* is a binary variable representing a household's choice of SAP, *x* is a set of explanatory variables and $\Phi(x\beta)$ is the cumulative distribution function. The same set of explanatory variables was used for all four models.

b) Explanatory variables

The independent variables capture categories of demographic and socioeconomic characteristics. Literature was reviewed to identify the factors that were found to influence the adoption of SAPs (Mensah, 2015; Abdulai et al., 2011, Makate, 2016; Fouladbash and Currie, 2015; Nigussie et al., 2017). The variables were classified into i) farm's head characteristics, ii) household characteristics, iii) farm characteristics and iv) institutional characteristics. The farm's head variables include gender, age, education level and farming experience; a household's characteristics include household size; farm characteristics include land ownership and land size; and institutional characteristics are access to credit and membership to farmer groups.

The association between the use of SAPs and food security measures were analysed using the chi square test.

3.3.4. Testing of Research Hypotheses

Hypothesis1 stated that land tenure insecurity under customary land is associated with higher food insecurity. The descriptive statistics chi square tests and ordered probit regression model assess this hypothesis.

Hypothesis 2 stated that land tenure security enhances the adoption of sustainable agricultural practices. This hypothesis is explored through the probit regression models. The dependent variables are four models of SAPs and exploratory variables include farm characteristics specifically land ownership.

Hypothesis 3 stated that adoption of sustainable agricultural practices positively contributes to increasing household food security. This hypothesis is examined using descriptive statistics chi square tests. The four SAPs are tested along with the food security indicators (FCS and HHS).

The Statistical Package for Social Sciences IBM (SPSS) and STATA software were used for the data analysis.

3.4. Description of model variables

The description of variables used in ordered and probit regression model is provided in Table 1 separately for statutory and customary land tenure.

Crop diversification adoption was higher in statutory land ownership with 81.5% while 59.5% adoption was reported in customary land ownership. Adopting of intercropping accounted for 34% and 29.5% in statutory and customary land ownership respectively. In statutory land tenure, adopting of agroforestry was reported at 40% which is higher when compared with 21% in customary land ownership. It is not surprising that the adopting rate for agroforestry is higher in statutory land due to secure ownership rights to land which can support a long-term investment. The use of planting basins was dominant in the statutory land ownership with 35% and customary land ownership adopting 27.5%.

Gender of the farm's head was dominated by males in both land tenure systems with 65% and 62% in statutory and customary respectively. The average age was 40 years in statutory ownership and 42 years in customary ownership. In statutory land ownership, 15% of the household heads did not

have any education while regarding their counterparts in customary land ownership it was 30%. The household with off farm activities constituting the formal and informal sectors had 46% in customary tenure, while statutory tenure had 37%. The mean household size was 7 and 6 members for statutory and customary land ownership, respectively. The household with off farm activities constituting the formal and informal sectors (construction, bricklaying) had 46% in customary tenure, while statutory tenure had 37%. Livestock ownership is a dominate active among the population and it is considered an important assert. Some households sale the livestock to boost their subsistence income. The average income is 1630 and 530 Zambian kwacha for statutory land tenure and customary land tenure respectively. The average land size was with 3.8 hectares higher in statutory land ownership then with 2.7 hectares in customary tenure. In this survey, the distribution of farm land size demonstrates that in customary land tenure 64.5% of the farmers control less than 2 hectares while 40.5% of the farmers in statutory land tenure own less than 2 hectares. Furthermore, observed that some farmers in this sample cultivated as low as 0.2 hectares of land. Access to credit was low with 17% and 16% in statutory and customary land ownership, respectively. Farming group member membership was the same across the tenure systems.

Table 1 Description of Variables

Variable	Description	Statutory tenure (*n= 200)*	Customary tenure *(n= 200)*
Sustainable Agricultural Practices			
Crop diversification	Household adopted crop diversification (yes = 1)	81.5 %	59.5%
Inter – cropping	Household adopted intercropping (yes = 1)	34.0%	29.5%
Agroforestry	Household adopted agroforestry (yes = 1)	40.0%	21.0%
Planting basins	Household adopted planting basins (yes = 1)	35.0%	27.5%
Farm's head characteristics			
Gender	Sex of household head (male = 1, female =2)	64.5%	61.5%
Age	Number of years for household head	40.07 (12.20)	41.54 (14.3)
Education level	0 = none 1 = primary 2 = secondary 3 = tertiary	0 = 14.5%	0 = 30%
Farming experience	Number of years spent in farming	10.43 (9.99)	9.55 (9.58)
Household characteristics			
Household size	Number of members	7.04 (3.30)	6.36 (3.14)
Self-employment	Household has business yes =1	52%	51%
Remittances	Family received money from relatives yes=1	28.0%	25.0%
Off farm	Household has salaried or waged incomes yes=1	37.5%	46.0%
Livestock income	Household has an income from livestock sales	1638 (3606)	530 (1950)
Farm characteristics			
Land ownership	1= statutory 2= customary	n=200	n=200
Land size	Size of agricultural land in hectares	3.77 (2.99)	2.75 (2.55)
Institutional characteristics			
Access to credit	Household has access to credit (yes =1)	17.0%	16.0%
Member of faming group	Household belongs to farming group (yes =1)	52.0%	52.0%

Note: The mean values are reported with the standard deviation in parentheses. Percentages are reported as indicated. 1US dollar = 10 Zambian Kwacha.

