NETWORKING CAPABILITY, ADOPTION TENDENCIES AND COMMERCIALIZATION: CASE OF DECENTRALIZED *CLEAN SEED* POTATO MULTIPLICATION AGRI-ENTERPRISES IN NAKURU COUNTY, KENYA

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been submitted to Egerton University or any other University for the award of a degree.

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Recommendation

This thesis has been submitted with our approval as the University supervisors.

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DEDICATION

I dedicate this thesis to my husband Mr. Justus Wangolo, my daughter Patience, son Emmanuel, and potato sector stakeholders in Nakuru County.

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ABSTRACT

Quality of seed is a major yield determinant in potato (*Solanum tuberosum* L.) production and therefore global food security. Unfortunately, due to its shortage, only 2% to 2.6% of 600,000 to 800,000 potato farmers have access to certified seed potato. Consequently, about 95% of Kenyan potato farmers continue to rely on degenerated seed from the informal sector resulting in low yields. Alternatively, the semiformal system has the potential to improve the supply of *clean seed*, however its uptake and commercialization are low. Despite salient adoption studies, little has been done on adoption tendency, which shows an individual's gradual willingness towards agri-enterprise uptake, based on the Trans-theoretical model of behaviour change. Entrepreneurial development can be enhanced through networking capability (NC), which ensures access to productive resources at low transactional cost. This study focused on factors influencing farmer's adoption tendency and commercialization of decentralised *clean seed* potato multiplication agri-enterprises (CSPMAE) in Nakuru County. Molo, Kuresoi North, and Kuresoi South Sub-Counties were purposively selected due to their dominance in potato production. Primary data was collected through a cross-sectional survey, using a researcher administered semi-structured questionnaire on 54 *clean seed* potato producers (CSPMA) and 192 non-seed potato producers, who were selected through a multistage sampling technique. Descriptive statistics on adoption tendencies showed that about 53% of the households were in the pre-contemplation stage, 15% in the contemplation stage, about 10% in the preparation stage and nearly 22% in the action stage. A two-tailed t-test comparison of networking capability revealed that CSPMA had significantly high NC attributes compared to non-CSPMA. Gender, household size, proportion of potato land, farmers' literacy level, ownership of storage and transport asset, access to certified seed, membership to potato related group, and networking capability of the household head had a significant influence on the uptake of CSPMAE. Fractional regression analysis revealed that household's head age, household size, level of education, selling outlet, access to certified seed, and the amount of credit accessed significantly influenced the extent of *clean seed* potato commercialization. Nakuru County stakeholders in the seed potato value chain and donors should prioritize their support for *clean seed* agri-enterprises to farmers with such traits. Reinforcement of policies that promote farmers' capacity building and access to institutional amenities is also paramount. This is likely to lead to increased uptake and commercialization of CSPMAE hence supply and access of *clean seed,* thereby improving potato yields in Nakuru County and ultimately in Kenya.

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LIST OF ABBREVIATION AND ACRONYMS

AVCD	Accelerated Value Chain Development
AVE	Average Variance Extracted
BNR	Building New Relations
CIP	International Potato Centre
CR	Composite Reliability
CSPMA	*Clean seed* Potato Multiplication Agri-entrepreneur
CSPMAE	*Clean seed* Potato Multiplication Agri-Enterprises
CFA	Confirmatory Factor Analysis
CS	Coordination Skills
DHM	Double Hurdle Model
FRM	Fractional Response Model
GDP	Gross Domestic Production
HHH	Household Head
HCI	Household Commercialization Index
IC	Internal Communication
KALRO	Kenya Agricultural Livestock and Research Organization
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenyan Shillings
KMO	Kaiser-Meyer-Olkin
MoALFI	Ministry of Agriculture, Livestock, Fisheries and Irrigation
NC	Networking Capability
OLS	Ordinary Least Square Mode
PK	Partner Knowledge
QMLE	Quasi Maximum Likelihood Estimation
RMT	Rapid Multiplication Technology
RS	Relational Skills
SME	Small and Medium Enterprises
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
TTM	Trans-Theoretical Model

