



**Improving adoption of certified seed potatoes by farmers in the southern highlands' regions of
Tanzania**

Presented by **Michael Anthony Sanga**

September 2020

Velp.

The Netherlands.

Thesis submitted to Van Hall Larenstein University of Applied Sciences in partial fulfillment of the requirement for the Master Degree in Agricultural Production Chain Management: in Horticultural Chains

Submitted by Michael Anthony Sanga

Supervisor: Arno de Snoo

October 2020

Van Hall Larenstein University of Applied Sciences, Velp

The Netherlands

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DEDICATION

This work is dedicated to the potato farmers of the southern highlands' regions in Tanzania.

ACKNOWLEDGEMENT

I would like to extend my sincere gratitude to my Almighty God for his grace that made me finish this work.

The deepest gratitude goes to the Dutch Ministry of external affairs for the scholarship that has made this dream come true. Special thanks go to my supervisor, Mr. Arno de Snoo and the accessor, Mr. Petros Maliotis and Mr. Johan Meinderts for their continued support and guidance throughout the research period. The role played by my academic mentor, Ms. Albertien Kijne throughout my whole academic period is indispensable. I really appreciate. This wouldn't be possible without the support from the course coordinators and staff from Van hall University of Applied Science; I am a proud student.

I would like to thank Stawisha for being part of this research especially in making arrangements of the field works, information and contacts to the experts I interviewed.

ABSTRACT

The southern highlands regions of Tanzania form the important potato growing part of the country. Several initiatives have been and they are still being established to develop the sub-sector, CD-PIT being part of them. Productivity is the key challenge that farmers face which is articulated with their farming practice being in seed potatoes, varieties, pests and diseases control or other inputs. This study was conducted with an objective to provide an in-depth investigation of the factors influencing the farmers' adoption of (CSPs) in Iringa, Mbeya and Njombe regions of Tanzania with the view of recommending interventions that will be used by Stawisha to improve the adoption of CSPs by farmers.

Data was collected from the regions of Iringa, Mbeya and Njombe through an online questionnaire. Interviews were conducted through Skype, MS Teams, Zoom and WhatsApp. The obtained quantitative data collected from the online survey was analyzed by use of MS Excel and IBM Statistical Package for Social Science (SPSS) software. The qualitative data was analyzed through narrative method. Descriptive statistics was used to provide summaries and the graphs were applied to compare and contrast different variables of the sample. The results about 62% of the respondents do not use CSPs. The findings have also revealed that amongst other reasons lack of knowledge about varieties, their quality attributes, the unavailability of CSPs, perceived high price of CSPs and the non-cooperative membership are hindering the CSPs adoption by farmers. On the other hand, the marketing strategies of the CSPs producers be it in inadequate promotion, not having CSPs access point for farmers and pricing contributes to the hindrances of the farmers to not adopt CSPs.

To improve farmers adoption to CSPs it is recommended to coordinate stakeholders, CSPs producers to market their products and facilitate input financing to potato farmers. In the long run, business models that engage farmers in CSPs production are recommended.

Keywords: CSPs, CD-PIT, adoption, business models, southern highlands regions.

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ACRONYMS

AMCOS	– Agricultural Marketing and Cooperative Societies
ASDP II	– Agricultural Sector Development Programme Phase 2
ASI	– Access to Seed Index
CD – PIT	– Center for Development of Potato Industry in Tanzania
CIP	– International Potato Center
CSPs	– Certified Seed Potatoes
FAO	– Food and Agriculture Organization of the United Nations
GAP	– Good Agricultural Practices
KIT	– The Royal Tropical Institute, Dutch
KT	– Kilimo Trust
MoA	– Ministry of Agriculture, Tanzania
MoF	– Ministry of Finance, Tanzania
NGOs	– Non-governmental organizations
QDS	– Quality Declared Seeds
QDS	– Quality Declared Seeds
RS	– Regional Secretariat
RVO	– Netherlands Enterprise Agency
SAGCOT	– Southern Agricultural Growth Corridor of Tanzania
SHZ	– Southern Highlands Zone
SMEs	– Small & Medium-sized Enterprises
TFRA	– Tanzania Fertilizer Regulatory Authority
TOSCI	– Tanzania Official Seed Certification Institute
TPRI	– Tropical Pesticides Research Institute
TSH	– Tanzanian Shilling
UN	– United Nations

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CHAPTER ONE: INTRODUCTION

1.1 Background

Potato is the third most grown crop after maize and paddy in Tanzania in terms of production area and tonnage harvested (MoA, 2017). The crop has a major importance to the local economy whereby it is becoming an increasingly important source of income and employment to the farming communities. This is as a result of the growing demand for round potatoes among communities in the country whose population has seen an increase from 44,928,923 to 57,637,628 (NBS, 2013; NBS 2018) in the last 8 years. Most of the potatoes from the southern highlands of Tanzania are destined in the Cities of Dar es Salaam, Arusha, Mwanza, Tanga and Dodoma (Kusiluka, 2019). The demand for round potatoes however goes beyond the local level as neighboring countries like Kenya, Democratic Republic of Congo (DRC), Zambia and Rwanda also demand potatoes from Tanzania making it an important cash crop (RVO, 2017; Kusiluka, 2019).

Potato has huge potential due to the good economic returns per hectare (KT, 2018). The demand for the crop is growing fast and has doubled over the last two decades and expected to triple by 2030 (Stawisha, 2018). The regions produce around 1,515,000 tons of potato in total having 57,000 tons from Iringa Region, 871,000 tons from Mbeya Region and 587,000 tons from Njombe Region (Stawisha, 2018). The regions have a total of about 71,499 small scale farmers with the largest proportion farming at land of below 2 hectares as illustrated in table 1.

Table 1: Number of potato farmers in Iringa, Mbeya and Njombe regions

Regions	Number of farmers/hectares group			
	0.8 - 2 ha	2.1 - 8 ha	8.1 - 20 ha	> 20 ha
Njombe	45,774	708	40	-
Mbeya	24,095	355	74	10
Iringa	413	20	10	-
Total farmers	70,282	1,083	124	10

Source: Stawisha (2018)

Currently Tanzania is implementing the second phase of the Agricultural Sector Development Programme (ASDP II) which focuses on priority crop value chain development (MoA, 2017). On the face of it, the potato industry in Tanzania still faces the challenges of availability of clean seed potato tubers, poor production technology, poor market access, insufficient crop protection measures, low fertilizer application and poor storage facilities (Stawisha, 2019). It was previously attested that inadequate high quality-seed potatoes and limited knowledge on seed is among the reasons for low productivity compared to the potential of the sub-Saharan region, Tanzania being one of the countries (CIP, 2011). Although, the crop has a potential to contribute vastly in economic and food security to the farming communities (Kwigizile, et al., 2017), most farmers in the southern highlands of Tanzania often harvest an average of 7 tons per hectare in one harvest which is low yield compared to the potential that is 30 to 40 tons per hectare (Stawisha, 2019). It has been observed that with use of Good Agricultural Practices (GAP) including the use of Clean seed potatoes, yields can double and the farm gate income can quadruple (KT, 2018).

In a study by Bentley, et al (2011) it was revealed that very few farmers use quality seeds and most of them source their seed potatoes from their own farms or neighboring farms. In relation to that, Mpogole (2012) highlighted that there is a tendency of the farmers in the southern highlands of Tanzania to reserve some ware potato to be used as seed potatoes for the next season. It was found out that 88% of produce is traded and the rest is consumed and used as seeds.

Clean seed potatoes have disease incidences below the threshold levels and using Certified Seed Potatoes (CSPs) has proven to minimize significant losses that result from diseases during production (Frost, et al., 2013). The seeds from the informal sector on the other hand have quality, purity and plant health issues yet low potato farmer's readiness to purchase certified seeds has been ruining the interest of the private sector to lay out capital on seed potato businesses (FAO, 2017). A study conducted by Mpogole & Kadigi (2012) mentioned that availability of seed tubers is one of the factors that dictates the farmers' discretion on the selection of the potato variety. Limited access to the best varieties and CSPs has been mentioned to be the key impediment of the potato sub-sector causing most of the seeds to originate from the non-formal sector (FAO, 2017).

Several initiatives like Southern Agriculture Growth Corridor of Tanzania (SAGCOT) Potato partnership in Njombe in 2015 aimed at transforming the potato sub-sector helped to increase access of clean seed potatoes to farmers (Kwigizile, et al., 2017). The project results areas were in clean and high yielding seed potatoes, improve potato yield, imparting production and storage technologies to farmers and farmers organizations. The project ended and it opened up the establishment of the Center for Development of the Potato Industry in Tanzania (CD-PIT) project (SAGCOT, 2017; Pioneers, 2018; Stawisha, 2019). Stawisha is a Non-government organization (NGO) which is the implementor of the project in collaboration with other stakeholders such as Europlant, Agrico, HZPC, Bayer, Yara, Grimme, Hanse Staalbouw joined hands together as partners to explore opportunities in areas of Seed Potatoes, Crop protection, Mechanization and Storage (Stawisha, 2020a).

According to Stawisha (2020d), since its establishment, Stawisha is running a model potato farm that is equipped with model irrigation system, zero energy potato storage warehouse, machinery for farm activities such as potato planting, ridging, fertilizer application. The organization has established and operated about 30 potato farmers field schools reaching out more than 2,000 farmers in the regions of Iringa, Mbeya and Njombe and has successfully supported the testing for registration of 10 potato varieties of which 6 were successfully registered. The business support provided by Stawisha to producers has successfully linkage the Agricultural Marketing Cooperative Societies (AMCOS) to other stakeholders including the financial service provider and that potato markets of Dar es Salaam and Zanzibar that provided competitive good prices to farmers. However, Stawisha has provided training on extensive potato production to 20 extension officers from districts of Mbeya region and to staff of Agricultural Training Institutes and University of Science and technology in Mbeya.

1.2 Stawisha

This research has been commissioned by Stawisha, a non-government organization which is a Local implementer of the Center for Development of the Potato Industry in Tanzania (CD-PIT) project. This project is a public private partnership between Tanzania and Dutch Agricultural Ministries and the private potato sector in both countries.

Its mission is being centred at the following key objectives; developing a robust, competitive sector, with a focus on facilitating private sector sustainable development and creation of jobs, building capacity of farmers and companies in Tanzania involved in the value chain for sustainable potatoes production and marketing; creation of added value, sustainable business relations between Dutch and Tanzanian partners, improved food security, more safe and healthy food.

There is still much to win for the Tanzanian potato sector, as productivity is still low per hectare compared to 45-58 MT per hectare in the Netherlands (Weening, 2018). One of the ways to improve productivity is by using better seed (RVO, 2017).

Stawisha (2019) reports that Silverlands Tanzania; one of the commercial seed potatoes producers produced about 500 tons of CSPs in 2019 but market uptake was not ensured because farmers fail to adopt these certified seed potatoes (CSPs). Therefore, Stawisha requested the researcher to engage different stakeholders, primarily farmers to find out the factors that hinders farmers adoption of CSPs.

1.3 Research Problem statement

The plant life starts with seeds and therefore, the seed is the foundation input in agriculture. According to Singh (2008), success in potato farming is much influenced by the quality of the seed potato. The importance of improved seed in improving yield has also been mentioned by Jack & Tobias (2017). Seed potato is the primary input in potato production of potato farmers. However, the farmers in the southern highland part of Tanzania hardly adopt CSPs even though CSPs are available. Not using CSPs is one of the main causes for low productivity of potato farmers. Stawisha, a local implementer of the Center for Development of the Potato Industry in Tanzania mission is to achieve a sustainable potato value chain for the CSPs and therefore needs to know why farmers in the southern highlands of Tanzania particularly in Iringa, Mbeya and Njombe regions hardly adopt CSPs and how adoption of the CSPs can be improved.

1.4 Research objective

The objective of this research was to provide an in-depth investigation of the factors hindering the farmers' adoption of CSPs in Iringa, Mbeya and Njombe regions of Tanzania with the view of recommending interventions that will be applied by Stawisha and other stakeholders to improve the adoption of CSPs by farmers.

1.5 Research questions

- Q1. What is hindering farmers' adoption of CSPs in the southern highlands of Tanzania?
 - 1a. Who are the stakeholders and their roles in the potato sub-sector in the southern highlands of Tanzania?
 - 1b. What are the determinants of farmers adoption of CSPs?
 - 1c. What are the production challenges faced by the potato farmers?
 - 1d. What marketing variables are used by CSP producers?
 - 1e. What are the challenges encountered by the CSP producers in promoting their products to farmers?
- Q2. What are the interventions to improve the adoption of CSPs in the Southern Highlands of Tanzania?
 - 2a. What opportunities can be harnessed by potato famers to improve adoption of CSPs?
 - 2b. What strategies are required by CSP producers to improve the adoption of CSPs?
 - 2c. What institutional support is required to improve CSP adoption?

CHAPTER TWO: LITERATURE REVIEW

This chapter highlights past studies about the key concepts used in this study. The chapter reviews issues relating to certified seeds, seed adoption, stakeholders in the potato chain, determinants of farmers for seed adoption, potato seed marketing and the challenges in the potato chain.

2.1 Certified seeds

Certified seeds have been defined by FAO (2018) as the first-generation seeds that has been multiplied and made available to farmers. The multiplication process needs to be controlled. CSP production demands a deep expertise on potato diseases and control as well as skills in storage and sprouting (Roo & Gildemacher, 2016). This process makes it a more professional sector and that it needs a well-organized seed system (CIP, 2011). Certified seeds are the seeds from a formal sector. The seeds from the informal sector have quality, purity and plant health issues and yet low potato farmer's readiness to purchase certified seeds has been ruining the interest of the private sector to lay out capital on seed potato businesses (FAO, 2017).

In Tanzania, the major source of seed potatoes is the informal sector as most farmers source seed potatoes from their own produce or neighboring farmers (RVO, 2017). The potato varieties started to be registered from the year 2012 and until January 2020 about 10 seed potato varieties has been registered (Stawisha, 2019; TOSCI, 2020). In 2012 the CIP origin varieties named Asante, Meru, Sherekea and Tengeru were registered before the registration of three Dutch varieties named Rumba, Jelly and Sagitta in 2016 followed by three more varieties (Sifra, Taurus, Panamera) which were registered by the end of 2018 (Stawisha, 2019).

An overview of the varieties, productivity potential and their attributes has been shown in table 1.

Table 2: List of the potato varieties registered in Tanzania as at January, 2020

S/N	Variety	Yield Potential (t/ha)	Agonomic Attributes/Suitability
	Jelly	35.9	Tolerates potato late blight, potato leaf blight, potato viruses, Storable and suitable for French fries
	Meru	35 – 50	Resistant to potato virus X and late blight
	Asante	20 – 30	Resistant to lodging and late blight
	Tengeru	30 – 40	Resistant to late blight
	Sherekea	40 – 70	Resistant to potato virus X and Y and late blight
	Sagitta	34.9	Tolerant to potato viruses, drought, tuber bight and common scub Resistant to physical damage, storable Suitable for French fries, crisps and normal cooking
	Rumba	35.6	Tolerant to tuber blight, late blight, common scab and leaf blight Storable and tough to physical damage
	Sifra	N/A	Open pollinated Variety
	Taurus	N/A	Open pollinated Variety
	Panamera	N/A	Open pollinated Variety

Source: TOSCI (2020)

According to Kwigizile et al (2017), the SAGCOT potato partnership project: Upscaling Improved Potato Varieties for Smallholder Farmers in Njombe Region provided training to farmers for them to engage in seed multiplication of which eight potato seed farmers each with ten acres plots produced seed

potatoes in contract with Mtanga Foods Limited and sold to the fellow farmers. That increased the availability of the farmers at their areas. The project successfully built eight diffused light each with 25 MT capacity for storage of potato seeds. Another result area was the production of soil fertility status report that could assist in recommendations of fertilizers applications by farmers.

During the 2014-2017 period, about 1,445 MT seed potatoes were produced by Mtanga Foods Limited and 396.8 MT of Quality Declared Seeds (QDS) were produced by farmers. Through the project, the skills of about 42 village and ward extension staff on potato was built. The project reached directly about 2,405 farmers (45% Female). The project facilitated the establishment of ISOWELU Agricultural Marketing and Cooperative Society (AMCOS). The project ended up by leaving behind some lessons which are:

- Immediate benefit is the key for farmers to invest in farming technology,
- Proper extension service to farmers improves potato quality and productivity,
- Field days, 88 exhibitions and demo farms are most efficient ways of reaching large number of farmers in terms of time.
- Farmers learn best from their fellow farmers and when they are organized
- Farmers are willing to become Seed producers.
- Even though seed production is a most profitable business, still ware potato production has a strength to transform the farmers from poverty within a short period of time.
- On top of that, improved varieties can increase the normal yield of a farmer by 40 percent.

Through all that, Stawisha (2019), reported that Mtanga Foods limited no longer produces CSPs and Silverlands and Tanzanice emerged as new producers. RVO (2017) also mentioned TARI Uyole as the supplier of clean seed potatoes to farmers but at limited quantities.

2.2 Seed adoption

Adoption has been defined by Sánchez-Toledano et al (2018) as the action taken by the farmer to switch from previous activity to the other. Feder et al. (1985), defines it as the extent to which a farmer grasps into application a new technology after having full knowledge of its potential. At farm level, adoption entails the farmers consciousness to choose to apply a new scientific know-how. In this study, the later definition is most relevant. This is because adoption of certified seed indicates the process in which farmers are fully informed on the presence of the certified seed including the productivity potential and decide to use or not. The study that was done to test the potato farmers on adoption of technologies by Namwata et al (2010) found out that access to extension services, household income, gender of a farmer and experience in farming have an influence in adoption of agricultural technology by farmers.

Fasoyiro (2012) attested that financial returns of technology and the way the farmers realize the difference influences the adoption technology. Also, too advanced technologies and not involving the farmers from the early stages affect their practice and so it becomes difficult to adopt. Viatte (2000) mentioned that apart from its needs for more disciplines to work together, adoption to technology by farmers has a connection with usefulness of the technology itself, visibility of the outcomes, amount of capital needed to invest, profitability and policy environment that may incentivize or disincentivize farmers.

Regular visits by extension officers, engaging the farmers from inception of the technology and access to financial services are important influencers of adoption to technologies (Lawal & Oluyole, 2008). It was learnt that the success of the adoption of technology can be realized if the technology development has considered the users affordability and their preferences, availability of financing services and market while keeping in mind that extension services only cannot give assurance of adoption of farmers but rather market linkage and financial facilities (Connexus, 2018).

According to Jack & Tobias (2017), communication is one of the key influencers of technology adoption by farmers. Farmers need to know the existence of the technology, a belief of its usefulness and knowledge of its application before they decide to adopt it. It has also been mentioned also that poor quality inputs is the main hindrance of farmers adoption to technology.

2.3 Stakeholders

According to Santoso & Delima (2017), a stakeholder is a person or firm that has interest in the business. In this study, stakeholders have been regarded as actors, supporters and influencers whose businesses, interests or activities have an effect on the shape of in potato sub-sector in the southern highland of Tanzania. According to Fasoyiro (2012), stakeholders play a vital role in promoting the technology to farmers and hence contributing to adoption.

KIT (2010) has indicated the way different stakeholders can collaborate to transform the chain. The potato processor teamed up with an NGO that was supporting farmers in order to enter contracts of potato supply with farmers groups instead of individual farmers. The realized benefits were staggered production in order to ensure constant supply of the potato of the needed variety, financial support to farmers, structured extension services and input supply.

According to Drost et al (2012), a stakeholder collaboration is productive when trust is built amongst them, the societies are represented, leadership from the private sector is strong and stakeholders are active and well involved. In addition to that, stakeholder involvement has proven to be a very important factor in creating an effective collaboration. Multi-stakeholder partnerships contribute to learning, sharing knowledge, collective action, improvement of access to new markets, quality-based pricing system, agronomic practices capacity building and product quality aspects.

Thiele et al (2011) denoted that Lack of trust among value chain actors has been causing an increase in the transaction cost. The multi-stakeholders' platforms have been observed to have a positive impact in farmers income which contributes to poverty alleviation to small-holder farmers.

SAGCOT (2020) mentioned key stakeholders who are active members of the potato partnership in the southern highlands of Tanzania as:

- Government organizations;
Ministry of Agriculture, Local Government Authorities, Regional Secretariats, TOSCI, TARI Uyole.
- National/International organizations;
USAID, Kilimo Trust, CD-PIT, CIP, AGRA, Royal Norwegian Embassy
- Private companies;
National Microfinance Bank (NMB), HZPC, Grimme, Europlant, Yara, Bayer Crop Sciences

According to Kusiluka (2019), the potato stakeholders in the southern highlands of Tanzania include:

- Direct actors;
Farmers, village traders, urban traders, wholesalers, supermarkets, exporters and consumers);
- Indirect actors;
 - Government,
 - Researchers (TARI Uyole),
 - Agricultural input suppliers (MONSANTO, Beula, BASF, YARA, Syngenta, TFC, Balton)
 - Cargo transporters (Usangu Logistics, Simba Logistics, Bravo logistics, Mohamed Enterprises Tanzania Limited, Export Trading Group),
 - Extension officers,
 - Tanzania Official Seed Certification Institute (TOSCI),

- Financial services providers (CRDB Bank, NMB Bank, FINCA, PRIDE, BRAC, SACCOS),
- NGOs (MVIWATA, MIICO), and
- Donors (DFID, USAID, SIDA, GIZ, IFAD, AfDB, WB, JICA)

2.4 Determinants of seed adoption

2.4.1 Seed acceptability by farmers

Vlassenroot (2008), defined the acceptability as to the way potential users respond (act and react) to a measure or product. Quality of seed and acceptance of seed potatoes and therefore farmers preference for certain varieties is influenced by the yield potential of the seed variety (Joshi & Ullah, 2017). The seed quality and farmers preferred varieties compared to the varieties available in the seed market can reveal the situation on seed potato acceptability (WUR, 2017). In this study acceptability implies the choice of the farmer to adopt the CSP based on the personal variety and quality of seed tubers preferences.