3.5. Description of Food Security Indicators

The Food Consumption Score was higher for households with statutory land tenure, with a value of 33.62, than for households with customary land tenure, with 20.26 (Table 2). Similarly, the mean score of the Household Hunger Scale was 0.91 among households with statutory tenure, which is lower than that of households with customary ownership, at 1.76. This indicates better food security among households with statutory land ownership than among those with customary land ownership. The average value for the Food Consumption Score of the two land ownership types was 26.94, and that for the Household Hunger Scale was 1.33.

Table 2 Description of food security indicators

Food security indicators	Description	Statutory ownership (n=200)	Customary ownership (n=200)	Pooled (n=400)
Food consumption score	Poor (< 21.5) Borderline (21.5-35) Acceptable (> 35)	33.62 (21.42)	20.26 (15.70)	26.94 (19.91)
Household hunger scale	Little to no hunger (scores 0-1) Moderate hunger (scores 2-3) Severe hunger (scores 4-6)	0.91 (1.40)	1.76 (1.70)	1.33 (1.63)

Note: The mean values are reported with the standard deviation in parentheses.

4. RESULTS AND DISCUSSION

The following section presents the results and discussion broadly under the following, i) relationship between land tenure and food security indicators ii) factors influencing food security iii) factors influencing the adoption of SAPs iv) sustainable practices and food security and, v) coping strategies and food consumption score.

4.1. Relationship between Land Tenure and Food Security Indicators

The proportion of food security status in households across both tenures is presented in Table 3. In statutory land, households account for 41% of acceptable FCS, while 14% is reported for customary land. The HHS in statutory land ownership indicate that 77% of the households is classified as little to no hunger, while customary land ownership reported 48.5% as little to no hunger. For both food security indicators employed in this study, the findings revealed that statutory tenure households are more food secure than those in customary land tenure. Despite this study focusing on land tenure and food security, however, acknowledge that results in distribution of food security scores can not only be attributed to land tenure alone as other factors can play an important role. Therefore, to further understand this will follow up with the regression analysis of factors contributing on household food security.

Table 3. Land tenure and food security indicators

	Food Consumption Score (%) *n = 400*				
Land tenure	Poor	Borderline	Acceptable	χ^2	p
Statutory	40	19	41	40.59	0.001*
Customary	67.5	18.5	14		
	Household Hunger Score (%) *n = 400*				
	Severe hunger	Moderate hunger	Little to no hunger		
Statutory	9.5	13.5	77	36.33	0.001*
Customary	20	31.5	48.5		

*Significance level at 5%

4.2. Factors Influencing Food Security

4.2.1. Land tenure and size

The average marginal effects of the ordered probit model estimating the effect of land tenure along with other factors on food security are presented in Table 4 and Table 5.

Regarding land tenure as a determinate on FCS (Table 4), the findings indicate that the households with customary land tenure have a 12.99 % more likely to be in the poor FCS category, 6% less likely to be in the borderline FCS category, and 12.91% less likely to be in acceptable FCS category. Similarly, the effect on land tenure as a determinant on HHS (Table 5) reveal that households with customary land tenure are 3.3% more likely to be in the severe hunger category, 8.1% more likely to be in the moderate hunger category, and 8.7 % less likely to be in the little to no hunger category, when compared to households under the statutory land tenure. In accord with customary land indicating poor food security status, Merten and Haller (2008) studied the effect of property rights on child growth and the food security of households in customary land tenure in Zambia. They found that insecure property rights in this type of land tenure negatively affected the food consumption pattern of the households. A study in Bangladesh by Nasrin and Uddin (2011) analyses tenure systems that were classified as share tenants without land rights and cash tenants who hold secure land rights. The study found higher food security in households that had secure land rights. In this study, results are in line with Ghebru and Holden (2013), who demonstrated that tenure secure households measured by provision of land certificates, have a positive association with food security in Ethiopia. Furthermore, the findings complement those found by Mueller et al. (2014), who studied the effect of land reforms programs of households provided with land titles to strengthen their land property rights on food security in Malawi. They demonstrate that food security of the households with more secure property rights improved on a longer term. Apart from the land property rights, increase of land size in resettlement schemes also contributed to food security. Analysing the same data as Mueller et al. (2014) from the Malawi community based rural land development project, Mendola and Simutowe (2015) use the propensity score matching to analyse the benefits of land distribution on the welfare of households in Malawi. They indicate that if the land property rights for the households increased, and their food security status improved with respect to food consumption. Findings in this study are in contrast with Santos et al. (2014), who assessed the impact of land allocation on food security in

West Bengal. Their findings identified that there was no statistically significant effect of land allocation observed. However, they pointed out that the land allocation and registration process had potential to improve food security in a long run since contributions towards agricultural outputs were reported.