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

The Kenyan economy largely depends on the agricultural sector, which is key towards accelerating the achievement of its economic pillar of national vision 2030 and food security pillar which is one of the presidential Big four agenda (legacy projects for the year 2018-2022) (GoK, 2017). Globally, agriculture contributes towards the attainment of the sustainable development goals (SDGs) by improving food security and poverty alleviation. The Kenyan agricultural crops sub-sector contributed about 27.8% to the gross domestic product and provided about 75% of employment opportunities in the year 2019. (KNBS, 2020). Maize is the main staple crop in Kenya although other food crops such as wheat, rice, sorghum, millet, sweet potatoes, potatoes, cassava, bananas, and legumes are produced for food. Horticultural crops, tea, and coffee are grown mainly for export.

Potato (*Solanum tuberosum* L.*)* is a vegetatively propagated tuber crop cultivated in more than 100 countries worldwide with a global average yield of about 17MT/Ha (FAOSTAT, 2018). Worldwide, potato is ranked as the most important non-cereal food crop and the fourth most important food crop after rice, wheat, and maize (FAO, 2013; KEPHIS, 2016). In Kenya, it is the second most important food crop after maize (MoALFI, 2016). Potato has a comparative advantage in yields per unit area and adaptability in high altitude areas where maize takes long to mature and provides employment to about 3.3 million people in its diverse value chain activities. Potato production can therefore contribute significantly towards income generation, employment, poverty reduction, and improvement of national food security (Chindi *et al.;* 2017; GoK, 2017; MoALFI 2016).

Globally, Asia, Europe, and North America are the leading potato producers whereas yields in Sub-Saharan Africa (SSA) are still low. Kenya ranked sixth in SSA with the production of about 1,519, 870 tonnes in 2017 (FAOSTAT, 2018). Potato yields in Kenya are estimated at 10MT/ha, which is far much below its potential of 40MT/ha realized under good agricultural practices. Kenya produces about 1.5 million tonnes of potatoes annually, worth KES 40 to KES 50 billion on about 161, 000 hectares of land (KEPHIS, 2016). This production is done by approximately 600,000 to 800,000 potato farmers of which 83% are smallholder farmers (Janssens *et al*.; 2013). Nakuru County is ranked second in national potato production with its main production intensified in Kuresoi North, Molo, Kuresoi South, and Njoro Sub-Counties (CIDP, 2018).

Agricultural productivity largely depends on sustainable supply and utilization of quality agricultural inputs and technologies among other factors. Quality seed is among the vital inputs and components of agricultural productivity with the potential to stimulate economic growth and entrepreneurial opportunities along the seed value chain (Louwaars & De Boef, 2012). A seed system that ensures seed security to farmers is essential towards the realization of the potential in potato production. Efficient seed markets are also crucial for enhanced agricultural-based economic growth and increased incomes for the rural agri-entrepreneurs (Almekinders & Louwaars, 2008; Chindi *et al.;* 2017; Okello *et al*. 2017; Rabbi *et al;* 2017).

Despite the potential in the potato sector towards the attainment of vision 2030 and the presidential big four agenda which envisions an increase in potato yields to 2.52 million MT by the year 2022, GoK (2017), its yields have been declining resulting in excess demand. The poor performance is attributed to several constraining factors which include; poor agronomic practices, unpredictable weather, disorganized marketing, and rudimentary seed sector. The use of poor quality seed by smallholder farmers is often cited as a major contributing factor to low yields (KEPHIS, 2016; Muthoni *et al*., 2013; Wasilewska-Nascimento *et al.,* 2020). The Kenyan seed system for hybridized crops is more advanced whereas that of vegetatively propagated crops is undeveloped. For instance, the formal seed potato system supplies about 2% to 2.6% of certified seed, which is far much below the demand exhibited by farmers. Besides, it is highly centralized and oligopolized thus leading to high transactional costs and price of certified seed which limits the resource-constrained smallholder farmers from accessing certified seed (Muthoni *et al*., 2010; Okello *et al*., 2017). The semiformal sector supplies around 4% of "*clean seed* " also called Quality Declared Seed (QDS) although *clean seed* is not legally recognized by the Kenyan seed regulatory and certification body (Demo *et al*., 2016; FAO, 2013; KEPHIS, 2016). Therefore informal system continues to dominate by supplying over 95% of poor quality seed used by smallholder farmers thus resulting in low potato yields (Gildermacher *et al*., 2009; McGuire & Sperling, 2016).