External potato quality attributes such as tuber shape, tuber size, tuber eye depth and internal quality attributes like starch content and dry matter content have been mentioned to be important and have influence on the selection of potato varieties (Kumari, et al., 2018). Also, a study done by Bekele & Haile (2019) mentioned marketability and acceptability of the potatoes to either processing or direct consumption influences farmers choice for potato varieties. TARI (2020), concluded that farmers choice of the variety depends on the market preferences which are also dynamic.

2.4.2 Perceptions

Perception has been defined by Qiong (2017) as the means of being aware or interpretation of sensory input. Farmers farming characteristics such as farmers decision to adopt can be reflected from the study done by Sánchez-Toledano et al (2018) that named demographics such as experience in farming, farmers family size, extension service, prosperity and school of thought of the farmers to be the influencers. Sánchez-Toledano et al. (2018) concluded that household size and age of the farmer have a negative relationship with the propensity to adopt certified seeds. The type of advice and frequency of contacts with the extension officers have a positive relationship with certified seed adoption.

According to Baglan et al (2020), prosperity, financial access, education level, head of household and size of the family are determining factors of the adoption of certified seeds by farmers. Okello, et al (2016), also mentioned household size, mobile phone ownership, distance to the market, marketing risks, household food security, perceived quality of the seed potato to pests and diseases and perceived taste affects the farmers decision on the choice to use or not use CSPs.

A study that was conducted in Tanzania on maize seeds revealed that size of the farm, literacy level, extension services and climatic factors (rain) influences the farmers adoption of improved seed (Nkonya & Norman, 2008). A seed technology study by Gesare (2012) listed information about the available varieties, perception on variety, farmers' prosperity and availability of manpower as key reasons for farmers adoption of certified seeds.

2.4.3 Seed accessibility

Accessibility is the degree of freedom from barriers for users with different needs and likes (UN, 2015). According to WUR (2017), seed accessibility implies the strategies and channels that are employed by the seed producers to market and sell the seed potatoes to the farmers. The seed accessibility laid down in this study implies the ease with which farmers obtain CSPs.

Sometimes farmers only access what is available in the market and so seed availability can dictate farmers seed accessibility. Roo & Gildemacher (2016) proved that poor availability of quality seeds,

high cost of quality seeds, lack of awareness to farmers about the presence and benefits of quality seeds have been reasons for smallholder farmers poor use of quality seeds. Also, a study conducted by Mpogole & Kadigi (2012) concluded that availability of seed tubers is one of the factors that dictates the farmers discretion on the selection of the potato variety. According to Okello, et al. (2016), the distance from the source of the CSPs has a negative relationship with the likelihood to use them. Farmers who live far from the CSPs source are less likely to use CSPs.

2.4.4 Seed affordability

WUR (2017) defined seed affordability as the financial capacity of the farmers to buy or not buy the seed potatoes. The idea carries with it the role of different stakeholders in providing financial support to farmers in purchases of quality seed. A balance between the need to make profit out of the seed business and price that is posed to farmers is necessary. ASI (2019) has pointed out how large or small the seed market is, depends on the number of potential farmers who are eager and can pay for quality seed. According to this study, strategies to increase the affordability of the quality seeds are access to finance, access to insurance, pricing strategy and collective purchase of seeds by farmers.

2.4.5 Seed attractiveness

According to WUR (2017) seed attractiveness is defined in relation to the rate of returns of quality seed in terms of yield and income effect on the farmer. The seed potato yield potential with its resultant income generation plays major roles in attracting farmers to opt for the use the seed potato. Good quality seed potatoes is the most influencing factor for the yield performance. It has been realized that through adopting good quality potato seeds, the yield can increase by 30 to 50 percent (Wang, 2008). According to Wang (2008), yield of a potato is affected also by age of seed potatoes, variety and agricultural practices which in turn may hinder seed potatoes attractiveness

2.5 Challenges for CSPs adoption

Challenges for CSP adoption can be political, economic, social, technological, environmental and cultural. A constraint has been defined by Umerez & Mossio (2016) as the restraint or predisposition on the prospect of change in certain elements. Lal, et al (2011) listed constraints faced by farmers in adoption of potato technology to be unfair business transactions by traders and middle-men, low potato farmgate price, high cost price that reduces profit, unavailable cold potato storage facility, low quality and fake inputs, lack of entrepreneurial skills by farmer and lack of good quality seed potatoes.

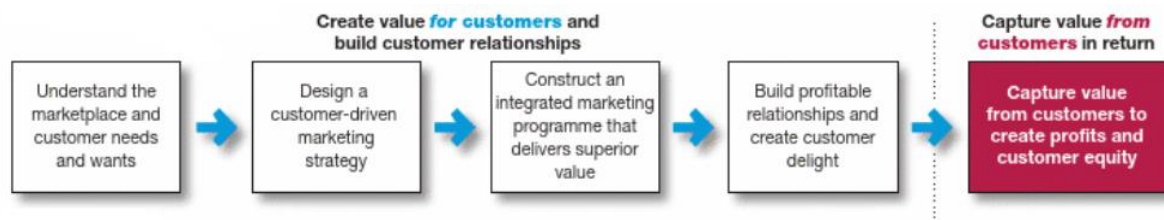
However, Kusiluka (2019) mentioned scarcity of the recommended seed potatoes, inconsistent weights and measures, dominance of middlemen, pests and diseases, adulterated agrochemicals, limited storage and value addition technologies, difficulty in accessing financial services. Meanwhile potato processors suffer the challenge of unstable supply of quality potatoes due to seasonality of the crop.

TARI (2020) denoted that the supply of quality and clean seed potatoes do not meet the increasing demand and the late blight, bacterial wilt and insects pests are threatening potato production. Also, the market unreliability of potatoes affects the farmers adoption of clean seed potatoes.

2.6 Seed marketing

Kotler, et al (2019), defined marketing as the way a business fascinate its customers and take charge to maintain a productive customer relationship. It involves also customer value creation aiming at capturing value from them as a reward. The marketing process involves different stages starting with understanding the market and ending with capturing value as illustrated in figure 1.

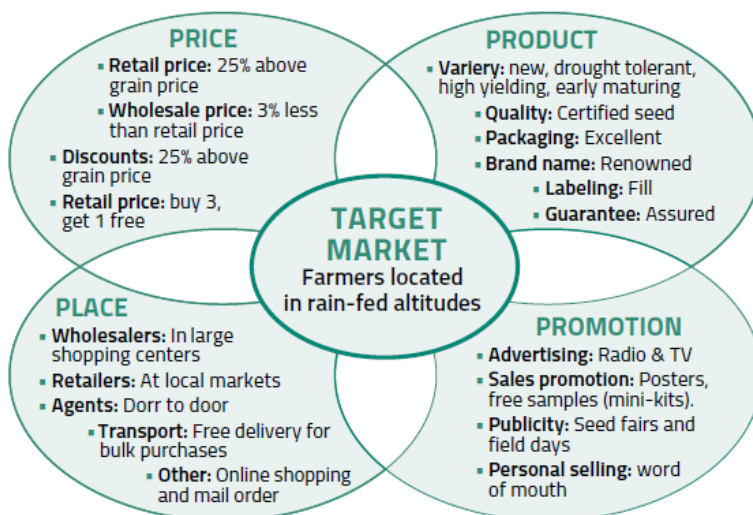
Figure 1: Marketing process



Source: Kotler, et al (2019)

According to FAO (2018), seed marketing starts with understanding the varieties farmers need and ends up with meeting their needs. A 4Ps marketing mix can be applied by a seed producer to put into action its marketing strategy in reaching its farmers as illustrated in an example in figure 3.

Figure 2: Example of the 4Ps of the seed business



Source: FAO (2018)

A study done by Kalam (2016) revealed that seed business without application of a proper marketing strategy is the source of farmers not using quality seeds. It was also attested that price is the most sensitive variable in seed business and so should always consider the reaction of the farmers. Promoting seeds by using electronic displays is recommended because it attracts farmers than other methods.

2.7 Strategies

In the attempts to improve farmers adoption to various technologies, some studies have been done specifically to potato farmers that also recommended interventions. Namwata, et al. (2010) recommended increasing access to financial services and improving extension services delivery as interventions to improve potato farmers adoption to agricultural technologies. In addition to that, Mpogole & Kadigi (2012) asserted the seed producers to start with the market in order to understand the preferability side of seed potatoes.

TARI (2020) has reported interventions that has been done to improve supply of good seed potatoes as capacitating the TARI Uyole Research Center by building two seed potato screen houses, installation of irrigation system for seed potato multiplication and equipment of the tissue culture laboratory in

order to support production of clean and quality early generation potatoes. Also, capacity building to farmers, extension officers and seed companies. With training and the seed potatoes from TARI Uyole some farmers in Mbeya Region achieved a yield of 20 MT per hectare from 10 MT per hectare they used to harvest from recycled seeds and managed to build their own potato storage facilities.

Adoption of Out-grower consortium business models have been one the interventions that have been suggested by Kusiluka (2019) to address the challenges that faces the potato value chain, seed potato legislation and limited availability being amongst them.

2.7.1 Inclusive business model

Pölling, et al (2017) defined a business model as the idea that is globally recognized that explains how firms interact in business and how value is generated and captured.

The term inclusive according to FAO (2015) means linking the smallholder farmers and SMEs to the market. An inclusive business model means a business model that provides an income to sustain life to the vulnerable groups. It is flexible in terms of trading arrangements, gives the famers a bargaining power and market information, capacitates the actors and promotes collaboration, can be applicable to other chains and allows diversification of income streams.

Conclusively, FAO (2015) defined ‘inclusive business model’ as the way enterprises being large or small, formal or informal deal, market their products, source inputs and finance. Its intention is to link the farmers into other chain activities. The way actors within the chain interact with each other defines the chains and has a positive or negative impact on chain development.

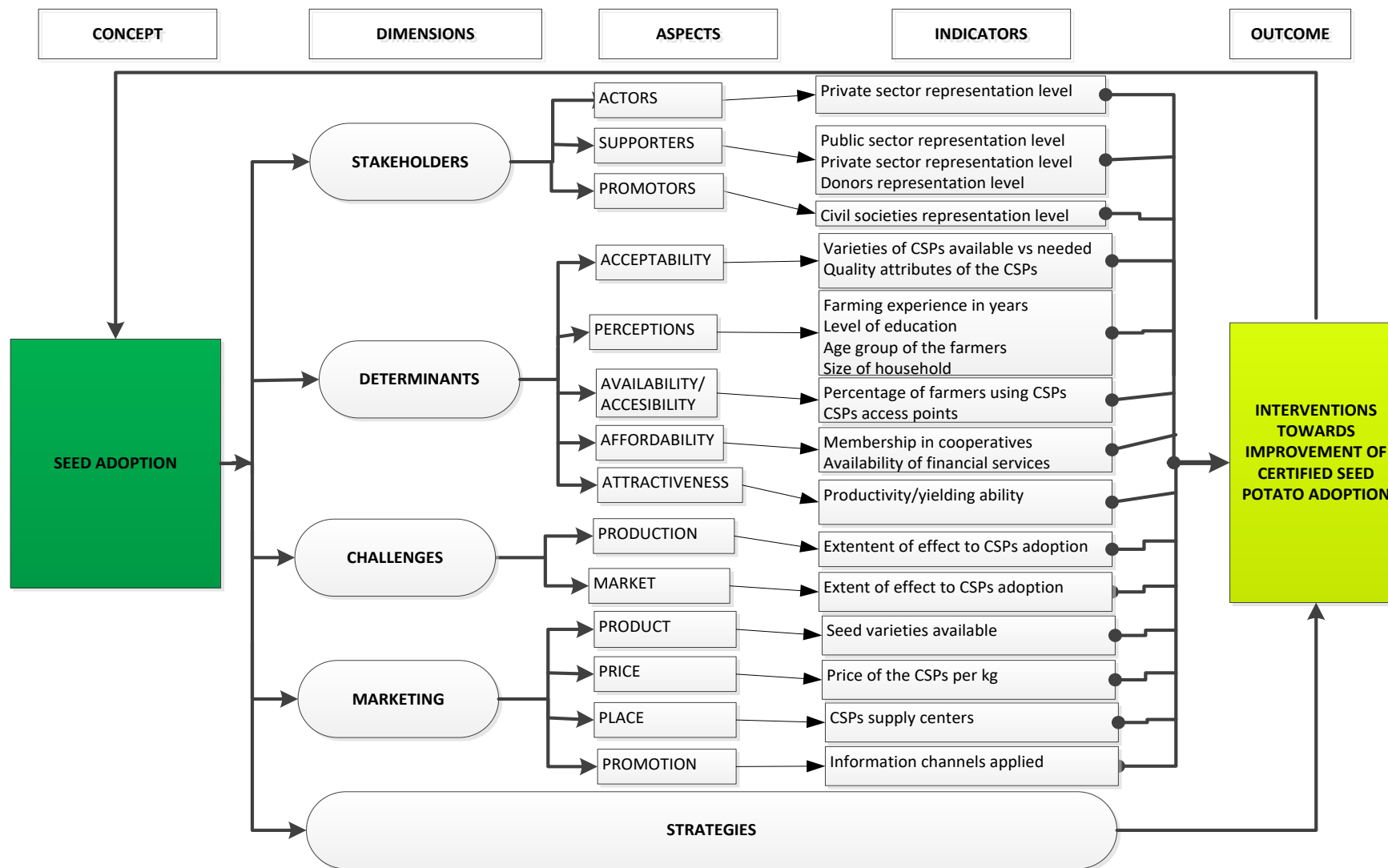
2.8 The Conceptual Framework

In this study, seed adoption is the core concept that has been broken down into dimensions of stakeholders, determinants, challenges, marketing, and strategies for better understanding of the core concept. For the stakeholders it is looked into who are the main actors, supporters, and promoters. Regarding the determinants for adoption of CSPs it is researched;

- How acceptability of the CSPs influenced adoption;
- How accessibility /availability of the CSPs influenced adoption;
- How farmers characteristics such as age, education, experience affect the decision to use or not use CSPs;
- How accessible are the seeds for the farmers;
- How affordable are the CSPs for the farmers;

The identified aspects of each dimension were selected as the prime focus of the study as extracted from different literature sources. Relevant indicators were identified to measure the various aspects of the dimensions towards seed adoption to ascertain evidence for suggested interventions as shown in figure 3.

Figure 3: Conceptual framework



Source: Author (2020)

CHAPTER THREE: RESEARCH METHODOLOGY

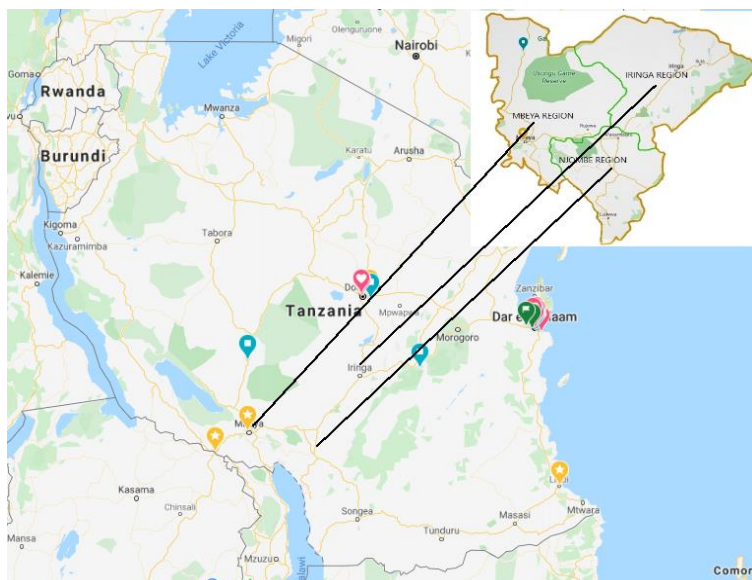
3.1 Study area

The research was conducted in the regions of Iringa, Mbeya and Njombe in the southern highlands of Tanzania. The regions shown in figure 4 are interconnected and located between latitude 6°55' and 10°32' South of the equator and longitude 32° and 36°55' East of the Greenwich.

The regions have been selected for the study because they are the three most important areas for potato production in Tanzania (Nyunza & Mwakaje, 2012). In addition, activities of Stawisha are concentrated in these three regions.

CSPs producers are in majority located in Iringa region. This could have an effect on the adoption of CSPs for farmers in the neighboring regions. Hence, the researcher selected these other regions to discover if the distance from the source can have effects on the way farmers opt to adopt or not in other regions.

Figure 4: The Map of the Study Area showing the location of Iringa, Mbeya and Njombe



Source: Google Map (2020)

The regions where research was conducted are supported with their features with some being closely related.

Land area

Iringa, Mbeya and Njombe have a land area of 35,743 Sq. Km., 35,954 Sq. Km. and 24,994 Sq. Km respectively. In total, the three regions have an area of 96,691 square kilometers occupying 10.2 percent of the Tanzania mainland total area.

Population

According to NBS (2013), the populations of the Iringa, Mbeya and Njombe are estimated at 1,149,481, 2,204,543 and 837,557 respectively in the year 2020. The population is about 7.3% of the country's total population.

Rainfall

The regions of Iringa, Mbeya and Njombe have total rainfall of 500mm to 1,600mm per annum, 650 mm to 2600 mm per annum and 600mm to 1,600mm per annum respectively. According to TMA (2020), the country receives an average annual total rainfall of 1283.5 mm.

Temperature

The Iringa region temperature ranges between 10°C to 28°C. Mbeya region temperature range between 16°C in the highlands and 25°C in the lowland areas. While the Njombe region temperature range from below 0°C to 26°C.

Topography and Soils

The Iringa region is found at the elevation ranging from 900m to 2,300m above sea level. The Iringa region soils are characterized as red/yellow, well drained, highly weathered soil and the leached clay soils, intermediate clay soils and the highly fertile red brown loams. Most of the farmlands are on sandy loams with some black cotton soils

The Mbeya region lies at altitudes range from 475m to over 2981m above the sea level. There is diversity in the geology, soils type and vegetation of the region whereby a large area is covered with thick layers of volcanic and alkali basalt soils; and limestone in low lying areas. The arable areas are mostly of moderate fertility, varying from sandy loam, alluvial soils to cracking clays.

The Njombe region lies at an altitude of 600m to 3,000m above the sea level. The soils of the Njombe region varies from the drained and leached clay soils to highly fertile red/brown loams.

3.2 Research Strategy

The study was a combination of desk study for secondary data and a survey and semi-structured interviews for primary data.

3.2.1 Research design

The COVID-19 pandemic has affected international travels and caused some actions to be taken by governments that includes social distancing and limited social interactions. Due to that, the study adopted on-line qualitative and quantitative approaches both primary and secondary data collection. Interaction with the farmers and observation for quantitative CSPs adoption were not possible due to limited international travel.

The data collection and analysis tools and sample size are presented in the following sections.

3.3 Data collection tools

3.3.1 Desk study

Secondary data about potato stakeholders and their roles, determinants of CSPs adoption and production challenges facing farmers was collected from different online literature sources though a review of various previous and latest scholarly and peer reviewed e-journal articles and e-books. Grey literature from regional government reports, fact sheets, policy statements, issues papers, and international organizations repositories.

3.3.2 Online Survey

Primary data was obtained through an online questionnaire. Data was collected from farmers in the three regions with the help of four field assistants who used the interpreted questionnaire and entered data into the online forms. The survey collected data about determinants of CSPs adoption, production challenges faced by potato farmers and marketing variables applied by the CSPs producers. The online survey was designed via Microsoft Office Forms program and shared with the four field assistants. The field assistants were trained about the research objectives and questions in order to prepare them for data collection and alerted to observe the health regulations pertaining the COVID 19 pandemic. See appendix 1 for the survey questions.

3.3.3 Online Interviews

Online semi-structured interviews were held with key informants from certified seed producers, extension workers, cooperative leaders, potato processors and experts who had experience in potato industry. The interviews were conducted through Skype, Zoom, MS Office Teams and WhatsApp and covered the following topics: Seed potatoes production; farmers adoption of CSPs and strategies; adoption; varieties of seed potatoes; challenges facing both CSPs producers and farmers; extension services delivery.

3.4 Sample size and selection

A total sample size of 55 persons was adopted for the study. Three regions (Iringa, Mbeya and Njombe) were selected with assistance of Stawisha by use of purposive sampling. Within each region, the sample of 15 farmers was selected at random from the potato growing districts.

15 Key informants were selected by a way of purposive sampling for the online interviews as shown in table 3.

Table 3: Overview of the sample size

Respondents	
Iringa	15
Mbeya	15
Njombe	15
Total	45 farmers
Key informants	
Extension Officers	3
Seed Producers	3
Potato Processors	3
Cooperative Leaders	3
Experts	3
Total	15 key informants

The extension officers are from Iringa, Mbeya and Njombe regional offices. They were selected because they are superior in extension officers in the regions. The selected seed producers were Silverlands Tanzania Ltd., Tanzanice and Mtanga Foods Ltd., as they are official seed potato producers situated in Iringa region.