The results of the model show that a one hectare increase in land size is associated with being 2.4% less likely to be in the poor FCS status, 1.1% more likely to be in borderline status and, 2.4% more likely to be in an acceptable FCS status. Similarly, the HHS model demonstrates that the probability of a household with one-hectare larger land size is reduced by 2% and 5% to be in severe hunger category and moderate hunger category respectively while, the probability to be in the little to no hunger category increases by 5.3%. One plausible explanation is that in agriculture households with larger land size may have crop diversity providing potential diverse of nutritious crops when compared to households with smaller land size who may highly consider cultivating only staple cereals. Githinji (2011) studied how land influences household poverty levels in Kenya. The findings show that an increase in land size reduced the probability of households being in the poor poverty levels. Furthermore, the finding in this study is in agreement with that of Rammohan and Pritchard (2014), who use the ordered probit models to estimate if land holding was a determinant of household food and nutrition security in Myanmar. Their result indicates that an increase in land size enhanced household food security status. Similarly, this result is in alignment with that of Muraoka et al., (2018), who analysed the effect of land access on food security in Kenya. They demonstrated that an increase in land size resulted in a rise on household food security. With regard to the influence of farm size on welfare outcomes, Khonje et al. (2015), have studied the effect of adopting improved maize varieties on welfare outcome indicators namely, food security, poverty, crop incomes and consumption expenditure in Eastern province of Zambia. The findings on farm size and poverty revealed an inverse relationship. Households with smaller farm size of 0.1 - 3.5 hectares shows higher poverty levels in 54% cases as compared to households with more than 3.5 hectares where the poverty levels were in 33% cases.

4.2.2. Household head characteristics

In the model, household heads who are more educated are 12.6% less likely to being in poor FCS category, 6.1% more likely to be in the borderline FCS and 12.5% more likely to being in acceptable category of FCS. Regarding the HHS model, our finding indicates that with an increase in education level there is a respective 4.4% and 12% less probability of households being in the severe hunger and moderate hunger categories, while 11.6% more chance of being in the little to no hunger category. This result is similar to the work of Mason et al. (2015), who use the food consumption as an indicator of food security to determine the factors influencing food security in Tanzania. They found that households with household head with higher education level had better food security status. A study conducted by Ragasa and Mazunda (2018) revealed that households with higher education level were found to be more food secure in Malawi.

4.2.3. Household characteristics

The households that have off farm income were 10% more likely to be in poor FCS category in this study, 5% less likely to be in borderline FCS category and 10% less likely to being in acceptable FCS. The HHS indicate that an increase in off farm activities resulted in a household to be in a severe hunger category by 1.9%, 4.7% more likely to be in moderate hunger category and 5.3% less likely to be in the little to no hunger category. This finding can be attributed to the households devoted more time to off farm activities at the expense of farm activities that may provide higher food production for own consumption income. With similar results, Mabuza et al. (2016), have analysed the impact of income sources on household food insecurity in Swaziland. Their findings report that on farm income dependent households were more food secure when compared to their counterparts that depended on off farm income sources. In other studies, Beyene and Muche (2010) in Ethiopia, Babatunde and Qaim (2010) in Nigeria, have studied determinates of food security. The results indicate that off farm incomes positively contributed to the household food security. The policy aspect would to seek how to develop formal employment opportunities that would enhance income levels of the household. The improvement in conditions service would increase the number of people who will be able to acquire food and improve their food security status to substantiate the farm incomes.

According to results in this study, an increase in livestock incomes is associated with being less likely to be in poor FCS, and more likely to be in borderline and acceptable FCS categories.

Similarly, the HHS demonstrate that an additional increase in livestock income, reduces the probability of household to be in the severe and moderate hunger categories, while it increases the probability of being in the little to no hunger category. The explanation to this result is that ownership of livestock potentially provides meat, milk and other quality dairy products and increases quantity of nutritional foods for the households. Secondly, livestock sale that is usually the live animals enhances income that may improve the purchase power of the household. In support to the importance of livestock ownership and incomes to improving food security, Jodlowski et al. (2016), who studied the effect of livestock on food security in Zambia, have demonstrated that livestock ownership and sales contributed to the household food security through increase in food consumption expenditure and dietary diversity. Similarly, Kafle et al. (2016), have studied the effect of livestock transfer programs among poor secure households in Zambia. Their result reveals an increase in the financial capacity and household food security status, which was enhanced by training of households in livestock management topics. In contrast to finding in this study, Silvia et al. (2015), who analysed the determinants of farm household food security in Kenya, Uganda and Tanzania, found that ownership of livestock did not contribute to the enhancement of household food security.

4.2.4. Institutional characteristics

The households that are members of a farming group or cooperative indicate 8% less likely to be in poor FCS category, while have a respective 3.9% and 7.9% more likely to being in the borderline and acceptable FCS categories. The HHS reveal that membership to a farmer's organisation reduces the probability of a household being in severe hunger category by 6.9%, such a household is 15.9% less likely to be in moderate hunger and 17.5% more likely to be in the little to no hunger category. The group membership can for example provide networking and connections which may empower individuals or groups with various businesses ventures to enhance income generation, nutritional programs to address issues of food insecurity.