There have been collaborative efforts and interventions by the government and donor community to increase the supply of quality seed through rapid multiplication technologies (RMT). These organizations include; International Potato Centre (CIP), Kenya Agricultural Livestock and Research Organization (KALRO) Tigoni, Agricultural Development Corporation (ADC) Molo, private seed potato companies, and non-governmental organization such as Value Chain Development programs (AVCD) (CIP, 2011; Demo *et al*., 2016; Gildermacher *et al*., 2009). Despite the efforts, the supply of certified and *clean seed* is still

insufficient in Kenya, especially in Nakuru County. Enhanced uptake and commercialization of the formal and semiformal seed multiplication enterprises can mitigate the deficit. Decentralized *clean seed* potato multiplication agri-enterprises (CSPMA) are more crucial for enhanced supply and accessibility of *clean seed* potato by resource-constrained smallholder farmers (Chindi *et al.,* 2017; Kaguongo *et al.,* 2014).

Even though salient studies have been done on the adoption of new agricultural technologies, the majority consider adoption as a binary decision, hence limiting the respondents from revealing their gradual willingness to adopt a technology. Lemken *et al*. (2017), in a study on adoption tendency of mixed cropping, applied the Trans-Theoretical Model (TTM) of behavior change by capturing adoption in four stages, i.e., pre-contemplation, contemplation, preparation, and action) of increasing willingness towards adoption. Klonek *et al*. (2015) earlier proposed the need to apply TTM to understand reasons why individuals were hesitant to exploit entrepreneurship opportunities. Identification of an individual's entrepreneurial development stages (adoption tendencies/stage of change) might be key in the application of stage-matched interventions rather than imposing similar interventions for all individuals. Profiling of adopter (action stage) characteristics can also guide the selection of potential individuals for entrepreneurial uptake as proposed by Lemken *et al*. (2017).

The networking approach to entrepreneurship posits that network resources, activities, and network support are vital for enterprise establishment. Bengesi and Roux (2014) consider networking as a necessary entrepreneurial capability that can ease the development and utilization of linkages to gain access to resources, knowledge, and complementary assets at minimal transaction cost hence improving enterprise performance. Parida *et al.* (2017) established that an entrepreneur's networking capability (partner knowledge, relational skills, coordination skills, internal communication, and building new relations) had the potential to enhance SMEs' performance. Demo *et al*. (2016) and Almekinders *et al*. (2019) proposes the need for seed potato multiplication agri-preneurs to develop linkages with other stakeholders in the potato value chain. However, the role of networking capability attributes on the establishment of seed potato multiplication agri-enterprises is not clear.

1.2 Statement of the problem

The planting of poor quality seeds is one of the major factors contributing to declining potato yields in Kenya. Approximately 95% of smallholder potato farmers continue to use degenerated seed due to inadequate supply and inaccessibility to quality seed. Whereas the formal sector is mandated to supply certified seed, it only supplies about 2% to 2.6% of certified

seed potato, which is far much below the annual demand exhibited by smallholder farmers. The semi-formal sector is decentralized and has the potential of improving the supply and access to *clean seed* potatoes by smallholder farmers. However, there is low uptake and commercialization of decentralized CSPMAE among potential farmers in Nakuru County resulting in unsatisfied demand. This contributes to low potato yields among smallholder farmers as a result of planting poor quality seed which impends the development of the sector. Even though identification of farmers' adoption tendencies and networking capability is a key approach in agri-enterprise development and commercialization, its role in the establishment of CSPMAE has not been studied. This study, therefore, sought to determine the influence of entrepreneur's networking capability, socioeconomic traits and institutional factors on adoption tendencies and commercialization of the decentralized CSPMAE in Nakuru County. The study assumed that networking capability could enhance adoption tendencies and performance of the CSPMAE through linkages, which enhance access to productive resources.