Mamujee Foods Ltd., Beta Foods Ltd., Optimal (T) Ltd., were the selected potato processors. They are established potato processors who have invested in machinery for processing and they fetch raw materials also from the regions of Mbeya, Iringa and Njombe. The cooperative leaders were selected from ISOWELU AMCOS (Njombe), Rungwe Smallholders Tea Growers Association (RSTGA) SACCOS

(Mbeya), Mtambula AMCOS (Iringa) due to having potato as their main cash crop or part of their growing crops. Key potato experts selected from SAGCOT Center Ltd., TARI Uyole, Stawisha as potato is their entire business or part of their business. SAGCOT Center Ltd., had a project in Njombe region on seed potatoes and is the lead organization of the Potato Partnership. TARI Uyole as the public research Institute has been working with potato stakeholders including farmers and contributed to the supply of clean seed potatoes. See appendices 2 to 6 for the checklists for interviews.

3.5 Data analysis

The results from the online survey with farmers were clustered according to regions (Iringa, Mbeya and Njombe), farmers demographics (age, gender, education attainment, family size), land size and land ownership in order to assist in studying the differences and similarities amongst the different variables in the study. The later categories were used because the literature review showed that these characteristics can influence the adoption of CSPs. The One-Way analysis of variable (ANOVA) test was conducted to determine whether there are any statistically significant differences between the means of the prices of CSPs between regions. The Chi Square test was also used to test for differences use of CSPs between the age group of farmers. Kruskal Wallis Test results for difference in perception on quality attributes.

Qualitative data collected via semi structured interviews was analyzed by use of the narrative method as a way of interpreting responses from the interviewees told within the context of study. The process was used to identify patterns, codes and themes as a way of interpreting the interview outcomes.

A stakeholders analysis and a value chain map were used to map the potato stakeholders by defining their different roles in the potato chain.

Literature sources were used to benchmark determinants of CSP adoption against what has been collected from survey and interviews. An overview of the data collection tools engaged in this study have been shown in table 4.

Table 4: Overview of data collection tools for the study and justification

Research questions	Research Questions	Data Collection tool	Justification of tool
Main question	Q1. What is hindering farmers' adoption of CSPs in the southern highlands of Tanzania?		
Sub questions	1a. Who are the stakeholders and their roles in the potato sub-sector in the southern highlands of Tanzania?	Desk study	Stakeholder mapping from published and grey literature sources
		On-line Interviews	Ascertain opinions and experiences about stakeholders from the interviewees
	1b. What are the determinants of farmers adoption of CSPs?	Desk study	Ascertain evidence of the determinants from published and grey literature sources
		On-line survey	Ascertain farmers responses about determinants

Research questions	Research Questions	Data Collection tool	Justification of tool
		On-line Interviews	Ascertain opinions and experiences about the determinants from the interviewees
	1c. What are the production challenges faced by the potato farmers?	Desk study	Ascertain evidence of challenges from published and grey literature sources
		On-line survey	Ascertain farmers responses about their production challenges
		On-line Interviews	Ascertain opinions and experiences about the farmers' production challenges from the interviewees
	1d. What marketing variables are used by CSP producers?	On-line Interviews	Ascertain opinions and experiences about the marketing variables from the interviewees
		On-line survey	Ascertain farmers responses about their views on marketing variables
	1e. What are the challenges encountered by the CSP producers in promoting their products to farmers?	On-line Interviews	Ascertain opinions and experiences about challenges from the CSP producers
Main question	Q2. What are the interventions to improve the adoption of CSPs in the Southern Highlands of Tanzania?		
Sub questions	2a. What opportunities can be harnessed by potato famers to improve adoption of Certifies Seed Potatoes?	Desk study	Ascertain evidence of the opportunities from published and grey literature sources
		On-line survey	Ascertain farmers views about the opportunities to adoption
		On-line Interviews	Ascertain opinions and experiences about opportunities from the interviewees
	2b. What strategies are required by CSP producers to improve the adoption of CSPs?	Desk study	Ascertain evidence of some strategies on seed potatoes from published and grey literature sources
		On-line survey	Ascertain farmers views about the strategies to improve adoption of CSPs
		On-line Interviews	Ascertain opinions and experiences about the strategies from the interviewees
	2c. What institutional support is required to improve CSP adoption?	Desk study	Ascertain the institutional support needs from published and grey literature sources

Research questions	Research Questions	Data Collection tool	Justification of tool
		On-line survey	Ascertain farmers views about the institutional support to seed potato adoption
		On-line Interviews	Ascertain opinions and experiences about the institutional support from the interviewees

Source: Author (2020)

CHAPTER FOUR: RESULTS

The chapter provides the research findings.

4.1 Potato stakeholders and their roles

The key informants were asked to mention the stakeholders in the potato sub-sector in the southern highland regions of Tanzania in order to evaluate and relate the current seed potato situation to the way they act or they are coordinated. The interviews results showed that there are many stakeholders who play different roles in the potato sub-sector. The stakeholders were then grouped into categories of Actors, Supporters and Promoters. The table 5 shows what stakeholders and roles the key informants mentioned when asked about the stakeholders and their roles.

Table 5: Stakeholders and their roles

Stakeholder group	Stakeholder	Mentioned roles
Actors	Producers	Farmers
		• producers of potatoes
	Input suppliers	Silver lands Tanzania Limited
		• seed producer
		Bayer
		• supply agrochemicals
	Processors	Yara Tanzania Limited
		• fertilizer supplier and technical supporter;
		OCP Tanzania Limited,
		• fertilizer company
Supporters	Retailers	Beta food products
		• Processes potatoes into crisps and other products
		Mamujee Foods limited
		• processes potatoes into various products
		Optimal (T) Limited
		• A processor of potato
	Public	Shoppers Plaza Supermarkets
		• The outlet of ware potatoes and processed products
		Government/ Ministry of Agriculture
		• supports the sub-sector-registration of varieties from the Netherlands
		• change of regulation to accommodate seed potatoes
		• construction of market infrastructure,
		• regulation of inputs
		• regulates weights and measures
		• overseer of the agriculture sector
		• provide extension services
Promoters	TARI	• Research
		• Trials of imported varieties
		• Soil testing
	Tanzania-Netherlands G2G project	• Capacity building of Tanzania and facilitated the formation of Stawisha
		• registration and CSPs
Private/NGOs	Stawisha	• provide technical support to the sub-sector
		• Source of quality potato as raw materials

Stakeholder group	Stakeholder	Mentioned roles
	AGRA	collaborated with SAGCOT to technically support the sub-sector
	Wageningen University and Research	collaborates with TARI to provide technical expertise in potato sub-sector
	USAID Mboga na Matunda project and Advancing Youth Project	- collaborated with SAGCOT to technically support the sub-sector - Capacity building to farmers - provide technical support
	SAGCOT Center Limited	through clusters provide linkages to stakeholders
	Agriterra	organizing farmers
	Briten	building capacity of farmers
	National Microfinance Bank (NMB)	financial service provider
	Tanzania Agricultural Development Bank (TADB)	financial service provider;

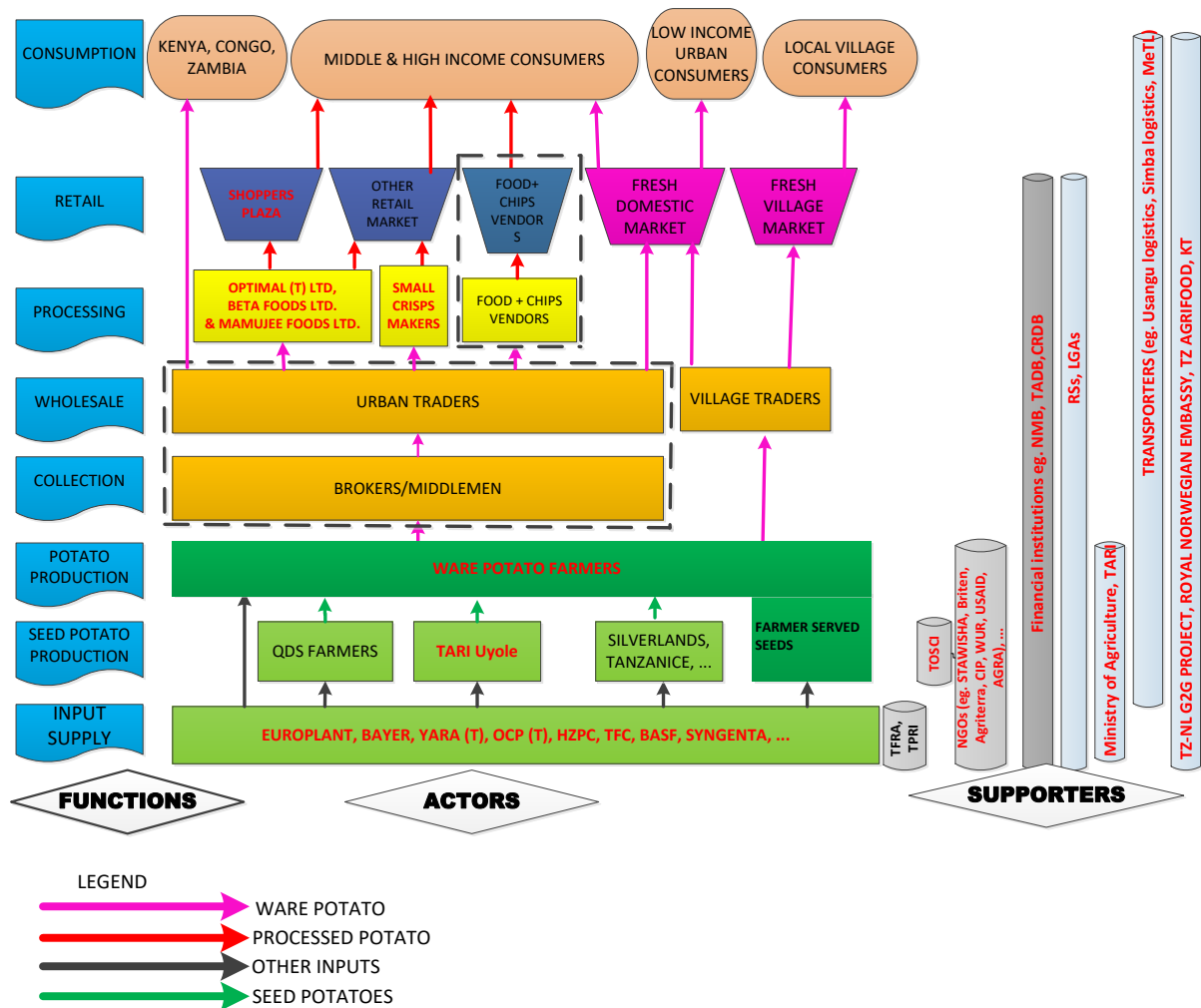
Source: Findings from interviews (2020)

The review of the literature about the stakeholder and their roles also indicated Local Government Authorities, Regional Secretariats, HZPC, Kilimo Trust, Royal Norwegian Embassy, Tanzania Agrifoods Limited, CRDB Bank, National Microfinance Bank (NMB), Europlant and CIP as additional potato stakeholders (SAGCOT, 2020). However, Kusiiluka (2019) mentioned the following as potato stakeholders in the southern highland of Tanzania:

- Direct actors
 - farmers,
 - village traders,
 - urban traders,
 - wholesalers,
 - supermarkets,
 - exporters, and
 - consumers
- Indirect actors
 - government,
 - researchers (TARI Uyole),
 - agricultural input suppliers (MONSANTO, Beula, BASF, YARA, Syngenta, Tanzania Fertilizer Company (TFC), Balton),
 - cargo transporters (Usangu Logistics, Simba Logistics, Bravo logistics, Mohamed Enterprises Tanzania Limited (MeTL), Export Trading Group (ETG),
 - extension officers,
 - Tanzania Official Seed Certification Institute (TOSCI),
 - financial services providers (CRDB Bank, NMB Bank, FINCA, PRIDE, BRAC, SACCOS),
 - NGOs (MVIWATA, MIICO), and
 - Donors (DFID, USAID, SIDA, GIZ, IFAD, AfDB, WB, JICA).

The different identified stakeholders have been mapped in the potato value chain as shown in the figure 5.

Figure 5: Potato value chain map



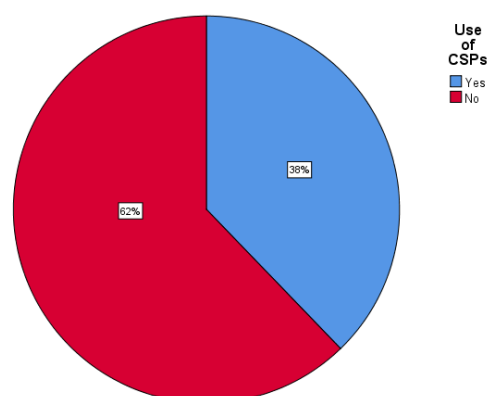
Source: Authors interview data and literature (2020)

4.2 Determinants of farmers adoption of CSPs

This section is presenting the results about the determinants of farmers adoption which are acceptability, perceptions, availability/accessibility, affordability, and attractiveness.

During the survey, respondents were asked as to whether they use CSPs or not. The results show that most farmers do not use CSPs as indicated in figure 6.

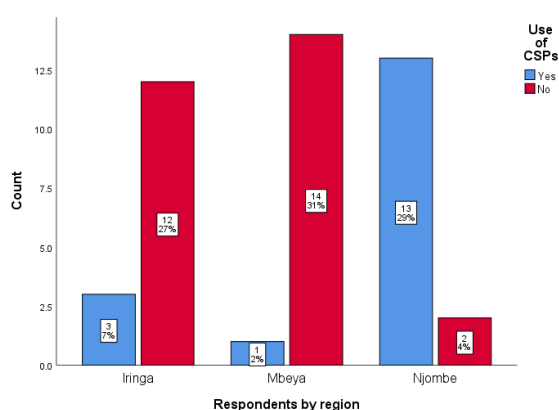
Figure 6: Respondents use of CSPs



Source: Authors survey data (2020)

However, Njombe region had a large proportion of respondents who use CSPs much more than other regions as indicated in the figure 7.

Figure 7: Respondents use of CSPs by Regions



Source: Authors survey data (2020)

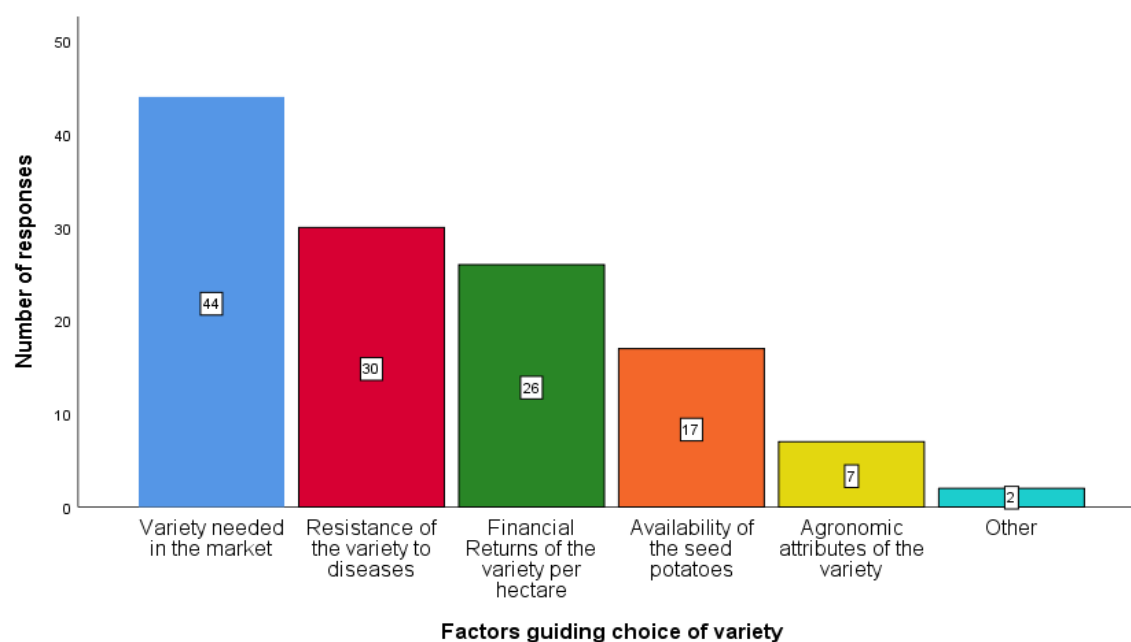
4.2.1 Acceptability

Acceptability of the seed is comparing the preferences of the farmers towards certain varieties based on their quality attributes.

Variety

Farmers of all the regions considered the variety needed in the market to be the most guiding factor and the availability of the seed potato to grow to be the least guiding factor in the selection of seed potato to grow as shown in figure 8.

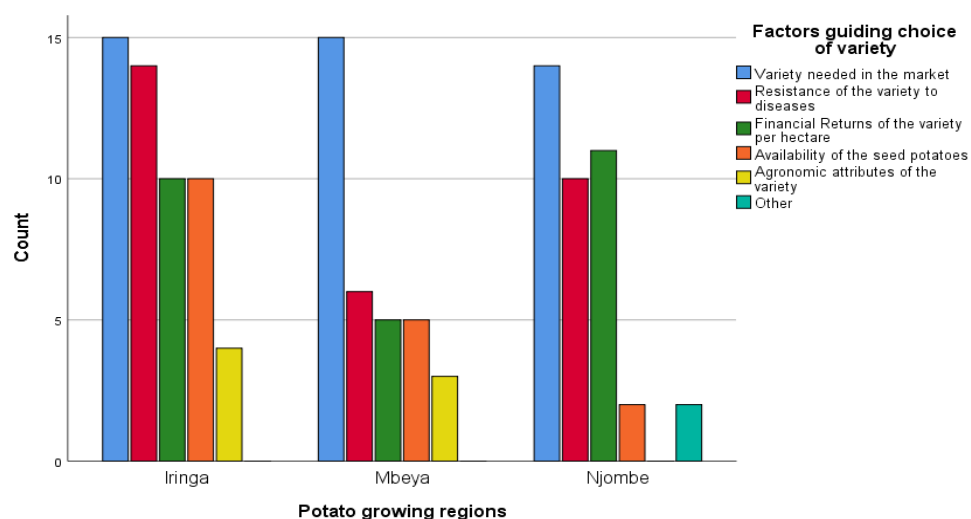
Figure 8: Factors guiding farmers choice of variety



Source: Authors survey data (2020)

The farmers reaction on factors guiding their choice for potato varieties in the three regions indicates that, the marketable variety is the most influencing factor in all three regions as indicated in figure 9. Other factors which was considered in Njombe region was mentioned to be high yield of the variety.

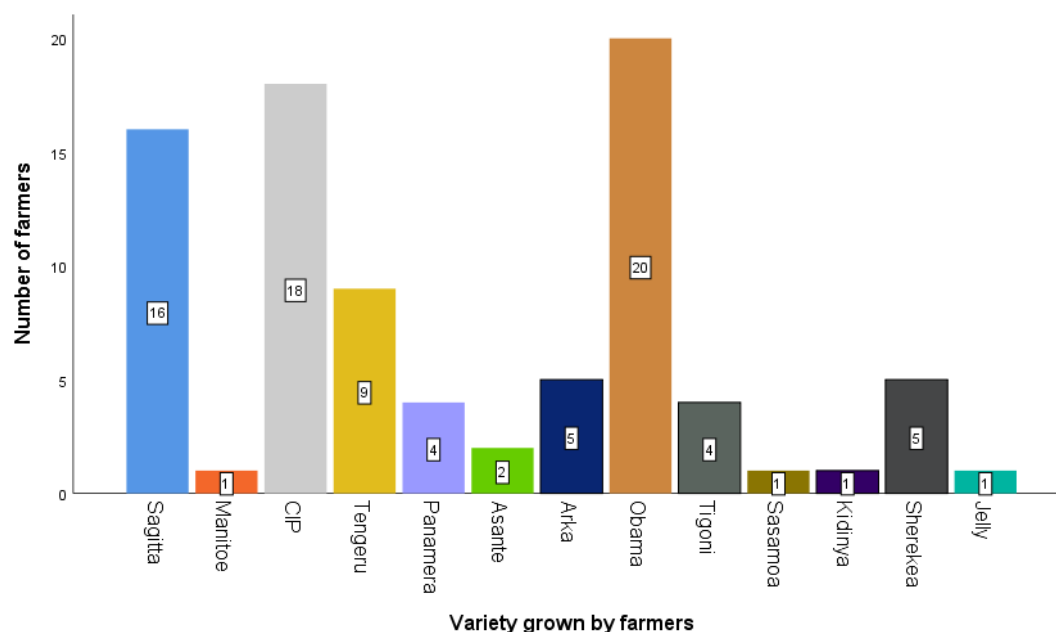
Figure 9: Factors guiding the choice of potato varieties to grow by region



Source: Authors survey data (2020)

Respondents were asked about the actual variety they are growing in order to add an insight about their potato variety preference and they mentioned about 13 different varieties. The figure 10 shows the respondents farming varieties and according to the results, Obama, CIP and Sagitta varieties were the prominent ones.