Table 4. Ordered probit regression model (FCS)

Variables	Coefficient	Food Consumption Score		
		Poor	Borderline	Acceptable
Household head characteristics				
Gender	0.0980	-0.0262	0.0129	0.0258
	(0.146)	(0.039)	(0.020)	(0.038)
Age	-0.0113	0.0030	-0.0015	-0.0030
	(0.007)	(0.002)	(0.001)	(0.002)
Education level	0.4723***	-0.1264***	0.0610***	0.1259***
	(0.092)	(0.023)	(0.016)	(0.025)
Farming experience	-0.0117	0.0031	-0.0015	-0.0031
	(0.010)	(0.003)	(0.001)	(0.003)
Marital status	-0.2881*	0.0771*	-0.0372*	-0.0769*
	(0.161)	(0.043)	(0.023)	(0.042)
Household characteristics				
Household size	0.0840***	-0.0225***	0.0109***	0.0224***
	(0.025)	(0.006)	(0.004)	(0.007)
Self-employment	0.0211	-0.0057	0.0027	0.0056
	(0.138)	(0.037)	(0.018)	(0.037)
Remittances	-0.2555	0.0683	-0.0355	-0.0644*
	(0.157)	(0.042)	(0.024)	(0.038)
Off farm	-0.3882***	0.1039***	-0.0502***	-0.1035***
	(0.085)	(0.021)	(0.014)	(0.023)
livestock income	0.0002***	-0.0004***	0.0000***	0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)
Farm characteristics				
Land ownership	-0.4854***	0.1299***	-0.0611**	-0.1291***
	(0.137)	(0.035)	(0.020)	(0.037)
Land size	0.0906***	-0.0242***	0.0117***	0.0241***
	(0.026)	(0.007)	(0.004)	(0.007)
Institutional characteristics				
Access to credits	0.1284	-0.0344	0.0155	0.0355
	(0.185)	(0.049)	(0.021)	(0.053)
Farming group	0.3013**	-0.0806**	0.0388**	0.0799**
Member	(0.143)	(0.038)	(0.019)	(0.038)
Cut1	0.4314			
	(0.363)			
Cut2	1.2021			
	(0.367)			
Number of observations	400			
Prob > chi^2	0.000			
Pseudo R^2	0.264			

Note: *** p<0.01, ** p<0.05, * p<0.1**.** The average marginal effects are reported with the standard errors in parentheses

Table 5. Ordered probit regression model (HHS)

Variables	Coefficient	Household Hunger Scale		
		Severe hunger	Moderate hunger	Little to no hunger
Household head characteristics				
Gender	0.009	0.001	0.002	-0.002
	(0.147)	(0.014)	(0.034)	(0.036)
Age	0.007	0.001	0.002	-0.002
	(0.006)	(0.001)	(0.002)	(0.002)
Education level	-0.468***	-0.044***	-0.120***	0.116***
	(0.096)	(0.012)	(0.025)	(0.022)
Farming experience	-0.003	-0.000	-0.001	0.001
	(0.010)	(0.001)	(0.002)	(0.002)
Marital status	0.010	0.001	0.002	-0.002
	(0.103)	(0.010)	(0.024)	(0.026)
Household characteristics				
Household size	0.000	0.000	0.000	-0.000
	(0.027)	(0.003)	(0.006)	(0.007)
Self-employment	-0.101	-0.010	-0.024	0.025
	(0.142)	(0.013)	(0.033)	(0.035)
Remittances	0.015	0.001	0.004	-0.004
	(0.165)	(0.016)	(0.038)	(0.041)
Off farm	0.201**	0.019**	0.047**	-0.050**
	(0.792)	(0.008)	(0.019)	(0.019)
Livestock income	-0.000***	-0.000***	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Farm characteristics				
Land ownership	0.354**	0.033**	0.086**	-0.088**
	(0.145)	(0.015)	(0.034)	(0.035)
Land size	-0.215***	-0.020***	-0.050***	0.053***
	(0.044)	(0.005)	(0.011)	(0.010)
Institutional characteristics				
Access to credits	-0.077	-0.007	-0.018	0.019
	(0.219)	(0.019)	(0.050)	(0.054)
Farming group	-0.706***	-0.069***	-0.159***	0.175***
Member	(0.155)	(0.019)	(0.036)	(0.036)
Cut1	-0.6856			
	(0.356)			
Cut 2	0.3834			
	(0.358)			
Number of observations	400			
Prob > chi^2	0.000			
Pseudo R^2	0.270			

Note: *** p<0.01, ** p<0.05, * p<0.1**.** The average marginal effects are reported with the standard errors in parentheses.

4.3. Factors Influencing the Adoption of SAPs

The results of the probit model are presented in Table 6 with average marginal effects reported for the variables. The results indicate that households under customary tenure had a 17.4%, 17.2% and 9.1% lower probability to adopt crop diversification, agroforestry and planting basins, respectively. Rammohan and Pritchard (2014) documented that the adoption of farming practices and farmers' decision on the type of crops to be cultivated on their farm were influenced by land right security in Myanmar. Regarding crop diversification, the findings are in line with Fosu-Mensah et al. (2012), who reported an increase in the adoption of crop diversification for farms cultivated by landowners with full tenure security when compared to farms cultivated by tenants who have no tenure security in Ghana. Kassie et al. (2015) studied the adoption of sustainable practices that include crop diversification in Malawi, Tanzania, Kenya and Ethiopia. Similarly, findings in this study are in agreement with their results that indicate that the adoption of crop diversification was higher among farmers with full property rights in Ethiopia and Tanzania.