1.3 Objectives of the study

1.3.1 General objective

To contribute towards improved performance of potato subsector through enhanced uptake and commercialization of decentralized CSPMA among smallholder agri-enterprises in Nakuru County.

1.3.2 Specific objectives

i. To compare the networking capability of *clean seed* potato multiplication agri-preneurs and non-*clean seed* potato multiplication agri-preneurs in Nakuru County.
ii. To determine the influence of networking capability, socio-economic and institutional characteristics on adoption tendencies of *clean seed* potato multiplication agri-entrepreneurs in Nakuru County.
iii. To determine the factors influencing the extent of commercialization of *clean seed* potato multiplication agri-enterprises in Nakuru County.

1.4 Research questions

i. How is the networking capability of *clean seed* potato multiplication agri-preneurs compared to non-*clean seed* potato multiplication agri-preneurs in Nakuru?

ii. How do networking capability, socio-economic and institutional characteristics influence the adoption tendencies of *clean seed* potato multiplication agri-enterprises in Nakuru County?

iii. What are the factors influencing the extent of commercialization of *clean seed* potato multiplication agri-enterprises in Nakuru County?

1.5 Justification of the study

Seed quality is a significant input and determinant of potato productivity. The utilization of quality seed potato by smallholder farmers has the potential of increasing potato yields (Okello *et al*., 2017). An increase in potato yields can accelerate attainment of the Nakuru county potato strategy 2018-2022 (CIDP, 2018), one of the presidential big four agenda on food security and nutrition GoK (2017) and the economic pillar of vision 2030 which is anchored on agriculture (MoALFI, 2016). Previous interventions in the Kenyan seed potato sector have concentrated much on RMT to boost basic and certified seed production. However, the slow adoption and commercialization of these technologies have continued to hamper the sufficient supply of certified seed despite the demand and farmers' willingness to pay (Kaguongo *et al.,* 2014). Also, the marginal growth and commercialization of decentralized CSPMA continue to hamper the supply of *clean seed* potatoes (Okello *et al*., 2018). Klonek *et al*. (2015) propose the need for policymakers and projects advocating entrepreneurship to understand the reasons why individuals are hesitant to exploit entrepreneurship opportunities. The study of individuals' adoption tendencies is therefore considered vital in the identification of potential entrepreneurs in any economy that seeks to grow (Klonek *et al*., 2015). Previous studies also recommend the establishment of linkages and networking between the formal and semiformal sectors to enhance the supply of quality seed for the vegetatively propagated crops (Almekinders *et al*., 2019; Demo *et al*., 2016).

This study, therefore, sought to fill these gaps by researching on networking capability of the farmers and factors influencing adoption tendencies and commercialization of the decentralized CSPMA. The findings can provide insight for further projects that seek to apply stage-matched interventions and provide policy recommendations, which upon enforcement can lead to vibrant commercialized decentralized CSPMA. This would eventually lead to an improved supply of *clean seed* and increased potato yields resulting in improved food security. The application of the trans-theoretic (TTM) model in adoption analysis and fractional response model (FRM) in commercialization analysis of this study can also provide insight for adoption literature.

1.6 Scope, limitation, and assumption of the study

The study focused on farmers who were engaged in CSPMAE and the non-CSPMA, who were producing ware potato. This research was embedded in the seed potato value chain community action research project (SPVC CARP) at Egerton University. The project aims at enhancing the availability and accessibility of quality seed potatoes among smallholder farmers in Nakuru County. Therefore, the study was limited to Molo, Kuresoi North, and Kuresoi South, which were the major potato-producing sub-counties in Nakuru County. The accuracy of the household commercialization index (HCI) depended heavily on the respondent's records or ability to recall past information and to answer the questions accurately. This was however minimized by probing the farmers in case of inconsistencies. The study assumed that the household heads were available and willing to participate and give correct information that was not biased and would answer the questions objectively.

1.7 Operational definition of terms

Adoption tendencies- gradual stages of entrepreneurial behavior change that helps in the identification of potential entrepreneurs for stage-matched interventions.

Certified seed potato- these are seed tubers produced from basic seed by licensed formal sector companies under the authorization, inspection, and regulation of KEPHIS.