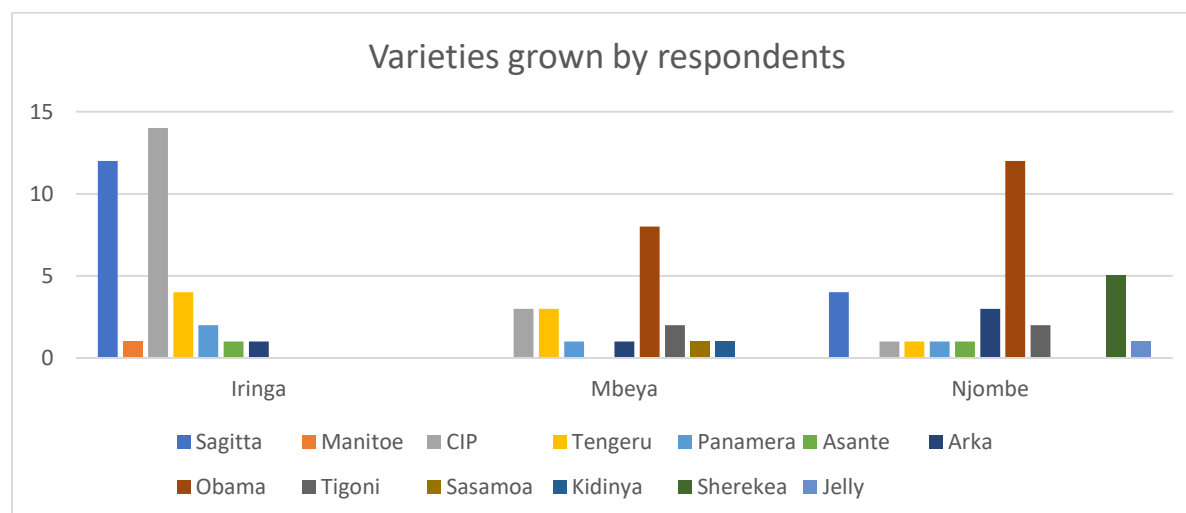
Figure 10: Potato varieties grown by farmers



Source: Authors survey data (2020)

Farmers choice per region indicated CIP to be in the most grown in Iringa region and Obama the most grown variety in Mbeya and Njombe as figure 11 indicates.

Figure 11: Potato varieties grown by farmers by region



Source: Authors survey data (2020)

In the interviews, the CSPs producers were also asked about the varieties of CSPs they are producing and they mentioned Sagitta, Jelly, Panamera and Rodeo. Of these varieties, farmers indicated they used mostly sagitta.

Quality attributes

As shown in table 6, eye depth was ranked by the farmers as most important potato quality attribute. The Kruskal-Wallis test was done to test for a difference in respondents' perception between the potato quality attributes. The p value of >0.001 ($p < \alpha = 0.05$) indicated that there is a significant difference in farmers perception between various potato quality attributes (Appendix 8).

Table 6: Summary of the potato quality attributes scores

Potato quality attributes	Farmers perception	Percentage of responses
Eye depth	Most important	69
Tuber shape	Important	42
Tuber size	Important	9
Skin colour	Less important	11
Flesh colour	Not important	27

Source: Authors survey data (2020)

Another key informant from Silverlands Tanzania argued that farmers preference on the skin colour of the seed potatoes is the key when they make a decision to buy or not buy. They also mentioned the flesh colour (the yellow or orange) as one of the driving forces for farmers decision to purchase CSPs variety. According to one key informant,

"... Sagitta is the one that's got the good reputation and is actually the far better potato from the market point of view, yellow fleshed. Sagitta has got like a very pale flesh..." KI-5 (2020)

4.2.2 Perception influencers on CSPs adoption

Respondents were asked about their level of education, experience in farming, size of their households and their main source of income in order to get an understanding on how these characteristics influence their perception about CSPs.

Respondents level of education

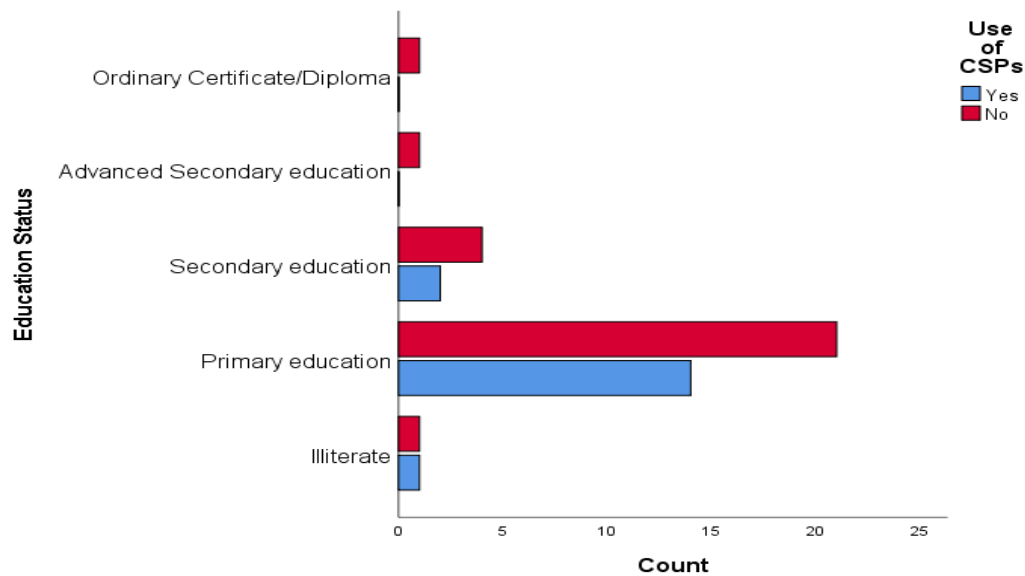
Irrespective of the regions, the largest group of respondents are at primary education status as it has been shown in table 7.

Table 7: Respondents Education status

		Frequency	Percent	Cumulative Percent
Level	Illiterate	2	4.4	4.4
	Primary education	35	77.8	82.2
	Secondary education	6	13.3	95.6
	Advanced Secondary education	1	2.2	97.8
	Ordinary Certificate/Diploma	1	2.2	100.0
	Total	45	100.0	

The results indicates a higher use of CSPs by the less educated than by higher educated farmers as it is depicted in figure 12.

Figure 12: Respondents use of CSPs by education status

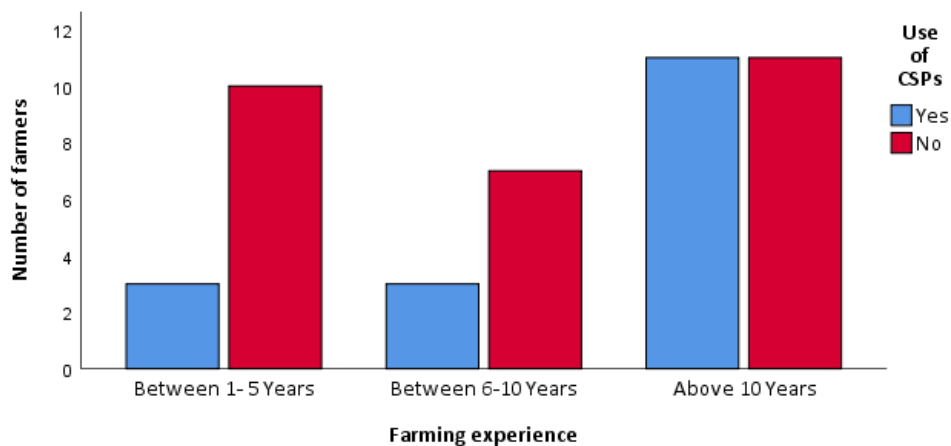


Source: Authors survey data (2020)

Respondents farming experience

Most of the less experienced farmers responded to not use the CSPs as it is depicted in figure 13. The least experienced group has a big proportion of non CSPs users compared to the proportions in mid-experienced and especially highly experienced farmers.

Figure 13: Respondents use of CSPs basing on farming experience



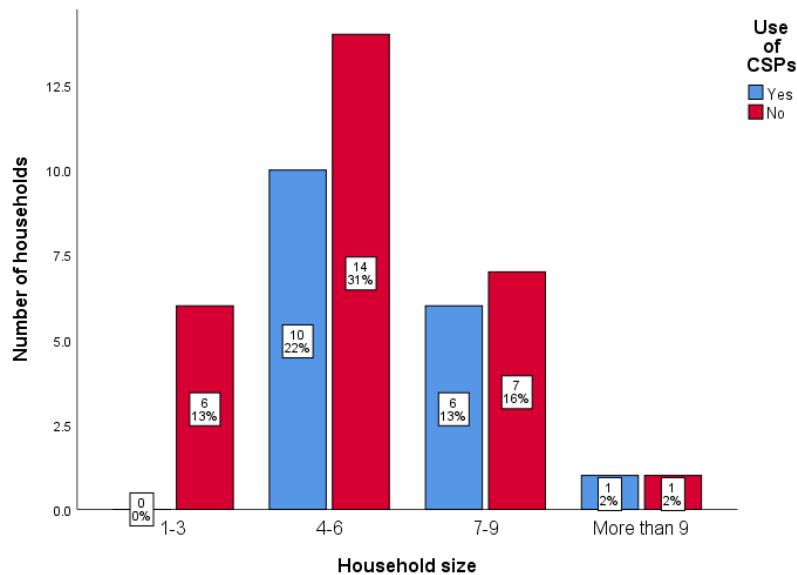
Source: Authors survey data (2020)

However, the Chi square test for the difference in the use of CSPs between farmers with different levels of experience indicated that there was no significant difference in the use of CSPs between the different levels of experience in CSP farming, with P-value of 0.098 ($P=0.098 > \alpha=0.05$) Appendix 5)

Size of the household

Most of the households have between 4-6 family members and a size range 7 – 9 family members comes as the next group. In both cases, the number of CSPs users is less than the number of no CSP users as it has been illustrated in figure 14.

Figure 14: Respondents group of size of the households

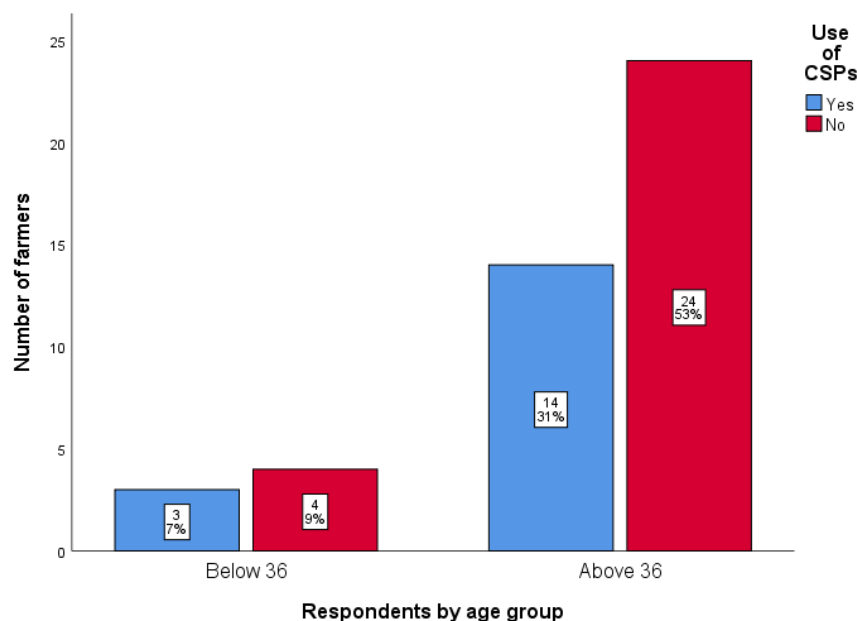


Source: Authors survey data (2020)

Age group

The adults' group of users of CSPs with age of above 36 years old is bigger than the youth group with age below 36 years old. The proportion of the CSPs users in the youth group is higher. Nevertheless, in both age groups the non-users of CSPs exceeds the users of CSPs (figure 15).

Figure 15: Respondents use of CSPs basing on the age group

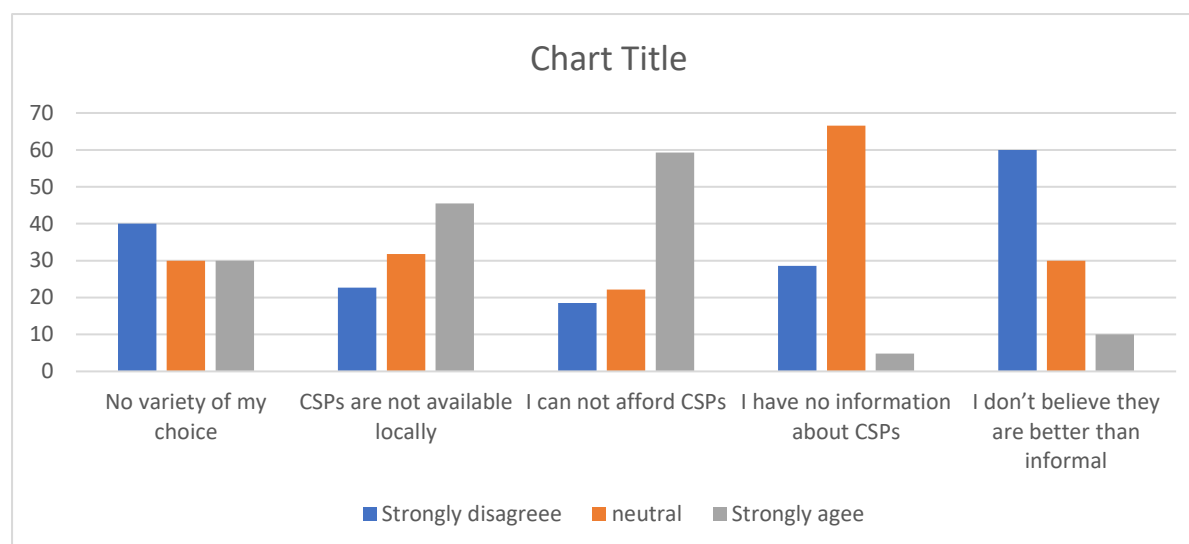


Source: Authors survey data (2020)

4.2.3 Seed accessibility/availability

The farmers not using CSPs ranked unavailability as the second reason after seed affordability when asked to give opinions about the reasons for not using CSPs (figure 16).

Figure 16: Reasons for not using CSPs by farmers



Source: Authors survey data (2020)

Also, when farmers were asked to mention the challenges that they face on potato production, they clearly mentioned amongst others the unavailability of CSPs. The key informants during the interviews mentioned that CSPs producers have not produced enough to fill the market and so there is inadequate supply of the CSPs. According to a key informant from SAGCOT Center Ltd.,

“...we have been working as Ihemi cluster to support the sector and recently we have been trying to find a way to make farmers produce Quality Declared Seeds (QDS) so that they get used to clean seed potato and it's because this time the seed potatoes are scarce while the demand is high...” KI-2

4.2.4 Seed affordability

When the farmers not using CSPs were asked to give opinions about the reasons for not using CSPs they mostly strongly agreed that they cannot afford the cost of the CSPs (figure 14). Also, some key informants from the cooperatives, extension and a public-private institute mentioned the price of the CSPs to be high.

During the interviews, the CSP producers mentioned that they do not sell to small individual farmers due to the logistic challenges in dealing with seed potato. They explained that selling to individual farmers would lead to higher transport costs and more problems with handling seed potatoes that may lead to impair the seed quality.

According to the key informant from one of the farmers cooperatives, the farmers who use CSPs have a great chance to double their incomes compared to the non -CSP users. The findings from interviews and reports from regions show that a CSPs user in the southern highland part of Tanzania has a chance of earning 4,242,000 TSH compared to 2,445,000 TSH that is gained by the non-CSP user as indicated in the tables 8 and 9. The details of the costs of production has been shown in Appendices 10 and 11.

Table 8: Profitability of informal seed potato users

Revenue		
Number of acres	acre	1
Crop per acre	T/acre	12
Total crop	T	12
Minus % not for crop	0%	-
Net total crop	T	12
Unit price	TSh/kg	400
Total cash in	TSh net total crop	4,800,000
Cost of production		
Direct costs per acre	from part A	2,355,000
Minus % not for crop	0%	-
Cash out		2,355,000
Gross profit per acre	rev -/- costs of production	2,445,000

Table 9: Profitability for CSPs users

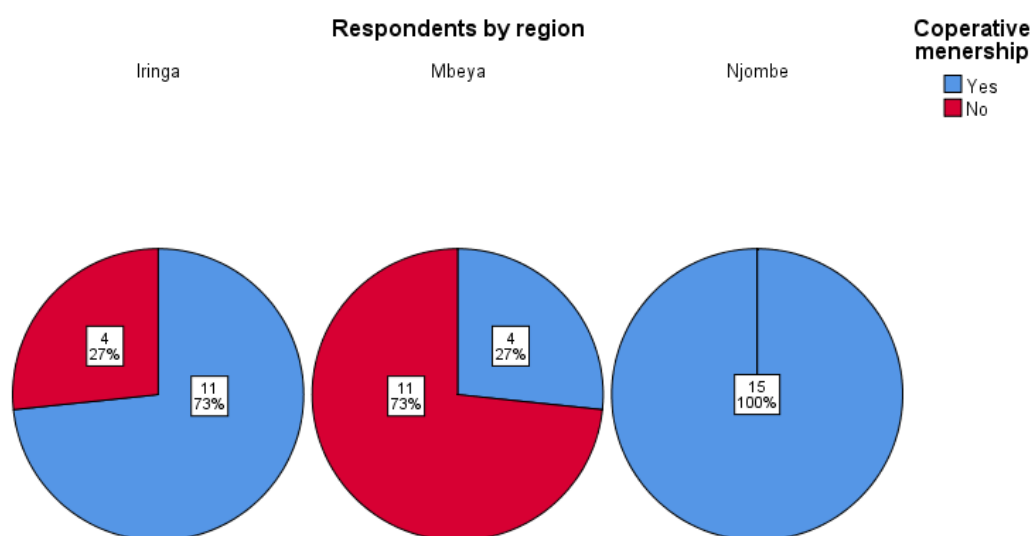
Revenue		
Number of acres	acre	1
Crop per acre	T/acre	16
Total crop	T	16
Minus % not for crop	0%	-
Net total crop	T	16
Unit price	TSh/kg	450
Total cash in	TSh net total crop	7,200,000
Cost of production		
Direct costs per acre	from part B	2,958,000
Minus % not for crop	0%	-
Cash out		2,958,000
Gross profit per acre	rev -/- costs of production	4,242,000

Source: Author interviews data and regional reports (2020)

Membership in cooperative organization

All respondents in Njombe region are members of the cooperatives as it shows in figure 17.

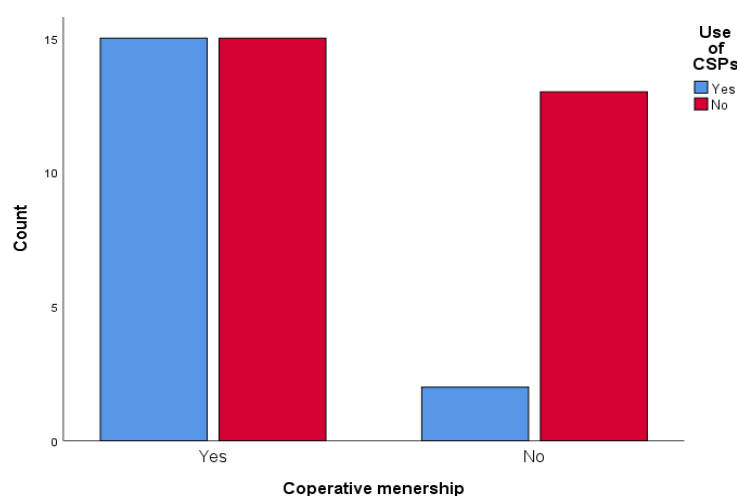
Figure 17: Respondents cooperative membership by regions



Source: Authors survey data (2020)

Respondents membership on cooperative organization has indicated a positive impact on the use of CSPs and shown in figure 16.

Figure 18: Respondents use of CSPs by cooperative membership

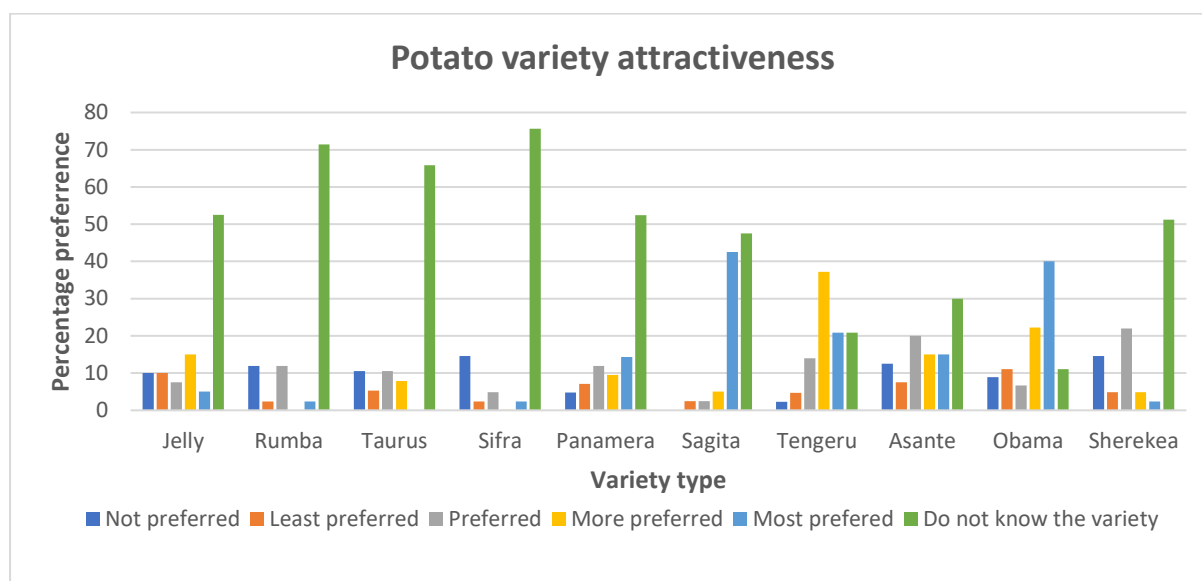


Source: Authors survey data (2020)

4.2.5 Seed Attractiveness

Farmers were asked about the guiding factors for the choice of their variety to grow and they ranked the financial returns as the third reason after marketable variety and resistance of the variety to diseases (figure 8). Farmers were also asked about their preference for a number of potato varieties in order to understand types of potato variety that are most attractive to the farmers. Most of the CSPs varieties mentioned seemed to be unknown to most farmers but Sagitta attracted most respondents during the survey as shown in figure 19.