Concerning agroforestry, results here reinforce the findings of Nyaga et al. (2015), who assessed the factors that impact the adoption of agroforestry on smallholder farms in Kenya. Their findings identified that the farms with secure land tenure adopted a higher diversity of agroforestry practices when compared with the farms without secure land tenure. Land security was divided into two categories: first, secure farms had legal documentation as assurance of land ownership (title deed), and second, insecure farms had no title deed as assurance of property rights. Similarly, secure land use rights were found to have a positive effect on the adoption of agroforestry in Liberia (Fouladbash and Currie 2015).

Following intercropping, the findings are consistent with those of Kassie et al. (2013), who studied the factors influencing the adoption of SAP including intercropping in Tanzania. Their results indicate that land security is not an important factor in the adoption of intercropping. The argument is that farmers may treat intercropping as a short-term input investment that is not necessarily affected by tenure property rights.

Regarding the effect of gender, the results of this study show that farms headed by women had a 12% and 10.5% lower probability of adopting agroforestry and planting basins, respectively, than the male-headed farms. An explanation for this may be that, due to gender differences in labor roles, most female household heads may not feel secure in practicing agroforestry activities. This

result is consistent with that of Fouladbash and Currie (2015), who indicated that farms headed by women had lower rates of agroforestry adoption in Liberia.

Regarding the age of the household head, the study shows that a one-year increase in farmer age results in a 0.5% lower likelihood to implement crop diversification. The argument is that younger farmers are more flexible in considering farming as a business and prefer to adopt practices that yield better performance and lower risk. Older farmers were found to be less likely to adopt legume intercropping when compared to younger farmers as it was considered a risk diversifying practice in Tanzania (Kassie et al., 2013)

More educated farmers were 6.8% less likely to adopt planting basins. This is a surprising result, as the expectation is that with increasing education, the household's knowledge of new technologies or practices increases, which leads to increased adoption of such practices and improved performance. Mensah (2015) emphasized that higher education levels improve the knowledge of, exposure to and adoption rate of SAP.

A one-year increase in farmer experience reveals a 0.5% higher likelihood of adopting crop diversification and agroforestry practices. The assumption is that more experienced farmers can understand and identify changes related to farming practices more easily. The findings are in accordance with Faße and Grote (2013), who indicate that farmers with more years of farming experience were more likely to adopt agroforestry when compared with those who had fewer years of farming experience in Tanzania.

An increase in land size by one hectare increases the likelihood of the adoption of crop diversification by 3.3%. This finding corroborates with the results of Makate et al. (2016) from Zimbabwe and is supported by Quinion et al. (2010), who revealed that the choice to adopt this SAP was largely dependent on land holding and offered more benefits to larger holdings. In addition, Saenz and Thompson (2017) have indicated ambiguity with regard to the effect of land size on crop diversification in Zambia. They found that for some farm household an increase in land size translated to higher production of single crop on a farm plot. Nevertheless, they further revealed that for other farm households, holding large land size enhanced the cultivation of a variety of crops on their farms. A study by Harris and Orr (2014), focused on the impacts of agricultural innovations on improvement in food security in Africa and India. They contend that provided that rural households control small land sizes, there is little contribution for innovations

to remove smallholder farmers from the high poverty levels. Coulibaly et al. (2017) have contended that smaller land sizes realized the highest benefits from agroforestry when compared to farmers with larger land size in Malawi and this is attributed to the small-scale farmers efficiency use of resources.

During the cropping seasons, financial institutions provide mainly short-term credits to farmers that are creditworthy. The credits are mainly used for buying inputs. The main constraint to receive credit for farmers is lack of collateral. This results in many farmers failing to access credit (in our sample, approximately 16.5% of farmers had access to credit). Households with access to credit were 13.6% and 24.2% less likely than households without credit access to adopt crop diversification and agroforestry. In contrast, households with access to credit were 17.1% and 34.5% more likely to adopt intercropping and planting basins, respectively, than households without credit access. The opposite influence of credit access on the adoption of different SAP is unexpected. On one hand, it can be attributed to farmers opting to use credits on practices that are labor demanding, such as planting basins. On the other hand, with respect to crop diversification, the likelihood of having access to subsidized input through group membership is higher, hence, farmers may use credits on other SAP with limited financing options. To understand this ambiguous result on effect of credit access, more research would be needed.

For small-scale farmers, farming group membership can be a channel for better access to extension services and for the exchange of experiences and information with other farmers. The results of the model show that members of a farming group are 20.6% more likely to adopt crop diversification than non-members. One explanation for this, in addition to the exchange of experiences and information, may be that farmers have access to different crops' seeds at lower than market prices as subsidized by the government through farmer groups. Kankwamba et al. (2012), has focused on the effect of input support program on crop diversification in Malawi. They indicate that farm households that participate in such programs adopt more crop diversification.