Clean seed - this is a better quality seed than farm-saved seed which is obtained from the multiplication of certified seed under good agricultural practices by trained farmers under the supervision of agricultural extension officers.

Commercialization- is the extent of market participation or any form of selling that is stimulated by an increase in output supply among other factors. Was measured as HCI.

Decentralized seed agri-enterprises- they are seed multiplication businesses, which are located in remote areas where farmers can easily access the seed at minimal transaction cost.

Formal seed sector- are legally recognized seed potato systems in which seed potatoes are produced and distributed by licensed registered public and private seed companies under KEPHIS regulation.

Informal seed sector-is a farmer-based seed potato system in which tubers of unknown quality are produced and distributed by farmers without any regulation. Include farm-saved seed.

Latent variable-variables that are not observable, are measured through indicators.

Seed potato- is a potato that has been regrown under special good agricultural practices to be replanted to produce ware potatoes. It's usually egg size with several sprouted eyes.

The semiformal seed sector- is a seed potato system in which QDS or *clean seed* are produced and distributed by trained farmers although they are not legally recognized and regulated by KEPHIS.

Ware potato- these are mature potato tubers, usually large which are produced and sold to final consumers as tubers for food.

CHAPTER TWO
LITERATURE REVIEW

2.1 Global potato production

Potato (*Solanum tuberosum* L.) is a stem tuber crop belonging to the Solanaceae family. It is the principal staple non-cereal food crop, and the fourth most key food crop in the world in terms of consumption after rice, wheat, and maize (CIP, 2011). Potato is produced in more than 100 countries worldwide with total production estimated at 388,191,000 tonnes in 2017 according to FAOSTAT (2018). It is a fundamental element in global food security due to its high productivity per unit area, short maturity, and nutritional qualities. Globally, Asia and Europe are the major potato-producing regions accounting for more than 80% of world production followed by North America and Africa (FAOSTAT, 2018).

2.2 Potato production in Africa, Kenya, and Nakuru County

The potato was introduced in most of the African countries in the 20th century and its production has been increasing over the decades. Potato is considered a food security and cash crop for the majority of smallholder farmers in potato-producing countries due to its high yields per unit area, short maturity, and nutritional value. The annual consumption of potatoes in Africa was estimated at 5-15kg per capita and 100 kg per capita in potato-producing areas (Demo *et al*., 2016). The FAOSTAT (2018) data on African potato production ranked Algeria as the leading producer followed by Egypt, South Africa, Morocco, Tanzania, and Kenya in the sixth position with the production of approximately 1,519, 870 tonnes in the year 2017.

The potato was introduced in Kenya in the 19th century, the yields however began to decline due to high disease incidences. Potato development program and research facilities were established at KALRO Tigoni in the year 1967 to mitigate some of the challenges associated with diseases and scarcity of quality seed (MoALFI, 2016). Potato production is mainly done by smallholder farmers in the Kenyan highlands that are found in the slopes of Mt. Kenya, Mau escarpment, slopes of Mt. Elgon, Cherengany hills, and Aberdare ranges. Such agro-ecological zones have high altitudes of 1,500m to 3,500m above sea level, cool temperatures, and rainfall of about 800mm per annum. This enables farmers to cultivate potato biennially hence giving potato a comparative advantage over maize, which can be produced once per year in such high altitude potato growing agro-ecological zones (FAO, 2013). Meru, Embu, Laikipia, Nyeri, Murang'a, Kiambu, Nyandarua, Narok, Nakuru, Molo, Bomet, Koibatek, Uasin Gishu, Nandi, Trans Nzoia, Marakwet, Kericho, Kisii and Taita Taveta are among the areas where potatoes are cultivated (MoALFI, 2016). The potato sector employs

about 3.3 million people directly and indirectly in its diverse value chain activities as seed producers, ware producers, transporters, processors, traders, and casual labors (FAO, 2013). Potato is also among the key food crops anticipated to contribute towards the attainment of the presidential big four agenda through its contribution to food security (GoK, 2017).