Figure 19: Potato variety attractiveness



Source: Authors survey data (2020)

During the interviews, one of the key informants from Silverlands Tanzania Limited mentioned that farmers prefer Sagitta even though Jelly is the better variety from all improved due to its resistance to diseases and drought. According to the key informant Tengeru is the best potato for small holder farmers because it is much tougher to diseases and drought even though it is not a high yielding variety when compared to other improved. Meanwhile, Panamera was produced but did not do well in the market. According to a key informant from Silverlands Tanzania Limited,

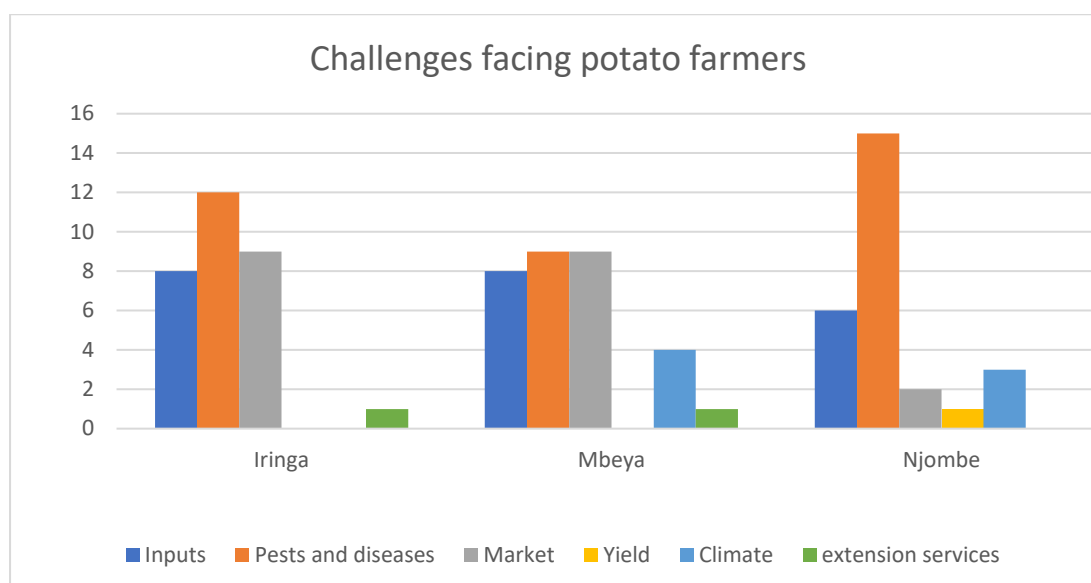
“...Panamera have achieved yields of 55 tonnes per hectare on a small block and we could only sell about one third of the crop because the market did not want it, no matter how we made it cheaper. They said they don’t want it at all...”KI-5 (2020)

Moreover, another key informant, a CSPs producer mentioned Sagitta to be the variety that attracts most farmers with Jelly and Panamera taking the second and third positions.

4.3 Production challenges faced by the potato farmers

When asked about challenges, the respondents mentioned different challenges according to their experience. The responses were grouped into six themes as input challenges (lack, adulterated, unavailability of CSPs and other, low quality, lack of capital, high price), pests (white flies) and diseases (early and late blight, fusarium wilt) challenges, markets challenges (low potato price, unstable markets, market infrastructures), yield (low yield), climate challenges (less rain) and extension services (inadequate extension services). The results have been illustrated in figure 20.

Figure 20: Challenges facing potato farmers



Source: Authors survey data (2020)

The main challenge mentioned in all three regions was pests and diseases. They named white flies as the pest and early and late blight and fusarium wilt as diseases. Another important challenge mentioned was inputs availability, high price, poor quality and lack of financing.

This was confirmed by key informants from farmers cooperatives, CSPs producers and extension that also added dependence on rainfed farming, untested soils and poor soil nutrition. According to the Key informant from a CSP producer, Silverlands Tanzania Ltd.,

"...I've taken extensive soil analysis in Njombe area and I've not found even a single farm that is anywhere near or anywhere close to optimal for production. They all are extremely deficient in phosphate and very low in pH..." KI-5 (2020)

Another challenge mentioned was lack of market infrastructures (potato collection centers, storage facilities). Other challenges mentioned were Price (high price of CSPs), availability (less CSPs in the market) and inputs (capital, adulterated pesticides).

4.5 Marketing variables used by CSP producers

This section presents the results from interviews with key informants on how the CSPs producers market their seeds in order to understand how it relates to CSPs adoption.

4.5.1 Product

CSPs producers mentioned that they produce only Sagitta, Jelly, Panamera and Rodeo seed potato varieties. It was also found out that they sell in bulk and deliver the seeds to the customers depending on the volume.

4.5.2 Price

In order to get an insight of the price variable, farmers were asked about the price they bought their seed potatoes. The price means of the three regions were compared to test if there is a significant difference. A one-way ANOVA test was conducted to compare the means of the price of CSPs between the regions at a level of confidence of 95%. The p value of 0.573 ($p > 0.05$) indicated that there is no significant difference between the mean prices of the seed potatoes between the regions of Iringa, Mbeya and Njombe (Appendix 2).

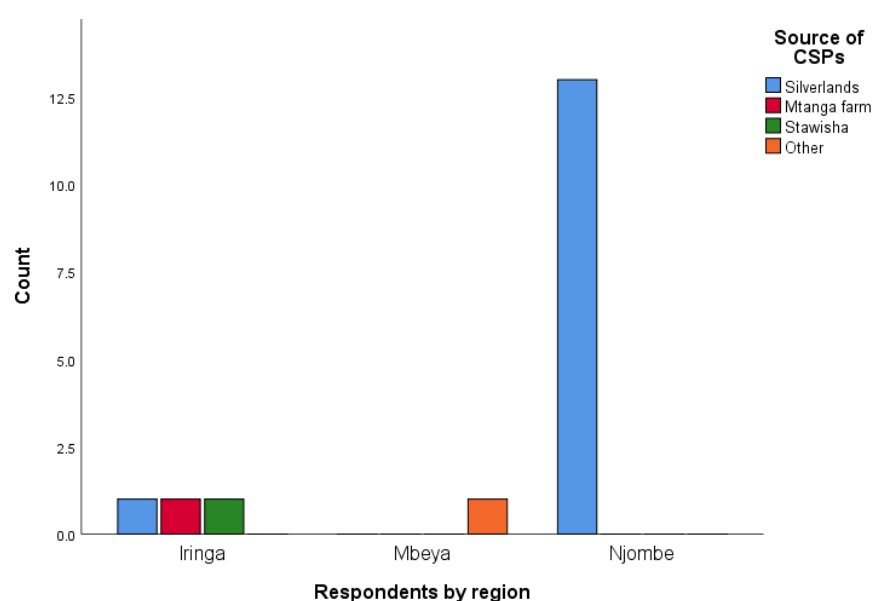
The minimum CSP price mentioned by the farmers was 300 TSH and the maximum price was 1000 TSH and the mean CSPs price was 859 TSH.

However, the CSPs producers mentioned that they sold the CSPs at a price of 870 to 1,000 TSH per kilo of seed. So, the price range they mentioned is much smaller than the price range the farmers indicated. The mentioned 870 TSH per kilo was a negotiated discounted price to the AMCOS that also included delivery.

4.5.3 Place

The survey asked the farmers who are using the CSPs to mention the source of their CSPs in order to understand how the CSPs producers market the seed to farmers. Most farmers in Njombe region source their seed potatoes from Silverlands. In other regions, farmers hardly use CSPs and they come from different sources, see figure 21.

Figure 21: Sources of CSPs for farmers



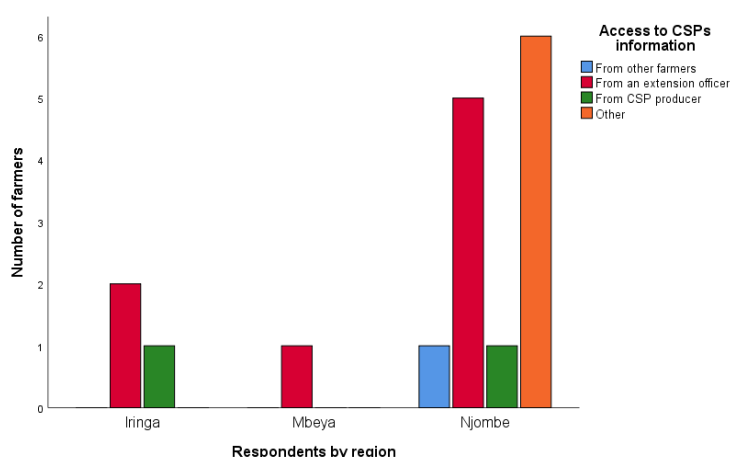
Source: Authors survey data (2020)

During interviews with the key informants, a CSP producer mentioned that it's not common for a CSP producer to sell CSPs to individual smallholder farmers. They rather sell to cooperatives and companies. The CSPs producers are all in Iringa region and distribution of the CSPs to customers is done direct from the CSPs producer to the customer by road transport.

4.5.4 Promotion

The survey requested the farmers to mention different ways they get to know the availability of the CSPs in order to relate to the CSPs producer's promotion channels. In Njombe region farmers hear about CSPs from other farmers. In Iringa and Mbeya regions farmers were hardly informed about CSPs. The few farmers that were informed, heard about CSPs mainly from the extension officers. The marketing channels and the numbers of mentions have been clustered according to regions and are shown in figure 22.

Figure 22: Access to CSPs information by farmers



Source: Authors survey data (2020)

The Chi-square test was performed to compare the promotion channels of the CSPs producers between the regions. However, as too many cells counted less than 5 it was not possible to produce reliable test results (See Appendix 13).

The key informants said they make their products known to farmers by provision of training to farmers through farmers field schools. However, this was not shown by the results from the farmers survey.

4.6 Challenges encountered in promoting CSPs

During the interviews the key informants were asked about the challenges that the CSP producers face. The mentioned challenges have been categorized into themes of production challenges and market challenges as it is shown in table 10. According to one of the key informants, a CSPs producer,

"...they planted our varieties last year, they failed because it rained too much. And they didn't use chemicals properly and they didn't use the right fertilizers. So that was a failure, I don't even know if they're going to ask us for any seed next year because they failed..." KI-5 (2020)

Table 10: Challenges faced by CSP producers

Production challenges	Market Challenges
Varieties not matching with high rainfall	CSPs price perceived to be high
Import duty on importation of early generation seeds	Slow rate of adoption
Seed regulations restricting further seed multiplication	CSPs customers depending on rainfed agriculture
	Farmers lack of advice from extension services

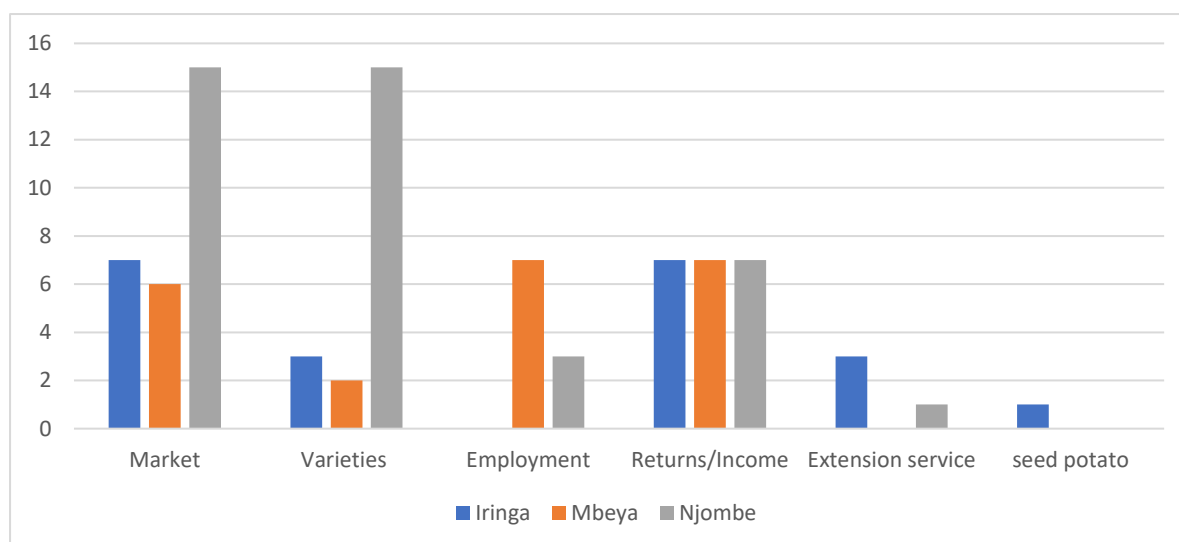
Source: Authors interviews data (2020)

4.7 Opportunities to improve adoption of CSPs

Key informants were asked about the opportunities they think if harnessed can help improve the adoption of CSPs. The results were summarized into themes of market, varieties, source of income/returns, extension services and seed potatoes. As it has been depicted in figure 23, the growing potato market and the presence of high yielding potato varieties was the most frequent

mentioned by the respondents in Njombe region with other opportunities being source of employment, high returns from farming potatoes and the increasing extension service due to the presence of support. a respondent from Iringa region mentioned the seed potato production as an opportunity that can be harnessed by farmers.

Figure 23: Opportunities to improve adoption of CSPs



Source: Authors survey data (2020)

The information obtained during the interviews with key informants revealed the existence of improved seed potato which are registered and other which are still under testing are seen as opportunities for the farmers to adopt the use of CSPs.

Also, the existence of NGOs such as Stawisha, USAID, Agriterro, Yara Tanzania, Silverlands and Tanzanice that provide capacity building to farmers and government enforcement on weights and measures of the potato weighs were part of the opportunities mentioned. According to the key informant from a farmer's cooperative,

"...We believe that there is an opportunity. With the restrictions that has been initiated by the government such as enforcement on acceptable bagging, we believe it has started to pick up and farmers will benefit and invest more on farming..." KI- 11 (2020)

The presence of the financial institutions that can provide input credit financing was another mentioned opportunity that will help farmers to afford the purchase of the CSPs.

4.8 Strategies for CSPs producers to improve the adoption of CSPs

In order to understand the strategies that the CSPs producers need to employ in requirement to improve adoption of CSPs by farmers, farmers who declared to not use CSPs were inquired to give their opinions about possible reasons for their choice.

The farmers who do not use CSPs strongly agreed with the reason that they cannot afford the CSPs as it is shown in the figure 16. The results also show that they strongly agreed the reasons that the CSPs are not available locally as the second reason and unavailability of the preferred varieties being the third. The reasons affordability, availability and acceptability ranked the first, second and third respectively.

A key informant from Silverlands Tanzania during the interview mentioned the need to import a huge number of varieties and test for suitability before registration and dissemination to farmers in order to get the right varieties for Tanzanian environment instead of testing few that may not perform well while producers have invested already. They also mentioned the need to have supply contracts of CSPs with farmers before production in order to ensure commitment by the farmers and the CSPs producer.

4.9 Institutional support to improve CSPs adoption

Key informants from CSPs producers, cooperatives, extension and NGOs mentioned several support areas that are needed to improve the CSPs adoption by farmers. They mentioned: -

- i. A need to conduct tailor made trainings on potato to extension staff in order for them to support farmers effectively.
- ii. The provision of financial support to farmers in purchasing CSPs,
- iii. Business facilitation between farmers and CSPs producers and farmers through production contracts to ascertain the CSPs requirements.
- iv. Facilitating the shortening of the procedure for registration of seed potatoes by allowing the information from the other countries about the properties of the introduced potato variety to be adapted and testing for a single season that will ultimately make it cheaper to farmers.
- v. Need of support in terms of machinery for potato processing to increase efficiency.
- vi. The government of Tanzania to remove the import tariff of 25% for early generation seed potato materials in order to reduce the cost price of the seed and that may make seed available at cheaper price to farmers.
- vii. The need for the government to change the regulation on seed multiplication procedure in order to allow a one step further multiplication for the CSPs producers to make the quality seed available at cheaper price.

CHAPTER FIVE: DISCUSSION

5.1 Potato stakeholders and their roles

This study found that there is a large number of stakeholders who have been categorized as actors and supporters. Some of the supporters of the potato subsector are NGOs such as Agriterra who are organizing farmers into cooperatives in order to benefit in areas of access to inputs, access to good markets and participate in policy forums. Having other stakeholders that supports the potato subsector is an advantage to Stawisha as Stawisha's objective is a robust value chain for potatoes. The Ministry of agriculture provides extension services of which it has been shown by this study that it is inefficient as farmers indicated that they were hardly informed by extension officers in Iringa and Mbeya (only 3 out of 30 farmers) and limited in Njombe (5 out of 15 farmers). Therefore, the reach for extension needs to be improved.

The existing potato partnership in the chain does not yet include traders, processors and consumer representatives which are very important in transformation of the chain as it has been stipulated by KIT (2010). Drost, et al (2012) indicated how multi-stakeholders' partnerships can benefit the potato industry in the southern highlands of Tanzania. The importance of trust in multi-stakeholders' partnerships should not be undermined (Drost, et al., 2012; Thiele, et al., 2011). The situation of Potato in the southern highlands of Tanzania of not having traders, processors and consumer in a multi-stakeholders partnerships could be because the crop does not have its governing crop Board as with other crops in Tanzania such as tobacco, sugar and coffee where its stakeholders' forums are clearly stipulated in the regulation (MoA, 2017).

In the coffee sub-sector, due to the existence of its own board, stakeholders participation is high to the extent of establishment of the development strategies, and a Coffee trust fund (TCB, 2012). Considering the stakeholders potential in promoting adoption as it has been mentioned by Fasoyiro (2012) and the importance of crop boards in promoting partnerships, the establishment of a Horticultural Board of Tanzania can be beneficial in promoting a good multi-stakeholders partnership in the potato sub-sector. Better cooperation in a Board can also help to increase CSPs adoption by farmers.

5.2 Determinants of farmers adoption of CSPs

5.2.1 Acceptability

When choosing a variety, farmers considered variety needed in the market to be the most important factor followed by the resistance of the variety to diseases.

The CSP producers mentioned Sagitta, Jelly, Panamera and Rodeo as the varieties they are growing. However, in addition to that, the findings also show that for both certified or uncertified seed source, the Obama, CIP and Sagitta varieties were the most cultivated varieties by the farmers. This implies that, out of the CSPs registered varieties with TOSCI, farmers mostly choose Sagitta when they adopt CSPs. This could be because Sagitta variety is tolerant to diseases, withstands physical damage and therefore has good storage qualities and is multipurpose in its usage (TOSCI, 2020). According to WUR (2017), variety preference affects the way farmers adopt to seeds.

Farmers perceived eye depth as the most important potato quality attribute with tuber shape and tuber size also perceived as important, but the flesh colour was not considered important. This did not agree with a CSPs producer who mentioned the skin colour and flesh colour as the most influencing factors for farmers selection on the variety to grow. Harahagazwe, et al (2016), also mentioned CIP as the most preferred and highly competitive variety in the market in Tanzania due to its skin colour and its yielding ability. Apart from the skin colour, also Josh & Ullah (2017) insisted that yield potential of the variety influences seed acceptability that matches with the situation that CIP is amongst the mostly grown variety even though it is not a registered variety. The key informant from

Silverlands Tanzania Ltd., confirmed that Sagitta variety happen to have a good reputation in the market due to its light-yellow flesh colour and according to the findings of this study the variety appeared the most cultivated amongst the registered varieties. Therefore, it could be that even though the farmers indicated that skin colour is not an important attribute, unconsciously it is the more important than they indicated.

Kumari, et al (2018) and Bekele and Haile (2019) highlighted the influence of quality attributes and variety in marketability and acceptability which tends to influence the farmers selection of the variety to grow. The situation agrees with findings of this study that also showed that market mostly influences farmers choice of variety type to grow (figure 8).

Considering the existing situation of low seed adoption by farmers, variety promotion through farmers field schools could help farmers increase the knowledge about varieties and their attributes. This is especially important since also the registration of the first improved variety is recent (TOSCI, 2020).

5.2.3 Perceptions

From the results it is deduced that most of the CSP users are primary education level respondents (82%). Most farmers of the group are non-CSPs users. The same is however observed on the other higher levels of education (Table 7 and figure 12). This is in contradiction with the study by Baglan et al (2020) which concluded that a higher education level has a positive effect on the likeliness in technology adoption.

Namwata, et al (2010) also found that most potato farmers in Mbeya region had only primary school education level (85%) of the respondents. Common findings were observed by Mpogole & Kadigi (2012) who found potato farmers in Mbeya region had 86% farmers with primary school level and Nyunza & Mwakaje (2012), in Mbeya region who found in Mbeya region about 83% of potato farmers have primary education. This seems to be the typical characteristics of the potato farmers in southern highlands of Tanzania indicating that higher educated people do not engage much in farming activities. Education assists farmers in processing information and making decisions. However, the largest proportion of farmers can read and write and so I can infer that the level of education of the farmers did not seem to affect the decision to adopt the CSPs but rather other factors.