Differently, the probability of adopting planting basins is 12% less likely for group members. A plausible explanation is that learning from the experiences of fellow farmers by visiting their demonstration fields may show unsatisfactory results for adopting planting basins and hence yield a shift to other SAP. Another explanation could be that extension services put more focus on the adoption of SAP other than planting basins.

Table 6. Probit regression model analysis

Variables	Crop diversification	Intercropping	Agroforestry	Planting basin
Household head characteristics				
Gender	0.050	-0.043	-0.120**	-0.105***
	(0.044)	(0.050)	(0.048)	(0.046)
Age	-0.005***	-0.004	-0.001	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Education level	-0.036	-0.043	-0.000	-0.068**
	(0.027)	(0.031)	(0.030)	(0.029)
Farming experience	0.005*	0.004	0.005 *	-0.001
	(0.003)	(0.003)	(0.002)	(0.002)
Household characteristics				
Household size	0.009	0.000	0.007	0.002
	(0.007)	(0.007)	(0.007)	(0.003)
Farm characteristics				
Land ownership	-0.174***	-0.054	-0.172***	-0.091**
	(0.042)	(0.043)	(0.043)	(0.044)
Land size	0.033***	0.008	-0.003	-0.006
	(0.010)	(0.009)	(0.009)	(0.009)
Institutional characteristics				
Access to credit	-0.132 **	0.173***	-0.233***	0.344***
	(0.055)	(0.060)	(0.065)	(0.053)
Farming group	0.206***	0.039	0.038	-0.120**
Member	(0.041)	(0.049)	(0.00)	(0.046)
Number of observations	400	400	400	400
LR chi2(9)	86.89	19.79	41.02	57.71
Prob > chi2	0.0000	0.019	0.0000	0.0000
Pseudo R2	0.179	0.040	0.083	0.110

4.4. Sustainable Agricultural Practices and Food Security

Table 7 below presents the results of the chi square demonstrating the relationship between SAP adoption and food security indicators. The adoption of crop diversification and agroforestry is significantly associated with both food security indicators.

Regarding the crop diversification adopters, 44% households that belong to the poor FCS category adopt crop diversification compared to 21% in the borderline category and 34% of smallholders in the acceptable category. Regarding the crop diversification non-adopters, 76% households that belong to the poor FCS do not adopt crop diversification compared to 12% in the borderline category and 12% in the acceptable category. Similarly, the HHS indicates a 12% adoption rate for crop diversification for the group of farmers in the severe hunger score category, 15% in the moderate hunger and 73% in the little-to-no hunger categories. Regarding the crop diversification non-adopters, 22% households that belong to the severe hunger score category do not adopt crop diversification compared to 40% in the moderate hunger and 37% in the little-to-no hunger categories. The explanation for this result is that planting diverse crops contributes to increased nutritional quality and quantity. The findings are in line with Makate et al. (2016) in Zimbabwe and Mazunda et al. (2015) in Malawi. Michler and Josephson (2017) studied the impacts of crop diversification on household poverty status in Ethiopia. Their findings show that households that adopted crop diversification were less likely to be in poor poverty category when compared to the households that planted a single crop.

Regarding the adoption of agroforestry, 41% of households in the poor FCS category adopted this SAP compared to 20% in the borderline and 38% in the acceptable categories. Regarding the agroforestry non-adopters, 59% households that belong to the poor FCS do not adopt agroforestry compared to 18% in the borderline category and 23% of smallholders in the acceptable category. In terms of HHS, 9% of households in the severe hunger category adopted agroforestry compared to 17% in the moderate hunger and 74% in the little-to-no hunger categories. Regarding the agroforestry non-adopters, 18% households that belong to the severe hunger score category do not adopt agroforestry compared to 25% in the moderate hunger and 57% in the little-to-no hunger categories. This can be attributed to the fact that crop yields increase with the adoption of agroforestry (Thangataa and Alavalapati, 2003; Quinion et al., 2010), which in the long run can positively contribute to better food status of the household. Ajayi et al. (2007) found that adoption

of agroforestry contribute to an increase in maize yields and prolonged the food security in the households by 2 -3 months in Zambia. Similarly, 43% of the smallholder farmers reported an increase in crop yields after the adoption of agroforestry on their farms in Kenya. An increase in crop yields through the adoption of agroforestry resulted in a reduction of the number of food insecurity and vulnerability months by 2 to 3 months in a study in Kenya (Thorlakson and Neufeldt, 2012).