Nakuru County is among the potato-producing zones in Kenya. It is ranked second in terms of potato production after Nyandarua County. The Nakuru County Integrated development plan (CIDP 2018-2022) identified potato as one of the main cash crops in the County with about 39,000 Ha of land under potato production leading to the realization of approximately KES 7.7 billion in the year 2019. Administratively, it has eleven Sub-counties although potato production is mainly done in nine Sub-Counties namely Njoro, Molo, Kuresoi South, Kuresoi North, Rongai, Naivasha, Gilgil, Bahati, and Subukia. Most of the potato production is however concentrated in Kuresoi South, Kuresoi North, Molo, and Njoro with Kuresoi South accounting for over 30% of potatoes produced in Nakuru County. ADC Molo and Agrico East Africa are the major registered seed-producing merchants with ADC Molo concentrating on the multiplication of local varieties such as Shangi, Kenya Karibu while Agrico EA concentrates on the multiplication of imported seed potato varieties such as Markies, Destiny, and Manitou.

2.3 Seed systems in Sub-Saharan Africa

According to a study carried out across six African countries on seed systems smallholder farmers use, it was established that 90.2% of the seeds used by farmers are supplied by the informal seed system. The informal sector constitutes the seed of unknown quality which are mainly acquired from own farms, local market, and neighbors. Such seed potato tubers are regarded as poor quality seeds due to recycling for several generations leading to the accumulation of seed-borne diseases such as bacterial wilt. Reliance on seed supply from the informal sector across African countries has hampered the realization of potential in potato crops.

Most of the African counties (Kenya, Uganda, Tanzania, Rwanda, Malawi, Burundi, and Ethiopia) have formal seed potato systems. This system deals with the multiplication and marketing of certified seed potatoes. The formal seed potato system cannot however meet the demand for certified seed potato. McGuire and Sperling (2016) postulate that positive impacts in the seed sector can be realized by initiating smallholder responsive interventions in the formal seed sector. Collaborative linkages among seed value chain actors are also deemed crucial for the establishment of a sustainable seed delivery approach (Almekinders *et al*., 2019;

Demo *et al*., 2016; McGuire & Sperling, 2016). Huge research grants have been channeled to seed projects that focus on the improvement of smallholder farmers' livelihoods in Africa. For instance, the Alliance for a Green Revolution in Africa's Program for Africa's Seed System (AGRA/PASS) received a grant worth USD 35,244,164 to improve smallholder livelihoods (McGuire & Sperling, 2016). The World Bank also issued 87 grants worth USD 513,000,000 to seed projects in Africa to aid the vulnerable as cited by McGuire and Sperling, (2016). However, most of these interventions focus on the improvement of the formal seed sector leaving the semi-formal system marginalized.

2.4 Seed potato systems in Kenya

Potato is propagated vegetatively by tubers hence a need for disease-free tubers. The physiological genetic, sanitary, and physical characteristics are the main features of seed quality. Continuous recycling leads to degeneration of these qualities because potatoes are more susceptible to viral infection and contamination with soil-borne diseases such as bacterial wilt (Kiambi & Mugo, 2016). Formal, informal, and semi-formal are the main seed systems in the Kenyan potato sector (Kaguongo *et al*., 2014). The formal and informal sectors are the main seed potato systems recognized by KEPHIS with the semi-formal sector classified as informal.

2.4.1 Formal seed potato sector

The Kenyan formal seed potato sector supplies about 2% to 2.6% of certified seed which is far much below the annual demand of 70,000 MT (KEPHIS, 2016; Okello *et al*., 2017). This sector involves high investment cost in sophisticated RMT infrastructure consequently resulting in centralized oligopoly seed markets and eventually low seed supply and high cost of certified seed. Certified seed accounts for 40% to 50% of the total potato production cost as a 50kg bag of certified seed costs KES 2,500 to KES 3200 yet one acre requires 16 bags (Gildemacher *et al*., 2011; Kibe *et al*., 2019). Also, farmers travel for about 30 km to 120 km to access the certified seed (Muthoni *et al*., 2010). Procurement of seed from the public formal sector also involves lengthy procedures, which increases the transactional costs of searching and transporting the bulky seed hence delaying its availability during planting season (Kiambi & Mugo, 2016). Production of certified seed potatoes is regulated by strict legislations and policies that support commercial seed systems. Enforcement of certification schemes is guaranteed by KEPHIS to reduce the risk of disease transmission thus guaranteeing seed purity (KEPHIS 2016; Kiambi & Mugo, 2016).