The difference in use of CSPs between the most experienced farmers and the less experienced farmers is insignificant. This does not match with the findings by Namwata, et al. (2010). The difference has also been observed by Sánchez-Toledano, et al (2018) who concluded that the most experienced farmers adopt new technologies better than less experienced farmers.

The results have shown that, as the number of the household members increases in the household the use of the CSPs decreases (figure 14). This situation could be because the number of households' members has implications in the family spending which then affects the disposal income to spend on CSPs. The same situation was observed by Okello, et al. (2016) who also found out that a large household size has a negative relation with the use of CSPs. However, these findings contradicts with the study by Baglan et al (2020), that mentioned household size to have a positive effect on the adoption of new technologies due to availability of family labour. The situation in this study showed that increase in number of household members has a negative effect on the use of CSPs.

The findings show that the adults' group of users of CSPs over 36 years outnumbers the youth group, but in both age groups the non-users of CSPs exceeds the users of CSPs (figure 15). The two age groups are statistically different in use of CSPs with the youth group having a larger proportion of CSPs users than the adult group. This agrees with the study done by Sánchez-Toledano et al (2018) that concluded that the adults are more likely to keep on their usual way of farming than youth which ultimately affects the adoption of certified seeds.

It can be inferred that, farming experience did not seem to influence adoption of CSPs, and the size of household and the age of the farmers have a negative relationship to the adoption of CSPs. The provision of extensive extension services can help to enlighten the farmers and provide knowledge of the importance of the CSPs. This could be the immediate solution to change the situation because it has been proven to expedite the farmers' adoption to technology as it has been found out by the type of advice and the frequency of contact with an extension officer have influence in triggering farmers' adoption to technology.

5.2.4 Seed availability/accessibility

It was mentioned by key informants that scarcity of CSPs is the main challenge that is facing the sub-sector. However, the same was not mentioned by the farmers as challenge. This could be due to lack of extensive extension services that denies farmers knowledge and the fact that most farmers are still using recycled seed potatoes (figure 6) and they are still cultivating unregistered potato varieties (figure 10).

Meanwhile, quality seed unavailability was confirmed by Roo & Gildemacher (2016) to be one of the causes of poor use of quality seeds by farmers. Also, Mpogole & Kadigi (2012) mentioned availability of seed tubers to be the factor that influences selection of variety. Farmers will choose whatever seed material at their disposal when there is not enough CSPs in the seed market. Considering the fact that the CSPs producers are located in Iringa region and yet they need to supply to farmers in other regions, a need for a harmonized arrangement of production is needed. The need to have production contracts between the CSPs producer and the farmers in all regions is inevitable.

Business models that can engage production of CSPs close to the production areas could be the best solution.

5.2.5 Seed affordability

When farmers who do not use CSPs were asked to give their opinions on the reasons, they mostly strongly agreed that they cannot afford the cost of the CSPs (figure 16). Also, during the interviews it was mentioned that the price of the CSPs that range at 700-1,000 Tanzania Shillings per kilo of CSPs was perceived to be high. Yet the findings from this study show with the prevailing production costs that a farmer's gross income can double by just applying the CSPs. This scenario is also supported by KT (2010) that indicated that with the use of good agricultural practices and the CSPs, the yield can double and the income can quadruple. Meanwhile, most of the farmers who use CSPs are members of the cooperative organizations revealing the positive impact of cooperatives for input financing in seed adoption. According to Baglan, et al (2020) cooperatives not only provide financial support but also contribute to information availability and hence support seed adoption by farmers.

Membership in cooperative society was the key for the farmers in Njombe region to use the CSPs. This could be because in cooperatives the chances of input financing are high and that fills the gap that respondents showed when asked about the causal reason for them to not use CSPs (figure 16). The situation of Njombe is contributed also by Njombe region being the beneficiary of a 27 months 'Upscaling Improved Seed Potato Varieties for Smallholder farmers Project' that was led by SAGCOT Center Limited in the period of year 2015 – 2017. The later resulted into establishment of the CD-PIT of which Stawisha is the local implementor. The perceived opinion about price could be because the producers need to balance production costs and the need to make profit and the lack of knowledge of the financial benefit of using CSPs by the farmers.

The CSP producers do not sell to small individual farmers due to the fact that CSPs can not like other cereal seeds, be sold in stores by agro-dealer which makes seed potatoes hard to deal with. This has implications in cost of the seed as well as the handling in order to not impair quality.

Considering the situation that farmers perceive the CSPs to be expensive while the benefits of using CSPs are higher than not using, there is a need of provision of financial support to farmers for purchase

of CSPs. Additionally, there is a need of an extensive extension services and organizing farmers in cooperatives as has been stipulated earlier.

It is expected that after getting a financial support to purchase CSPs and get much higher incomes, that farmers will then continue to purchase the CSPs on their own. Organizing farmers and linking them into markets could help them identify niche markets such as processors, hotels, chips vendors of which they can fetch good prices that will increase their income that could be re-invested in purchase of CSPs and other inputs. Financial support while linking to market is a lesson learnt from the farmers adoption to CSPs and will ensure sustainable adoption of CSPs.

5.3 Production challenges facing the potato farmers

Respondents mentioned lack of inputs, presence of adulterated inputs, unavailability of CSPs and other inputs, lack of capital, high price of CSPs, pests and diseases, markets, low yield, climate changes and inadequate extension services as the challenges facing the farmers (figure 34). This implies that the farmers do not have quality inputs for optimal production and that calls for law enforcement by agricultural input regulatory bodies such as TFRA, TPRI and TOSCI.

Key informants added dependence on rainfed agriculture, untrained staff, poor soil nutrition, untested soils, lack of storage facilities and lack of potato collection centers as challenges facing farmers. According to Kwigizile et al. (2017), the soils of most farms have medium potential for production of potatoes with deficiencies of Nitrogen, Phosphorus and Potassium. This implies that applying the CSPs in unhealthy soils may not bring out the potential of the seed potato. However, an interview with key informant from Silverlands Tanzania Ltd., revealed that efforts have been made to train some farmers to improve soil health by applying lime but farmers hardly adopted it. This could be due to inadequate knowledge of fertilizer use and lack of appropriate advice from extension.

The challenge mentioned by key informants that seed potatoes are unavailable could imply that the farmers access the seed potatoes from the informal sector. According to FAO (2017), the seed from informal sector have a lot of issues including health, quality and purity. The perceived high price of CSPs implies that farmers can hardly buy CSPs and according to FAO (2017), there is limited chance for private sector to continue investing in CSPs production when farmers are not buying it.

In addition, farmers have experienced a burden of potato pests and diseases which could reduce both quantity and quality of the potatoes regardless of the seeds used being CSP or not CSP. Diseases have implications on crop yield and produce quality that affects shelf life and price (Rupp & Jacobsen, 2017). Considering the challenges faced by the farmers, the need for extensive extension services is inevitable.

5.4 Marketing variables by CSPs producers

Product

CSPs producers produced only Sagitta, Jelly, Panamera and Rodeo seed potato varieties. Farmers regardless of being certified or not certified seed mentioned Obama, CIP and Sagitta as the most cultivated varieties. So, as CSPs only Sagitta was mentioned to be mostly cultivated. This could be because most of the registered varieties are not known to farmers and therefore having been produced by the CSPs producers does not guarantee absorption by farmers. Therefore, the product being available is not yet enough for adoption. The CSPs producers deliver the seeds to the customers as an additional service that adds a competitive advantage to the producers in the seed market.

Price

The CSPs were sold at a price of 870 to 1000 TSH per kilo of which the farmers receive the CSPs at their place. The price could have been less than that if the overhead costs of transport could be avoided through local CSPs production. Also, the mentioned 870 TSH per kilo was a negotiated discounted price to the AMCOS in Njombe region indicating that the CSPs producers allow negotiation of the price to its customers. However, the non-users of CSPs ranked the reason that they couldn't afford CSPs (figure 16) as the most causal factor. This is in line with Roo & Gildemacher (2016), who attributed low use of quality seeds with high cost of obtaining it.

Place

The official CSP producers are all in the Iringa region and do have established production sites in the other parts of the southern highlands. This makes the seed potatoes customers incur the resultant shipping cost. Although that didn't have an implication in the price differences between the regions. This could be because the set price already considers the costs of transport of the seed potatoes to the farmers.

Promotion

The farmers that are using CSPs most mentioned extension officers and AMCOS when asked where they get information about CSPs. This could be due to the strategy that is being used by the CSP producers of conducting demo plots as the way to promote their seed potatoes. With the inefficiencies in extension services, most of the farmers were not informed or not well informed about the CSPs and their benefit. It is likely that this lack of extension resulted in less adoption.

According to FAO (2018), seed marketing requires the seed producers to start with understanding the needed varieties, ascertain the price, plan the right time to deliver and promote. There is a missing link in terms of farmers knowledge about varieties and their promotion and distance from the source that has implications in cost of the seeds. Embedded with the extension services that inform farmers about the CSPs varieties and their benefits, a pricing strategy that attracts the purchase of the seeds and right varieties and CSPs producer's marketing strategies for farmers adoption of CSPs is necessary.

5.5 Challenges encountered in promoting CSPs

The key informant from Silverlands Tanzania mentioned the following challenges; farmers perceive CSPs as expensive, have a slow rate of adoption, varieties are not doing well under high rainfall, import duty posed on early generation seeds, seed regulations limiting further multiplication and lack of advice from extension to farmers as the major challenges facing CSP producers.

The perceived high price of the CSP could have an implication in the adoption of CSPs by farmers because they may not purchase. According to FAO (2018), the farmers will always want to buy seeds at the lowest possible cost. On the other hand, the producer may not avail the CSPs because the market does not support. However, a CSP producer noted that even the price of 1,000 TSH per kilo of CSPs is low basing on the prevailing cost of production of CSPs.

So, the perceived high price of the CSPs could be due to high cost of production of CSPs. According to one of key informants from Silverlands Tanzania, the high cost of production is contributed also by the 25% import duty imposed when importing early generation seed potatoes.

Meanwhile, the government of Tanzania have removed import duties on a large number of agricultural inputs including the seeds packaging materials for a single year for local producers (MoF, 2020). The exclusion did not involve potato seeds. It would probably help if the government would also decide to lift the import duties on the early generation potato seeds which are used as source materials for propagation and selection of seed potatoes for Tanzanian market.

5.6 Opportunities to improve adoption of CSPs

Farmers mentioned mostly the growing potato market and improved varieties as opportunities that can be taken to advantage and improve CSPs adoption (figure 23). This agrees with the statement from the key informant from Tanzania, who mentioned market as the main driving factor in the sub-sector.

Having a large number of stakeholders is a good opportunity that can be taken to advantage to improve adoption of CSPs. The results from the interviews with key informants indicated that support from stakeholders in terms of capacity building is available to potato farmers and this is an opportunity to increase farmers' adoption to CSPs.

According to KIT (2010), the public private partnerships among farmers, service providers, financial service providers and a public sector can work well to develop the potato sub-sector and realize benefits such as access to quality seed potatoes, credit services, private buyer receiving a reliable supply of inputs at a desired quality. With the suggested improvements by involving some key chain actors, the existing Potato partnership can be harnessed to improve CSPs adoption by farmers.

The key informant from RSTGA SACCOS mentioned the presence of financial institutions in the chain as an opportunity for farmers to get input financing support. This agrees with the statement from the key informant from ISOWELU AMCOS who mentioned NMB Bank to finance their inputs including CSPs with a loan worth 350 Million TSH that has been recovered by 100%.

But according to CIP (2011), the relationship between a seed producer and a farmer is not an easy one to be attained unless it is a business relationship with the producer having desired varieties, quality seed potatoes available at the affordable price, right time and volumes. A business model that will support a relationship between a farmer and a CSPs producers is inevitable in order to benefit from the financial institutions.

5.7 Strategies to improve the adoption of CSPs by CSP producers

From the survey, the most mentioned reasons for farmers failure to use CSPs that they can't afford, followed by the CSPs hardly being available) (figure 16). This indicates that the strategies need to be geared to offset the challenges.

According to FAO (2018), it is suggested that producers should support the supply of the seed to the farmers by engaging themselves in storage for supply of seeds in other regions and transportation activities to ensure timely and quality delivery since seed potatoes are perishables. There must also be a production plan to guide the supply of seeds to farmers. The need for production plan agrees with what was mentioned by the key informant from Silverlands Tanzania who mentioned that farmers need to enter into contracts with producers in order to ascertain the producers' market and supply to customers.

Longo & Mangiafico (2016) asserted that, in public-private partnerships, a private sector needs to be enabled to buy farmers produce at fair prices and provide inputs; and a public sector needs to facilitate the access to inputs, market infrastructures and farmers need to be organized to ensure support, access of information, inputs, post-harvest processes and loan recovery order.

FAO (2018) suggests seeds producers to apply the marketing mix for the four variables which are Product (varieties needed, high quality), Price (promotion prices, affordable), Place (right place at the right time) and Promotion (information to the farmers). The marketing mix application could offset the challenges of growing varieties not preferred by farmers by cultivating seed varieties of their preference; CSPs pricing by having promotional and affordable prices; lack of information about CSPs through promoting the CSPs varieties; and unavailability of CSPs through ensuring even remote regions get the supply of CSPs.

5.8 Institutional support to improve CSPs adoption

The institutional support needed to improve CSPs adoption that were mentioned during interviews were mostly directed to support linking farmers with CSPs producers.

Apart from this, there is a need of tailor-made training on Good Agricultural Practices for potato cultivation including the use of good quality seed potatoes. The need for training was also supported by Mende, et al (2014). Capacitated extension officers will help the farmers to solve challenges of poor production practices.

There is a need for financial support to farmers for purchase of agricultural inputs. The mentioned need for financial support is in line with the information given by the key informant from ISOWELU AMCOS who mentioned to have received a support to purchase inputs including CSPs. Magali (2014) cautioned that financial support is more successful with good produce price. This could imply that any initiative to support farmers financially need to consider market aspects of the produce.

The government's tax regimes have always influenced the prices of commodities. The import duty that is being charged when import early seed potatoes generations could have an implication on the charged price of the CSPs. According to MoF (2020) the import duty of 0% is posed on seed packages and for a grace period of 1 year. This may help to decrease the cost of seeds somewhat. However, the import duties for the early generation seeds are still in place. Lifting these costs too would help to lower the costs of CSPs.

Allowing a huge number of varieties to be imported and tested simultaneously will help to increase the availability of varieties that suits the environment of Tanzania as it was suggested by RVO (2017).

The potato processors as the off-takers of potatoes mentioned that they needed the support in advanced machinery that may produce different products and at a more efficient way. Potato being a perishable crop needs processing as a way to minimize food loss and so supporting the post-harvest practices could have implications in the market absorption and increase the incomes of the farmers.

5.9 Reflection

This section reflects my personal role as a researcher during the whole research process. The experiences about the research "Improving adoption of certified seed potatoes (CSPs) by farmers in the southern highlands' regions of Tanzania" in form of designing, planning, implementation, adjustments and the methodology.

Research process and methodology

The research process started with the research proposal which had to be completed before the next steps of data collection, analysis and finally results that also needed to be discussed and produce conclusions. All the processes need to be geared towards the objective of the research. It started with the choice of my thesis topic. The topic that I presented the first time is different from the current topic although it is still about seed potatoes. The changes that were accommodated came as the result of the good feedback received from the supervisor and the assessor. I thought I had a very strong topic idea until I was critically challenged and realized I had to go on the right track. This stage reminded me that, working independently, being innovative and analytical is a necessary skill that a researcher needs to develop in order to produce a good thesis.

The selected value chain i.e. potato value chain was based on the personal experience as an extension officer in Mbeya region and the literature review. I also selected the potato value chain as the chain to spotlight during the module Value Chain Analysis. The experience that I got from the previous module got me into choosing potato as the chain of my thesis topic. I didn't know the magnitude of

the challenge on the seed potato until I contacted Stawisha for the assistance of recent reports about potato sector. I had a feeling that, everything with certified seed potatoes is going well because even the introduction of improved varieties to farmers is still on progress. Through exchanging views with Stawisha, I realized there were problems with farmers not adopting CSPs which later resulted into Stawisha being the problem owner and commissioner of this research.

The research proposal that was guiding the whole process was prepared in the period of May-June. The objective of the research was to provide an in-depth investigation of the factors influencing the farmers' adoption of CSPs in Iringa, Mbeya and Njombe regions of Tanzania with the view of recommending interventions that will be used by Stawisha to improve the adoption of CSPs by farmers. The first question needed to find out the reasons for low adoption of seed potatoes and the second question needed to find out the strategies that can be engaged to improve the farmers adoption to certified seed potatoes. The questions were formulated basing on the objective of the research. The research proposal preparation phase ended with the notice that I could not travel to Tanzania for data collection due to the COVID – 19 pandemic problem.

With the guidance from my supervisor and assistance from Stawisha, I had to hire consultants to conduct the survey on my behalf. I trained and tested the questionnaire with the four consultants in order to get them equipped with the research objective and conduct survey according the standards. The designed online questionnaire was then made simple to understand by translating it in Swahili language. I had a feeling that conducting physical survey is the experience that I personally needed in order to explore more through observation but I didn't get that chance.

Reflexivity of the research

During the whole data collection process, I was in close contact with the consultants that executed the field work for me, following the whole process and recommend whenever it was necessary. To influences on farmers opinions, the selected consultants do not have much contacts with the farmers they surveyed.

I also had to conduct online interviews with the key informants which I did myself. Unfortunately, I managed to complete only 13 out of 15 planned due to challenges that include communication protocols and bureaucracy. Some key informants claimed to not been allowed by their headquarters and did not reply to any emails. Online interviews were conducted via skype, MS Teams, Zoom and WhatsApp. The MS Teams seemed to be the most effective tool. The process went well and from the interviews I learned that potato sector still needs a lot of transformation. The same feeling that I was eager to feel by contacting farmers on survey I got it from the key informants whom some were farmers' cooperative leaders.

Reliability and validity

The research is a combination of primary and secondary data and qualitative and quantitative data. The data collection methods applied ensured accuracy and reliability of the research findings. The total sample size for survey was 45 farmers, 15 randomly chosen farmers representing each region. The sample size for each region fairly represents the regions but I believe the total of 45 is a good representation of the southern highlands area because of the common characteristics of the zone. Most of the variables have been studied as a whole for the total population of 45 farmers with some comparisons that were necessary due to the differences in CSPs production investment and support from different projects in different areas.

Online survey had some challenges because some of the respondents were in remote areas where internet is not available that forced the consultants to have printed questionnaire to fill in before uploading into the online form.

I missed interviews from Mamujee Foods Limited, a processor, TARI Uyole, a research institute and source of clean seeds and an extension officer from Mbeya and Iringa Regions. Mtanga Foods Ltd., is no longer in business and has sold its farm to another investor. I believe the missed interviews didn't affect my results as I got information from others that had comparable positions in the chain. But I managed to secure follow up interviews from another ISOWELU AMCOS leader and a Zonal relation manager - agribusiness of NMB Bank on their views about the input financial support.

I trust the process obtained reliable and valid data because I had a close follow up and Stawisha assigned a business advisor who was working alongside to ensure the process is successful.

Reporting the findings was the hardest part of the research process but also the very interesting one. This part is when I realized some information such as the exact interest rate of the loans from the Bank side. Due to the confidentiality policy of the Bank, they did not provide some information directly but it is something that could enable a researcher to get a full picture. I have used most of the time organizing data, processing information and reporting to produce this thesis report. In close contact with the supervisor I have managed to produce this concrete work which will help to serve farmers through Stawisha and other stakeholders. Some of the organizations of which I interviewed namely SAGCOT Center Limited, Silverlands Tanzania Limited, Beta Foods Limited, ISOWELU AMCOS were very much interested with the research and they requested to receive the report results.

CHAPTER 6: CONCLUSIONS

These conclusions are made based on the results from the survey, interviews and literature review.

1. The farmers adoption of the CSPs in the southern highlands regions of Tanzania is hindered by the following factors:
 - 1a. Low stakeholders' participation and coordination resulting into the existing inefficiencies regardless of their existence.
 - 1b. The missing link between the available CSPs varieties with what farmers cultivate the most; farmers perception about CSPs resulted from poor knowledge about the CSPs and their attributes due to inefficiencies in extension services, size of household having a negative relationship with use of CSPs; insufficient CSPs, distant access and difficulty in access for individual small farmer; lack of financial support to agricultural inputs primarily related to poor farmers organizations.
 - 1c. The production challenges faced by farmers that include: pests and diseases; inadequate and poor quality other agricultural inputs; perceived high price of CSPs that conflicts with the high CSPs production cost claimed by the CSPs producers; insufficient CSPs in the market; farming depending on rainfall.
 - 1d. CSPs producer's application of the four marketing variables is not sufficient enough to support adoption of CSPs as they produce some varieties not preferred by farmers; pricing that is perceived high by farmers even though some negotiations were allowed; Small holder individual farmers hardly access CSPs due to logistical issues; poor promotion as most of the farmers are not well informed about CSPs;
 - 1e. CSPs producers faces the challenges that include: perceived high price of the CSPs that also conflicts with the production costs; farmers low rate of adoption to technology; some varieties not doing well under high rainfall; import duty on CSPs early generation seeds that also contributes to CSPs price; limitation in seed multiplication cycles that could make CSPs even cheaper.
2. Interventions that will support the adoption of CSPs can be built on from the opportunities, strategies and needed institutional support. The interventions should capitalize from the following:
 - 2a. The potato market is growing. CSPs producers can take advantage though supply of the high quality, required volumes and varieties that will attract farmers to use CSPs; the presence of many stakeholders that plays different roles in the sub-sector; presence of the financial institutions that have already supported the input financing in potato could be an entry point to solve the challenges related to CSPs affordability.
 - 2b. Establishment of the production contracts between the CSPs producer and the farmers that will ascertain supply and quality while looking at the end product market perspective; CSPs producer to apply effectively the marketing variables of product, price, place and promotion.
 - 2c. The needed institutional support that is: tailor-made training on potatoes to extension staff for improved service delivery; facilitation of the financial support and good potato markets; lifting of the import duty by the government to minimize the costs of CSPs production; allow importation and simultaneous testing of the potato varieties to quick recognize the most suitable improved varieties for Tanzanian environment.