Table 7. Association of sustainable agricultural practices and food security indicators

(a) Food Consumption Score (FCS)
n=400

	Poor (%)		Borderline (%)		Acceptable (%)		χ^2	P
SAP adopted	Yes	No	Yes	No	Yes	No		
Crop diversification	44.4	76.3	21.6	11.9	34.0	11.9	34.90	0.000*
Intercropping	56.7	52.0	12.6	22.0	30.7	26.0	4.752	0.100
Agroforestry	41.0	59.3	20.5	18.0	38.5	22.7	13.37	0.001*
Planting basins	59.2	51.3	14.4	20.7	26.4	28.0	2.920	0.232

(b) Household Hunger Scale (HHS)
n=400

	Severe Hunger (%)		Moderate Hunger (%)		Little to No Hunger (%)		χ^2	P
SAP adopted	Yes	No	Yes	No	Yes	No		
Crop diversification	11.7	22.0	15.3	39.8	73.0	37.3	47.78	0.000*
Intercropping	11.0	16.5	19.7	24.0	69.3	59.5	4.246	0.236
Agroforestry	9.0	17.6	17.2	24.8	73.8	57.6	10.10	0.018*
Planting basins	17.5	13.0	20.0	23.6	62.5	63.4	1.961	0.581

The threshold interval for the FCS categories: poor (< 21.5), borderline (21.5-35) and acceptable (> 35). The HHS categories: little to no hunger (scores 0-1), moderate hunger (scores 2-3) and severe hunger (scores 4-6).

4.5. Findings on Research Hypotheses

Hypothesis 1 stated that land tenure insecurity under customary land is associated with higher food insecurity. The descriptive statistics indicated lower food security status in customary land for both food security indicators. The chi square tests indicated the association and ordered probit model analysis confirms that food insecurity is higher in customary land. Therefore, accept the hypothesis.

Hypothesis 2 stated that land tenure security enhances the adoption of sustainable agricultural practices. The analysis of the probit regression models revealed that higher adoption of SAPs is observed in statutory land that has secure land. However, this is observed specifically for crop diversification, agroforestry and planting basins practices while intercropping did not show a significant relationship. Therefore, this hypothesis indicates a more positive contribution.

Hypothesis 3 stated that adoption of sustainable agricultural practices positively contributes to increasing food security. The examined hypothesis through the chi square tests revealed significant association for two of the SAPs namely, crop diversification and agroforestry for both food security indicators (FCS and HHS). This finding provides some supportive evidence in favour of the hypothesis.

5. CONCLUSION AND RECOMMENDATIONS

The failure to provide land documentation and legal support to farmers on customary land tenure has contributed to the weakening of land governance and agricultural management options. The conversion of customary land for large scale acquisition that deprive the empowerment of local smallholder farmers is a concern for some traditional rulers who feel their land is expropriated. The pressure on customary land has mainly been mounted by global trends of government giving away large-scale land to investors for agricultural development with limited consultation and consideration for the smallholder farmers who occupy the land. The effects of land grabs are not only from foreign investors, the trend has also been observed from Zambian nationals coming from urban areas who are also acquiring larger areas of land as emergent farmers exacerbating the displacement of the smallholder farmers. Communities that should be stronger are viewed as weaker when compared to individuals due to lack of transparency from some traditional authorities and some government officials who are suspected of selling land without proper consent for personal gain and political patronage instead of protecting the local communities. The opportunities coming with land conversions are enjoyed by the foreign investors, urban elites and some traditional authorities at the expense of smallholder farmers.

The two main goals of first specific objective were first, to analyse the prevalence of food insecurity among the households under the statutory versus customary land tenure systems and second, to examine the effect of land tenure with the chosen factors as influencers on food security. The study was conducted in 2016 in Southern province in Zambia. Food security is measured by the food consumption score (FCS) and the household hunger scale (HHS) indicators. The descriptive statistics have demonstrated better food security results in statutory land tenure that contains secure land rights when compared to customary land tenure systems that have restricted land rights. Pertaining to the objective, regarding the effect of land tenure as a determinant on household food security, both the FCS and HHS ordered probit models findings reveal that households with customary land tenure have more likely to be in the poor or severe hunger category, respectively, when compared to households under the statutory land tenure. From this sample, apart from land tenure, found that land size, education levels, group membership and livestock incomes contributed to increase of household food security.

To improve household food and nutritional security in the long run, the development of food and land policies that are in accordance to the revealed determinants of food security may be recommended. The main result of the study shows that land tenure security increases food security. To increase food security thus, measures that would safeguard higher land security for households under customary tenure should be introduced. The most important in this respect is the implementation of more effective land rights protection law. To speed up the process, stakeholders such as the national farmers union or local municipalities needs to lobby the central government to implement the more effective law. Increased tenure security could be achieved for example through the inclusion of customary tenured households in land registration programs with legal recognition.

The size of land was found to have a positive effect on food security. Therefore, pursuit of policies that help smallholder farmers with holding of arable land especially in customary land tenure must be promoted. Recently, risks of some local traditional authorities not collaborating with communities within their authority has in some instances given rise to land grabbing. This is a case where the traditional leaders (chief) can decide to rent part of the land to an enterprise and make the land size of domestic farmers smaller. The decreasing farm size may affect the agricultural productivity of smallholder farms and limit their potential to attaining better food security.

The findings in this study demonstrate positive effect of farming group membership on food security. Therefore, interventions to support in organising and empowerment of existing informal and formal groups especially through community mobilising should be encouraged by private and government organizations. Facilitation of official registration of farmers groups at agricultural district offices should be a priority. The registration must be planned beyond the current situation where majority of the groups are only organised and oriented towards benefiting from programs such as the farmers input support. Only registered farming groups may provide training of members to help them improve the household food security status. Furthermore, farmers groups create opportunities for sharing of experiences among farmers and with other existing groups.