CHAPTER 7: RECOMMENDATIONS

On the basis of the findings, the study recommends the following interventions to be implemented.

Government

- i. The government through engaging stakeholders to establish a Horticultural Crops Board that will sustainably act as an institution that regulates and coordinates all matters related to horticultural crops and provide advice to the government on issues that involves farming and post-harvest technologies.
- ii. The government and Stawisha to provide tailor made training on potatoes to extension officers in order to improve the quality of extension service delivery and extend sustainable knowledge of CSPs to farmers that will improve CSPs adoption.
- iii. The government to support organization of farmers into cooperatives in order for farmers to sustainably benefit from the agricultural input financing schemes by government and private supporters. The input subsidy as also supported maize and paddy could be one of the best public support.
- iv. The government of Tanzania to review its agricultural import policy in order to accommodate tax relief to early generation seed potato materials to support the reduction of production costs of CSPs that could result in minimizing the price.

Stawisha

- v. Stawisha to support the CSPs producers to apply the following more sustainable business models in order to solve the challenges of availability/accessibility of CSPs;

a. A CSPs producer – out-grower – CSPs producer/ cooperative society business model

In this model, the CSP producer has full control over the flow of CSPs. The CSP producer to engage out growers to produce its seed potatoes in order to have a wide range of supply. The out-growers sell back to CSPs producer for it to be sold to cooperative farmers.

b. CSPs producer – cooperative QDS producer – smallholder individual growers/emerging farmers

In this model, a CSPs producer sells early generation seeds to the cooperative society with a structured selling and capacity to be a QDS grower. In this case, farmers in a cooperative society can specialise either to be a seed grower or a ware potato grower. Seeds from the cooperative society are sold to nearby farmers through the cooperative.

- vi. Stawisha to continue to promote the introduced potato varieties through demonstration farm and farmers field schools and engage consumers views in order to advice on the varieties and their qualities.

The researcher

As an extension officer employed by the government;

- vii. I can play a chain facilitation role by working on the government to reach out to Stawisha. I can do that by advocating within the government to work on the recommendations for the government as mentioned above while arranging stakeholders' meetings.
- viii. Apart from that, I can work together with Stawisha to provide tailor-made trainings on potatoes, and,
- ix. I can assist the CSPs producers by organizing farmers field schools and arranging the meetings with farmers.

REFERENCES

- ASI, 2019. *Access to Seeds Index 2019 Synthesis report*, Amsterdam, The Netherlands: Access to seed foundation.
- Baglan, M., Mwalupaso, G. E. & Geng, X. Z. & X., 2020. Towards Cleaner Production: Certified Seed Adoption and Its Efficiency. *Sustainability*, Issue 12.
- Bekele, T. & Haile, B., 2019. Evaluation of improved potato (*Solanum tuberosum* L.) varieties for some quality attributes at Shebench Woreda of Bench-Maji Zone, Southwestern Ethiopia. *African Journal of Agricultural Research*, 17(7), pp. 389-394.
- Bentley, J. W., Mele, P. V. & Reece, J. D., 2011. How Seed Works . In: P. V. Mele, J. W. Bentley & R. G. Guéi, eds. *African Seed Enterprises: Sowing the seeds of food security*. Rome, Italy: FAO and AfricaRice, pp. 8-24.
- CIP, 2011. *Potato in East Africa*. [Online]
Available at: <https://cipotato.org/research/potato-in-east-africa/>
[Accessed 20 May 2020].
- Connexus, 2018. *Promoting Agricultural Technology Adoption and Resilience: Lessons from the 2018 Conference*. Alexandria, Connexus Corporation.
- FAO, 2017. *Strengthening linkages between small actors and buyers in*. [Online]
Available at: <http://www.fao.org/3/a-i7166e.pdf>
[Accessed 31 May 2020].
- FAO, 2018. *Seeds Toolkit-Module 5: Seed Marketing*, Rome: FAO.
- Fasoyiro, S., 2012. Strategies for increasing food production and food security in Nigeria. *Journal of Agricultural & Food Information*, Issue 13, pp. 338-355..
- Feder, G., Just, R. & Zilberman, D., 1985. Adoption of Agricultural Innovation in Developing Countries: A Survey;. *University of Chicago Press*, Volume 33.
- Frost, k. E., Groves, R. L. & Charkowski, A. O., 2013. Integrated Control of Potato Pathogens Through Seed Potato Certification and Provision of Clean Seed Potatoes. *Plant Disease*, 97(10), pp. 1268-1280.
- Gesare, A. & M. R. & O. J. & K. M., 2012. The Role of Varietal Attributes on Adoption of Improved Seed Varieties: The Case of Sorghum in Kenya. *Agriculture & Food Security*..
- Harahagazwe, D. et al., 2016. *Participatory Evaluation of Resilient Potato Varieties in Climate-Smart Villages of Lushoto in Tanzania*.. Copenhagen: s.n.
- Jack, K. & Tobias, J., 2017. *Seeding success: Increasing agricultural technology adoption through information*, London: IGC Growth brief Series.
- Joshi, K. D. & Ullah, A. U. R. & G., 2017. Acceptance and competitiveness of new improved wheat varieties by smallholder farmers. *Journal of Crop Improvement*, 31(4), pp. 608-627.
- Kalam, A., 2016. APPLICATION OF MARKETING APPROACHES TO THE SEED MARKETING IN BANGLADESH: A STUDY ON DINAJPUR DISTRICT. *Journal of Science and Technology* 14(June 2016):36-41, Volume 14, pp. 36-41.

- KIT, 2010. Turning potatoes into crisps in Peru. In: *Value Chain Finance: Beyond Microfinance for Rural Entrepreneurs*. Amsterdam: Royal Tropical Institute, pp. 40-54.
- Kotler, P., Armstrong, G., Harris, L. C. & He, H., 2019. *Principles of Marketing*. 8 ed. London: Pearson Education Limited.
- KT, 2018. *Calories and Household Incomes from Potatoes Sub-sector (CHIPS)*, Dar Es Salaam: Kilimo Trust.
- Kumari, M., Kumar, M. & Solankey, S. S., 2018. Breeding Potato for Quality Improvement. In: M. Yildiz, ed. *Potato: From Incas to all over the World*. Ankara: IntechOpen, pp. 37-59.
- Kusiluka, M. A., 2019. Value Chain Analysis of Potato in the Southern Highlands of Tanzania: Constraints and Solutions. *The International Journal of Business & Management*, 7(1), pp. 105-116.
- Kwigizile, O. H., Ijumba, M. T., Kanyangemu, A. & Lyakaunda, J., 2017. *SAGCOT Potato Partnership Project: Upscaling Improved Potato Varieties for Smallholder-Final Project Report*, Dar es Salaam: SAGCOT Center Ltd..
- Lal, B., Sinha, T., Kumar, A. & N.K.Pandey, A. P. a., 2011. Constraints perceived by the farmers in adoption of potato technology. *Potato Journal*, 38(1), pp. 73-77.
- Lawal, J. & Oluyole, K., 2008. FACTORS INFLUENCING ADOPTION OF RESEARCH RESULTS AND AGRICULTURAL TECHNOLOGIES AMONG COCOA FARMING HOUSEHOLDS IN OYO STATE, NIGERIA. *International Journal of Sustainable Crop Production*, 3(5), pp. 10-12.
- Longo, R. & Mangiafico, M.-E., 2016. *Engaging with farmers' organizations for more effective smallholder development: Module - Support to farmers' organizations business models*, Rome, Italy: IFAD.
- Magali, J. J., 2014. Effectiveness of Loan Portfolio Management in Rural SACCOS: Evidence from Tanzania. *Business and Economic Research*, 4(1), pp. 299-318.
- Mende, D. H., Mwatawala, M. W. & Kayunze, K. A., 2014. Contribution of Round Potato Production to Household Income in Mbeya and Makete Districts, Tanzania. *Journal of Biology, Agriculture and Healthcare*, 4(18), pp. 1-11.
- MoA, 2017. *Ministry of Agriculture*. [Online]
Available at: <https://www.kilimo.go.tz/index.php/en/index.php/resources/view/agricultural-sector-development-programme-phase-ii-asdp-ii>
[Accessed 4 May 2020].
- MoF, 2020. *SPEECH BY THE MINISTER OF FINANCE AND PLANNING, HON DR. PHILIP I. MPANGO (MP), PRESENTING TO THE NATIONAL ASSEMBLY THE ESTIMATES OF GOVERNMENT REVENUE AND EXPENDITURE FOR 2020/21*, Dodoma: Ministry of Finance.
- Mpogole, H., 2012. Round potato (*Solanum tuberosum*) production in southern highlands of Tanzania: Are smallholder farmers becoming commercial?. *Journal of Agricultural Extension and Rural Development*, 4(14).
- Mpogole, H. & Kadigi, R. M. J., 2012. Round potato (*Solanum tuberosum*) profitability and implications for variety selections in the Southern. *Journal of Development and Agricultural Economics Vol. 4(9)*, pp. 258-267, 26 May, 2012, 4(9), pp. 258-267.

- Namwata, B., Lwelamira, J. & Mziray, O., 2010. Adoption of improved agricultural technologies for Irish potatoes (*Solanum tuberosum*) among farmers in Mbeya Rural district, Tanzania: A case of Ilungu ward. *Journal of Animal and Plant Sciences*, 8(1), pp. 927-935.
- NBS, 2013. *2012 POPULATION AND HOUSING CENSUS*, Dodoma: NBS.
- Nkonya, E. & Norman, T. S. & D., 2008. Factors affecting adoption of improved maize seed and fertilizer in northern Tanzania. *Journal of Agricultural Economics*, 48(1-3).
- Nyunza, G. & Mwakaje, A. E. G., 2012. Analysis of Round Potato marketing in Tanzania: The Case of Rungwe District, Tanzania. *International Journal of Business and Social Science*, 3(23), pp. 86-96.
- Okello, J. J., Zhou, Y., Kwikiriza, N. & Ogutu, S. O., 2016. Determinants of the Use of Certified Seed Potato among Smallholder Farmers: The Case of Potato Growers in Central and Eastern Kenya. *Agriculture*, 6(55), pp. 1-12.
- Pioneers, 2018. *Scoping Project: Tanzania's Horticulture Industry Business Opportunities Commissioned by the Netherlands Enterprise Agency*, Dar es Salaam: Embassy of the Kingdom of The Netherlands.
- Qiong, Q., 2017. A Brief Introduction to Perception. *Studies in Literature and Language*, 15(4), 18-28, 4(15), pp. 18-28.
- Roo, N. d. & Gildemacher, P., 2016. *Promoting Sustainable Sees Sector Development*, Wageningen, The Netherlands: WUR CDI & KIT.
- Rupp, J. & Jacobsen, B., 2017. *BACTERIAL AND FUNGAL DISEASES OF POTATO AND THEIR MANAGEMENT*. [Online]
Available at: <http://montanaspud.org/documents/extension-information/potatoes12-27-3.pdf>
[Accessed 12 October 2020].
- RVO, 2017. *Seed Potatoes Tanzania*, The Hague, The Netherlands: Netherlands Enterprises Agency.
- SAGCOT, 2020. *Potato Strategic Partnership*. [Online]
Available at: <http://sagcot.co.tz/wp-content/uploads/2020/08/SAGCOT-Brochure-Potato-Strategic-Approach.pdf>
[Accessed 20 August 2020].
- Sánchez-Toledano, B. I., Kallas, Z. & Rojas, O. P., 2018. Determinant Factors of the Adoption of Improved Maize Seeds in Southern Mexico: A Survival Analysis Approach. *Sustainability*, Issue 10.
- Santoso, H. B. & Delima, R., 2017. Stakeholder Definition for Indonesian Integrated Agriculture Information System (IAIS). *IOP Science*, Issue 185.
- Stawisha, 2018. *Agronomic Intelligence*, Mbeya: Unpublished.
- Stawisha, 2019. *Tanzania Potato Sector Status Report*, Mbeya, Tanzania: Unpublished.
- Stawisha, 2019. *Tanzania Potato Sector Status Report*, Mbeya, Tanzania: Unpublished.
- Stawisha, 2020a. *Success Story: How Dutch companies co-invested in transforming Tanzania's*, Mbeya: Unpublished.
- Stawisha, 2020b. *Success Story: How Dutch companies guided Stawisha in becoming a key service provider to Tanzania's potato sector*, Mbeya: Unpublished.

Stawisha, 2020c. *Success Story: How Stawisha supported organized potato farmers in being linked to trading, inputs, markets and finance*, Mbeya: Unpublished.

TARI, 2020. *Calories and Household Incomes from Potato Sub-sector (CHIPS): Enhancing Seed Potatoes Supply*, Mbeya: Unpublished .

TCB, 2012. *Coffee Industry Regulations, 2012*. [Online]

Available at:

http://www.coffeeboard.or.tz/News_publications/COFFEE_REGULATIONS_G_N_NO_187_OF_2012.pdf

[Accessed 3 October 2020].

Thiele, G. et al., 2011. Multi-stakeholder platforms for linking small farmers to value chains: evidence from the Andes. *International Journal of Agricultural Sustainability*, 9(3), pp. 423-433.

TOSCI, 2020. *Tanzania Official Seed Certification Institute*. [Online]

Available at: <https://www.tosci.go.tz/uploads/publications/en1590583265-Variety%20Catalogue%20Jan%202020.pdf>

[Accessed 17 7 2020].

Umerez, J. & Mossio, M., 2016. Constraint. In: D. W., W. O., C. KH. & Y. H., eds. *Encyclopedia of Systems Biology*. New York: Springer, pp. 490-493.

UN, 2015. *Accessibility and Development: Mainstreaming disability in the post - 2015 development agenda*. [Online]

Available at: https://www.un.org/disabilities/documents/accessibility_and_development.pdf

[Accessed 17 June 2020].

Vegetable Facts, 2020. *History of Potatoes*. [Online]

Available at: <http://www.vegetablefacts.net/vegetable-history/history-of-potatoes/>

[Accessed 3 May 2020].

Viatte, G., 2000. ADOPTING TECHNOLOGIES FOR SUSTAINABLE FARMING SYSTEMS: AN OECD PERSPECTIVE. *ADOPTION OF TECHNOLOGIES FOR SUSTAINABLE FARMING SYSTEMS*, 4-7 July, pp. 14-23.

Wang, F., 2008. *The importance of quality potato seed in increasing potato production in Asia and the Pacific*. Bangkok, Thailand, FAO.

Weening, K., 2018. *Dutch Potato Sector: An Overview*, The Hague: NAO.

WUR, 2017. *Food and Business*. [Online]

Available at: https://knowledge4food.net/wp-content/uploads/2017/05/170524_NFP-Jakarta-Introductory-paper-questions.pdf

[Accessed 5 June 2020].

APPENDICES

Appendix 1: Questionnaire

Improving adoption of Certified Seed Potato in the southern highlands of Tanzania

This questionnaire is used collect information that will be used to investigate the factors influencing the farmers' adoption of certified seed potatoes in Iringa, Mbeya and Njombe regions of Tanzania with the view of recommending inclusive business model interventions that will be used by Stawisha to improve the adoption of certified seed potatoes by farmers. Information collected through this questionnaire will be treated with high confidentiality. Thanks for your cooperation.

1.Region

Please choose the region you are

- ☐ Iringa
- ☐ Mbeya
- ☒ Njombe

2.Gender

Please select the appropriate sex group

- ☐ Male
- ☐ Female

3.Land ownership

please select the appropriate land ownership type

- ☐ Own
- ☐ Rented
- ☐ Family land
- ☐ Communal land
- ☐ Other (*please mention*)

4.What is your farm size in hectares?

Please fill the total size of the farms including of other crops

5.What is the land size under potato production in hectares?

6.What is your main source of income?

please select the source that provides more income than others

- ☐ Selling potatoes
- ☐ Selling other crops
- ☐ Other (*please mention*)

7.How long have you been farming?

please select the appropriate response

- ☐ <5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ >16 years

8. There are several improved potato varieties available, do you have a preference for a variety?
Please rank the potato varieties listed (1 =Not preferred, 2=Least preferred, 3=Preferred, 4=More preferred, 5 = most preferred)

	1	2	3	4	5	I don't know the variety
Jelly	☒	☐	☐	☐	☐	☐
Rumba	☐	☐	☐	☐	☐	☒
Taurus	☐	☐	☐	☐	☐	☐
Sifra	☐	☐	☐	☐	☐	☐
Panamera	☐	☐	☐	☐	☐	☐
Sagitta	☐	☐	☐	☐	☐	☐
Tengeru	☐	☐	☐	☐	☐	☐
Asante	☐	☐	☐	☐	☐	☐
Obama	☐	☐	☐	☐	☐	☐
Sherekea	☐	☐	☐	☐	☐	☐

9. Which potato variety do you actually grow?

10. Do you use Certified Seed Potatoes?

Certified Seed Potatoes = Seed potato and certified by TOSCI

- ☐ Yes
☐ No

11. If the answer in question 10 is YES, how did you get the information about the certified seed potatoes?

- ☐ From a neighbor farmer
☐ From an extension officer
☐ From media
☐ From the Certified Seed Potato producer
☐ Other (please mention)

12. If the answer in question 10 is NO, what is the source of your seed potatoes?

Please select from the list

- ☐ Own served

- ☐ Neighbouring farmers
- ☐ Other (*please mention*)

13.If you are NOT using Certified Seed Potatoes, how do you rate the reasons listed bellow?

1= strongly disagree, 2=neutral 3=strongly agreed

Reason for not using CSPs	1	2	3
No varieties of my choice	☐	☐	☐
Not available locally	☐	☐	☐
I can not afford it	☐	☐	☐
I have no information about the seed potatoes	☐	☐	☐
I don't believe it is better than the informal seed potatoes	☐	☐	☐

14.If you are using certified seed potatoes, where do you buy?

Please name the company or seed producer and location

15.How much is the price of a kilo of Certified Seed Potatoes?

Please enter the amount in Tanzanian Shillings

16.What is the important quality attribute of potato to you?

Please rate your preferences (1 =Not important, 2 = less important, 3 = Neutral, 4 = important, 5= most important)

Quality attribute	1	2	3	4	5
Tuber size	☐	☐	☐	☐	☐
Tuber shape	☐	☐	☐	☐	☐
Flesh color	☐	☐	☐	☐	☐
Skin color	☐	☐	☐	☐	☐
Eye depth	☐	☐	☐	☐	☐

17.What is guiding your choice of seed potato variety to grow?

You can select more than one choice

- ☐ Variety needed in the market?
- ☐ Resistance of the variety to diseases?

- ☐ Financial Returns of the variety per hectare
- ☐ Availability of the seed potatoes
- ☐ Agronomic attributes of the variety
- ☐ Other (*please mention*)

18. Where do you sell your ware potatoes?

select the selling channels (Multiple selections are allowed)

- ☐ Village traders
- ☐ Local markets
- ☐ Upcountry wholesale market
- ☐ Middlemen
- ☐ Potato processors
- ☐ Other (*please mention*)

19. How much do you sell per kilo of ware potatoes?

Enter the amount in Tanzania Shillings

20. How many times do you get the extension service in a year?

21. What are challenges do you face growing potatoes?

22. Are you a member of any farmers cooperative?

- ☐ Yes
- ☐ No

23. Do you have access to financial services eg loans, savings etc?

- ☐ Yes
- ☐ No

24. If the answer of the question 23 is YES, how many options of financial services do you have?

- ☐ 1 option
- ☐ 2 options
- ☐ 3 options
- ☐ >4 options

25. What opportunities are there in the potato sector?

26. Age (years)

Please select the appropriate age range

- ☐ 18-35
- ☐ Above 35

27. Number of members in the household

please select the appropriate family size range

- ☐ 1-3
- ☐ 4-6
- ☐ 7-9
- ☐ >9

28.Education Status

Please select the appropriate level of education

- ☐ Illiterate
- ☐ Primary education
- ☐ Secondary education
- ☐ Advanced Secondary education
- ☐ Ordinary Certificate/Diploma
- ☐ Advanced Diploma/Degree/Master degree

Appendix 2:: CHECKLIST FOR CERTIFIED SEED POTATOES PRODUCERS/MULTIPLIERS INTERVIEWS

- i. What seed potatoes varieties do you grow?
- ii. What is the price of the seed potatoes per variety per kilo?
- iii. What is the productivity potential of the varieties you are growing?
- iv. What is guiding your choice for the seed potatoes production?
- v. What is your target market for the seed potatoes?
- vi. How do you promote your seed potatoes?
- vii. How do you sell your seed potatoes? Deliver/have agents/online/physical
- viii. What enabled your seed potato growing business?
- ix. What hindered your seed potato business?
- x. What could be the possible solutions?
- xi. Who are the players/actors/stakeholders to provide the solution? Including your role.
- xii. What opportunities are there in the potato sub-sector?

Appendix 3: CHECKLIST FOR COOPERATIVE LEADERS INTERVIEWS

- i. What is the core business of your cooperative?
- ii. What are the benefits the members get from the cooperatives?
- iii. Do you have farmers who use certified seed potatoes? What role has the cooperative played in promoting the use of certified seeds?
- iv. For farmers who do not use certified seed potatoes, what could be the reasons?
- v. Who are important stakeholders in the potato sector?
- vi. What challenges do the farmers face in growing potatoes?
- vii. What opportunities are there in the potato sector?
- viii. What solutions to the problems mentioned do you suggest? And who are the stakeholders/actors to provide solution?

Appendix 4: CHEKLIST FOR EXPERTS INTERVIEW

- i. What role do you play in the potato sector? You and your Institution
- ii. What can you name as the causes for farmers to NOT use Certified Seed Potatoes?
- iii. What opportunities are there in the potato sector?
- iv. What are the challenges facing actors in the potato sector? Farmers, seed potato producers, researchers, etc
- v. What strategies do you think can be formulated to contain the challenges of the sector?
- vi. Who are important stakeholders in potato sector in Tanzania?
- vii. Are there any certified seed potato producers in your area?

Appendix 5: CHECKLIST FOR SEED POTATO PROCESSORS

- i. How do you source your raw materials (ware potatoes)? (direct from farmers, through middlemen, other)
- ii. How do you rank the quality if the potatoes you are getting from the market? (fair, good, best)
- iii. Do you face challenges on quality of the potatoes from your sources? What is the most quality challenge with the potatoes? (tuber size, variety, diseases, other)
- iv. What varieties do you prefer to process? And Why?
- v. What varieties can you get from the market? Is it sufficient?
- vi. What is your processing capacity? Does the supply fill the volume requirements?
- vii. What other challenges do you face on your business as a processor?

- viii. What solutions do you suggest to the named challenges?
- ix. Do you think there is an opportunity for the potato sector to grow? Can you name the opportunities?

Appendix 6: CHEKLIST FOR EXTENSION OFFICERS

- i. What role do you play in the potato sector? You and your Institution
- ii. What can you name as the causes for farmers to NOT use Certified Seed Potatoes?
- iii. How do you provide extension services?
- iv. Are there extension officers specialized in potato?
- v. What opportunities are there in the potato sector?
- vi. What are the challenges facing actors in the potato sector? Farmers, seed potato producers, researchers, etc
- vii. What strategies do you think can be formulated to contain the challenges of the sector?
- viii. Who are important stakeholders in potato sector in your area?
- ix. Are there any certified seed potato producers in your area?

Appendix 7: List of interviewees

CO DE	INSTITUTION	GROUP/POSITI ON	CONTACTE D PERSON (S)	PHYSICA L ADDRESS
KI-1	OPTIMAL (T) LTD. A potato processor based in Arusha Tanzania. Processes potatoes into different products including crisps. Currently Buys potato from Stawisha farm and little from the market.	POTATO PROCESSOR	JUSTINUS MASINGI	ARUSHA
KI-2	SAGCOT CENTER LTD. - Is a public-private partnership - Catalyses agribusiness investments, serves as a - Partnership-broker and information hub among its partners - SAGCOT Centre actively promotes and facilitates strategic partnerships due to - their high impact and potential for expansion. - The regions of Iringa, Mbeya and Njombe are in the SAGCOT area.	EXPERT/SUPPO RTERS	MARIA IJUMBA/ GERALD SAKAYA	DAR ES SALAAM
KI-3	BETA FOODS LTD. A processor who processes potato into different products. Buys potatoes from Stawisha farm and from other farmers.	POTATO PROCESSOR	ERNEST MAKENA	ARUSHA
KI-4	TANZANICE A CSPs producer based in Iringa.	SEED POTATO PRODUCERS	BRIAN KILUNDE	NJOMBE
KI-5	SILVERLANDS (T) LTD. A CSPs producer based in Iringa.	SEED POTATO PRODUCERS	REX FEY	IRINGA
KI-6	STAWISHA An implementor of the CD-PIT project and commissioner of this research.	SUPPORTOR	NOAH KITULO	MBEYA
KI-7	NJOMBE REGION A government office that acts as an extended arm of the Central government. Its acts as a link between central government and Local government Authorities.	AGRICULTURAL OFFICER	WILSON JOEL	NJOMBE
KI-8	ISOWELU AMCOS A farmer's cooperatives established in Njombe region. It is a primarily potato based cooperative.	COOPERATIVE SOCIETIES LEADERS	ERNEST MLIMBILA	NJOMBE
KI-9	ISOWELU AMCOS	AGRICULTURAL OFFICER	ROBINSON MPALANG' OMBE	NJOMBE

	A farmer's cooperatives established in Njombe region. It is a primarily potato based cooperative.			
KI – 10	MTAMBULA AMCOS A farmer's cooperative based in Iringa region. It is a primarily a mixed crop cooperative ie cereals and potatoes	COOPERTIVE SOCIETIES LEADERS	LEONARD MFIKWA	IRINGA
KI- 11	RSTGA A farmers SACCOS primarily for tea crop based in Mbeya region. Farmers also cultivates potatoes.	COOPERTIVE SOCIETIES LEADERS	JOSHUA SONGELA	MBEYA
KI- 12	NMB Bank SOUTHERN HIGHLAND ZONE A retail and commercial bank. Serves from individuals to large corporate clients. It has over 224 branches, over 6000 Agents its customer base is 3 million	FINANCIAL INSTITUTION	LUGANO FUNGO	MBEYA
K- 13	ISOWELU AMCOS A farmer's cooperatives established in Njombe region. It is a primarily potato based cooperative.	COOPERATIVE SOCIETIES LEADERS	CHESCO NGEVE	NJOMBE

Source: Author (2020)

Appendix 8: Kruskal Wallis Test results for difference in perception on quality attributes

Test Statistics^{a,b}

Farmers perception on quality attribute

Kruskal-Wallis H	31.827
df	4
Asymp. Sig.	.000
a. Kruskal Wallis Test	
b. Grouping Variable: Potato variety quality attribute	

Appendix 9: Chi-Square Tests results for age difference vs use of CSPs

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.735 ^a	1	.098
Likelihood Ratio	2.766	1	.096
Linear-by-Linear Association	2.675	1	.102
N of Valid Cases	45		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.31.			

Appendix 10: Calculation cost of Production per acre with informal seed potatoes

PART A:						
Direct costs for products, per acre	product name	unit	frequency	quantity	unit price (TSh)	costs
Land preparation: contracted out						
soil cultivation	casual labour OR tractor ploughing		1	1	50,000	50,000
soil hallowing	casual labour OR tractor harrowing		1	1	35,000	35,000
Total contracted out:						85,000
Labour						
Farm cleaning			1	4	5,000	20,000
Row making			1	4	5,000	20,000
Planting			1	8	5,000	40,000
Basal fertilizing			1	4	5,000	20,000

Top dressing			-	4	5,000	20,000
Spraying			10	3	5,000	150,000
Weeding			1	10	5,000	50,000
Earthing up			1	10	5,000	50,000
Defoliation (cutting plant)			1	4	5,000	20,000
Harvesting		bags (100kg)	1	80	3,000	240,000
supervising visits	1 person	entire season	-	1	50,000	50,000
<u>Total labour</u>						<u>680,000</u>
Seed potatoes		1kg	1	1,000	600	600,000
<u>Total seed potatoes</u>						<u>600,000</u>
Fertilizer						
Basal	Yara Otesha	50kg bags	1	3	63,000	189,000
1st top dressing	Yara Winner	50kg bags	-	2	68,000	136,000
1st top dressing	Nitrabor	25kg bags	-	2	32,000	64,000
Foliar feed	Yara Liva Tracel Biz	1kg	1	1	18,000	18,000
<u>Total fertilizer</u>						<u>407,000</u>
Fungicide						
Fungicide	Multipower Plus 78 wp	1kg	10	1	33,000	330,000
<u>Total fungicides</u>						<u>330,000</u>
Insecticide						
insecticide	Suracron	1Litre	5	0.4	30000	60,000
<u>Total insecticides</u>						<u>60,000</u>
Transport						
Seed from road to farm		T	1	1	20000	20,000
Fertilizer to farm		bags	1	1	3000	3,000
Supervisor		1 person	10	1	1000	10,000
Ware potatoes to trader truck		100kg bags	1	80	2000	160,000
<u>Total transport</u>						<u>193,000</u>
Grand Total direct costs, per acre						<u>2,355,000</u>

Appendix 11: Calculation cost of production per acre with CSPs

PART B:

Direct costs for products, per acre	product name	unit	frequency	quantity	unit price	costs
Land preparation: contracted out						
soil cultivation		tractor	1	1	50,000	50,000
	ploughing					
soil cultivation		tractor	1	1	35,000	35,000
	harrowing					
<u>Total contracted out:</u>						85,000
Labour						
Farm cleaning			1	4	5,000	20,000
Row making			1	4	5,000	20,000
Planting			1	8	5,000	40,000
Basal fertilizing			1	4	5,000	20,000
Top dressing			1	4	5,000	20,000
Spraying			10	3	5,000	150,000
Weeding			1	10	5,000	50,000
Earthing up			1	10	5,000	50,000
Defoliation (cutting plant)			1	4	5,000	20,000
Harvesting		bags (100kg) entire season	1	80	3,000	240,000
Supervising visits	1 person		1	1	50,000	50,000
<u>Total labour</u>						680,000
Seed potatoes						
Seed potatoes		1kg	1	1,000	1,000	1,000,000
<u>Total seed potatoes</u>						1,000,000
Fertilizer						
Basal	Yara Otesha	50kg bags	1	3	63,000	189,000
Top dressing	Yara Winner	50kg bags	2	2	68,000	272,000
Top dressing	Nitrabor	25kg bags	2	2	32,000	128,000
Foliar feed	Yara Liva Tracel Biz	1kg	1	1	18,000	18,000
<u>Total fertilizers</u>						607,000
Fungicide						
Fungicide	Multipower Plus 78 wp	1kg	10	1	33,000	330,000
<u>Total fungicides</u>						330,000
Insecticide						

insecticide	Suracron	1Litre	5	0.4	30000	60,000
Total insecticides						60,000
Transport						
Seed from road to farm	T		1	1	20000	20,000
Fertilizer to farm	bags		2	1	3000	6,000
Supervisor	1 person		10	1	1000	10,000
Ware potatoes to trader truck	100kg bags		1	80	2000	160,000
Total transport						196,000
Total direct costs, per acre						2,958,000

Appendix 12: One-way ANOVA test results for Price of CSPs differences between regions

ANOVA

Price of CSPs per kilo

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31817.496	2	15908.748	.579	.573
Within Groups	384358.974	14	27454.212		
Total	416176.471	16			

Source: Authors survey data (2020)

Test for differences in use of CSPs basing on Age

Chi square test at 95% level of confidence and confidence limit, $\alpha=5\%$ (0.05)

Hypothesis

- Null hypothesis, H_0 : There is no difference in the use of CSPs between farmers with different levels of experience in CSPs farming
- Alternative hypothesis, H_1 : There is a difference in the use of CSPs between farmers with different levels of experience in CSPs farming.

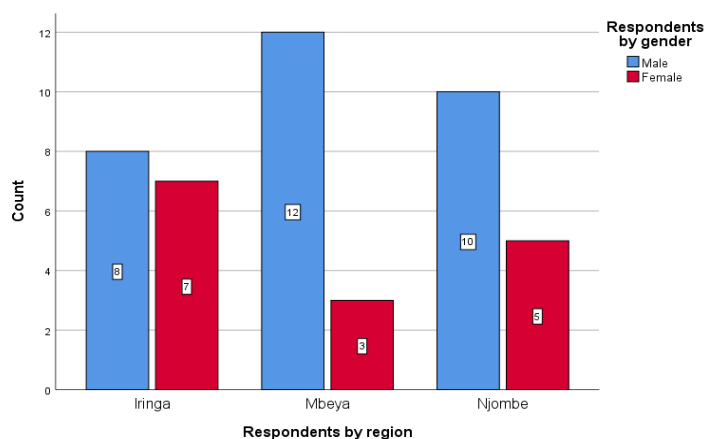
Appendix 13: Chi-square test results for test of difference in difference in access of information between regions

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.686 ^a	6	.585
Likelihood Ratio	5.872	6	.438
Linear-by-Linear Association	.922	1	.337
N of Valid Cases	17		

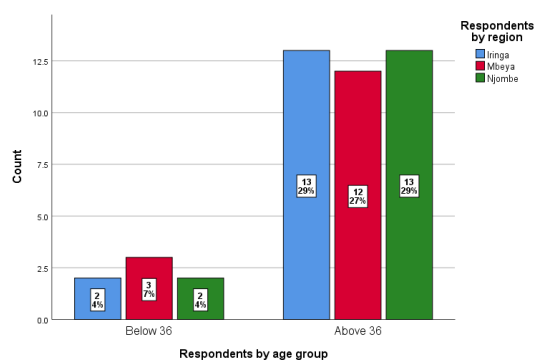
a. 11 cells (91.7%) have expected count less than 5. The minimum expected count is .06.

Appendix 14: The composition of the respondents by region and gender



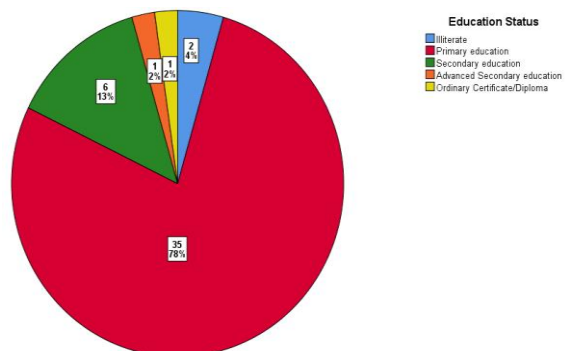
Source: Authors survey data (2020)

Appendix 15: The composition of the respondents by region and age group



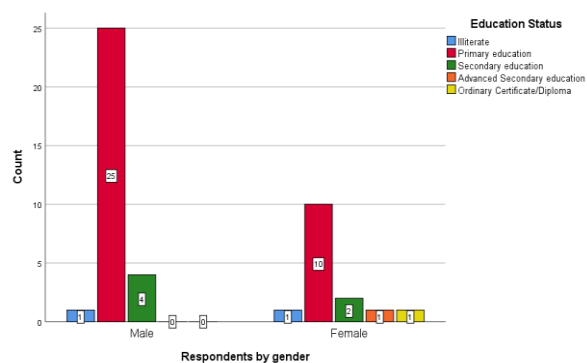
Source: Authors survey data (2020)

Appendix 16: Education status of the respondents

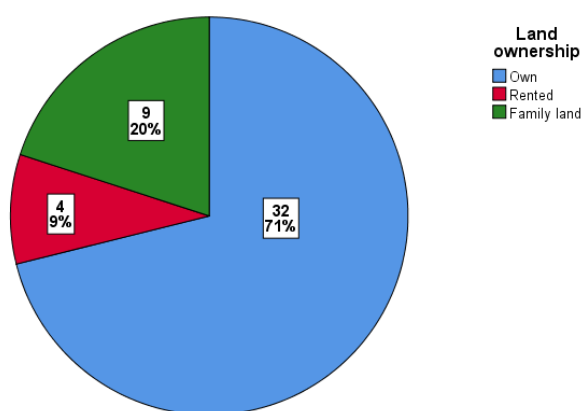


Source: Authors survey data (2020)

Appendix 17 Education status of the respondents by gender

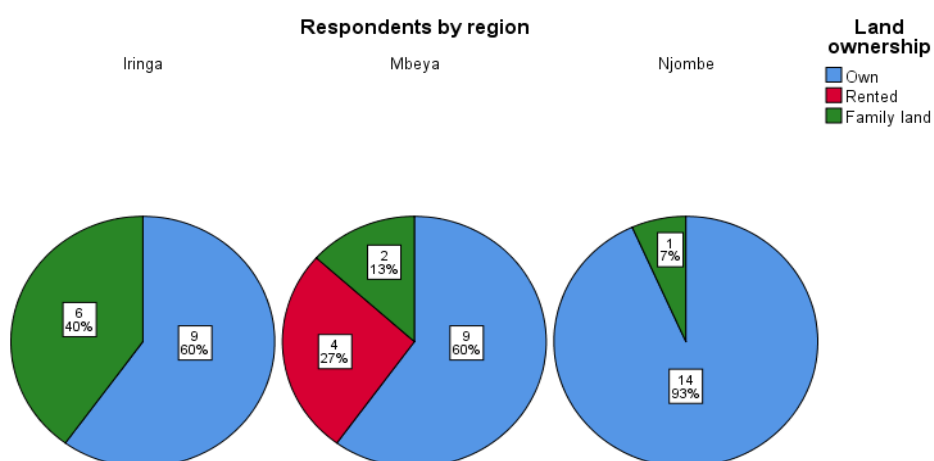


Appendix 18: Respondents land ownership status



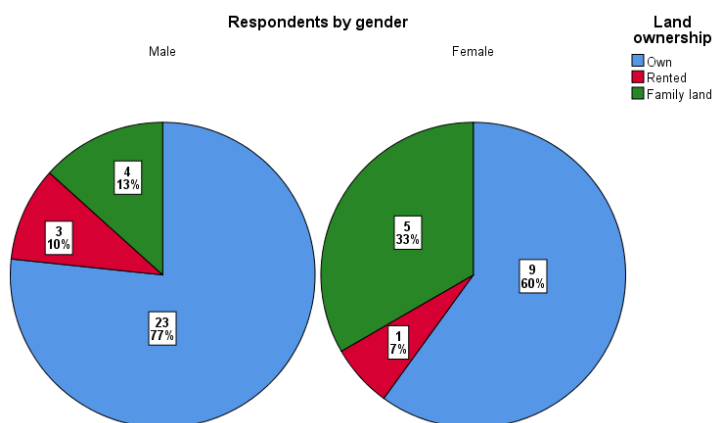
Source: Authors survey data (2020)

Appendix 19: Respondents land ownership status by region



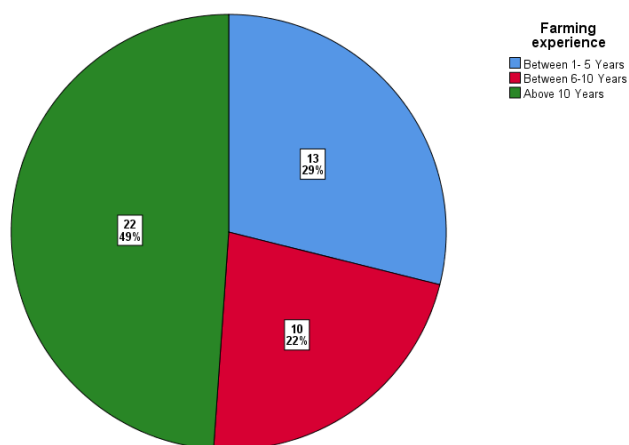
Source: Authors survey data (2020)

Appendix 20: Respondents land ownership status by gender



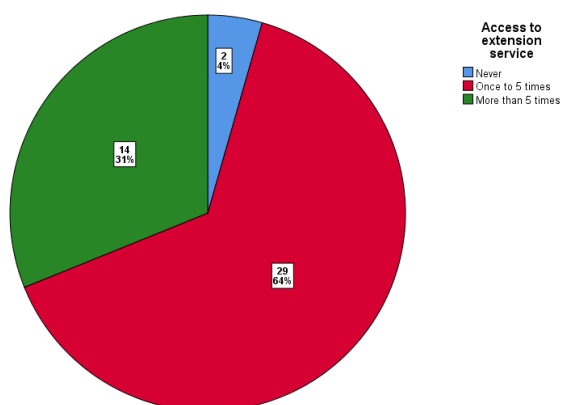
Source: Authors survey data (2020)

Appendix 21: Respondents farming experience



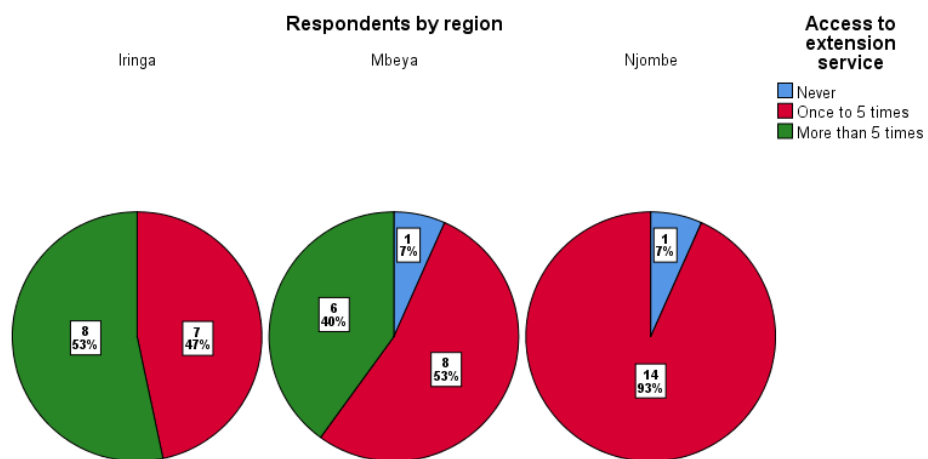
Source: Authors survey data (2020)

Appendix 22: Respondents access to extension services



Source: Authors survey data (2020)

Appendix 23 Access to extension services by regions



Source: Authors survey data (2020)

Appendix 24: Field work pictures



Source: Field work and Authors interviews (2020)