In relation to the second specific objective regarding SAPs, the two main goals of the study were to investigate the effect of land tenure system on adopting SAP and to evaluate the association between the adoption of SAP and food security indicators. Regarding the first question, the study reveals differences in the adoption of SAP between smallholder farmers cultivating land in

statutory land ownership associated with secure land rights and farmers cultivating land in customary land tenure with insecure rights. Households with customary land tenure had a lower probability to adopt crop diversification, agroforestry and planting basins, than households with statutory tenure. Customary land tenure can be strengthened to producing higher food security provided that the occupants feel protected and at liberty to conduct agricultural activities. The approaches to enhance this should be directed towards empowerment of the occupants with land documents such as land certificates and title deeds, that clearly define the land property rights. However, the starting point in addressing this issue should be directed towards relaxing the complex bureaucratic procedures in attaining land documents that attract high transaction costs and are not favourable for the smallholder farmers.

Regarding the second question, the study found that the adoption of crop diversification and agroforestry is associated with higher household food security in this case. The increasing adoption of SAPs, especially of crop diversification and agroforestry, should thus be a policy target in Zambia, as it has the potential to contribute to an increase in household food security. To encourage the adoption of sustainable agricultural practices by farmers on customary tenure, the first policy measure that provide similar land security and rights in customary tenure, as is already the case in statutory tenure should be formulated. Furthermore, the government and stakeholder participation in promoting sustainable management programs can play a significant role in increasing the awareness of SAPs. A lesson can be learned from Ghana, where increased adoption of SAPs in customary tenure was achieved through the establishment of land administration projects and customary land secretariats (Biitir and Nara, 2016). Anecdotal evidence says that in Zambia, currently, the lower adoption rates of intercropping may be attributed to the fact that some farmers perceive that intercropping is harmful to their crops and thus prefer monocultural cropping. The role of the government and farmers group would be to provide farmers with information based on scientific findings. Ortega et al. (2016), for example, suggest that less labor-requiring legumes be used in intercropping to enhance adoption rates in Malawi.

5.1. Perspectives for Future Research

The study is limited by geographical coverage, as it is based on one region in the southern part of the country. For further studies from the first specific objective, a focus on perceived tenure insecurity and inequalities among women and youth who are mostly reported as deprived in traditional land with respect to land holding and agricultural output may be of interest for consideration.

Pertaining to second specific objective, focusing on adoption of SAPs, future research to understand the effects of adoption of sustainable agriculture practices in distinctive agro-ecological regions with different climatic and soil conditions and rainfall patterns would help to ascertain the suitable practices for specific regions. Furthermore, investigation and understanding of farmers' perception of barriers to adopting different SAPs may be crucial for potential effective and efficient interventions. With regard for future research, from the methodological point of view, it would be interesting to include variable representing knowledge acquisition in the survey and analysis to understand the learning process of farmers on SAPs in more depth.

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APPENDIX

Questionnaire

Data collection is for academic purposes regarding land tenure and food security in the district. The duration of the interview is approximately 30 minutes and the respondents are kindly asked to provide honest answers.

Province			Enumerator	
District			Respondent	
Village			Date	

1. Household demographic and composition

Gender		
Age		
Marital status		
What is your highest level of education?		
Number of people in the household		
How many are;	Male	Female
Aged below 5 years		
Aged between 5-17 years		
Aged between 18-59 years		
Aged above 60 years		

2. Agriculture production and land holding

Total size of land	
Land owner	
How long have you been farming?	
Implements used for cultivation	
Main crops grown	
Production assets owned	
Major market for produce	
Distance to main market	
Access to credits	
Member of farming group	

3. Which of these practises, if any, have you adopted in your farming in past 5 years?

Practices	Tick appropriate box
Crop diversification	
Inter-cropping	
Agroforestry	
Planting basins	

3. Crop production

Types of crops	Quantity produced	Quantity sold	Price per unit	Total amount	Balance consumed

5. Livestock sales

Type of Livestock	Consumed (kg)	Sold	Price/ kg	Duration	Total

6. Household items and response codes (Recall period 4 weeks)

Household items	Frequency codes
1. No food to eat of any kind in your household?	Never, Rarely or sometimes, Often
2. Go to sleep hungry?	Never, Rarely or sometimes, Often
3. Go a whole day and night without eating?	Never, Rarely or sometimes, Often

7. Sources of Food

Food items	Times eaten in the last seven days	Sources of food	Food sources codes
Maize			1.Purchases
Rice			2.Crop production
Millet			3.Exchange item
Wheat			4.Exchange labour
Beans			5.Received gifts
Groundnuts			6.Food aids
Cassava			7.Other specify
Potatoes			
Sweet potatoes			
Fruits			
Beef			
Pork			
Goat			
Fish			
Chicken			
Eggs			
Milk			
Sugar			

9. Sources of cash income

Income source	Estimated cash for 30 days
Sale of own crop production	
Sale of Livestock and products	
Self-employment	
Employment paid in cash	
Remittances	

Comment about interview:

Thank you for your cooperation