Tissue culture, aeroponics, apical rooted cuttings and hydroponics are the main RMT used in formal seed sector. The RMT are mainly used by the primary and secondary seed multipliers in the seed potato value chain. The primary multipliers focus on multiplication of starter seed which include in vitro plantlets (G1), pre-basic minitubers (G2) and basic seed minitubers (G3). The G3 minitubers are passed to secondary seed potato multipliers for further multiplication to (G4) also called certified one (C1) and (G5) or certified two (C2) that is finally sold to ware potatoes producers (Janssens *et al*., 2013). There are few secondary seed potato multiplication enterprises hence limited capacity to multiply the basic seed to C1 and C2. As a result, most of this high quality early generation seed (C1) are not multiplied efficiently due to the demand from ware growers hence a need for a more commercialised seed agri-enterprises (Gildermacher *et al*., 2009).

Aeroponics technology also referred to as 3G seed strategy was introduced by CIP in 2009 to enhance production of G1, G2 and G3 minitubers for further multiplication into 4G and 5G. It involves growing of potatoes with roots suspended in dark containers installed in a greenhouse. The roots are nourished by periodic spraying of dissolved nutrients. A study conducted by Muthoni *et al*. (2011) shows that this RMT has high multiplication rates compared to the conventional method although it is expensive. The rooted apical cutting (ARC) technology involves production of minitubers from apical stem of in vitro plantlets that are hardened in screen house before transplanting to the field. It was introduced to complement the aeroponics since the supply of certified seed was still low even after introduction of aeroponics. Only two private companies have investment in ARC due to high initial investment cost in a tissue culture laboratory. Even though an efficient and responsive seed system needs to improve the supply, distribution and utilization of certified seed by the farmers, these sophisticated technologies and stringent legal requirements for joining the industry has deterred participation of the formal seed potato, private and public sector agri-entrepreneurs.

2.4.2 Semi-formal seed potato sector

The semi-formal is an intermediary or alternative system between formal and informal system (Kaguongo *et al*., 2014; Sisay *et al*., 2017). This system is decentralized hence commonly recognised as local or community seed system (Kaguongo *et al*., 2014). The seed potato produced in this system are referred to as *clean seed* or “quality declared seed” (QDS) by FAO and it only requires the development of protocols and legislation (FAO, 2017). The *clean seed* produced in semi-formal system are classified as informal by the Kenyan seed

regulatory body KEPHIS. Trading of QDS is legalized in some African countries although in Kenya trading of QDS is not legally recognized by KEPHIS laws hence further limiting access to quality seed (FAO 2013; Demo *et al*., 2016). The semi-formal system supplies about 4% of *clean seed* potato in Kenya. Multiplication is done by trained farmers, farmer groups and cooperatives. Kaguongo *et al.* (2014) in their study on the value of seed potato from the four systems recommends training of producers in semi-formal system in order to increase production of *clean seed* and positively selected seed. *Clean seed* potato is produced from the certified seed following all good agricultural practices although the seed production processes is not inspected by KEPHIS. Agricultural extension officers from MoALFI, trainer of trainers (ToT) and NGOs offers training to farmers engaged in CSPMAE (Demo *et al*., 2016). The decentralized seed system has potential of improving access to better seed since it is done at community level. Decentralization reduces the transaction cost of searching and transportation which has been emphasised as a barrier to usage of certified seed by smallholder farmers (CIP, 2011; McEwan *et al*., 2017; Rajendran *et al*., 2016).

Positively selected seeds are produced by farmers using simple techniques. Farmers are trained how to select and peg the healthy mother plants and harvest them separately for seed. Previous studies show that positively selected seeds can improve farmers yield by 34% (Gildemacher *et al*., 2011). Hirpa *et al*. (2010) highlights that increased supply of certified seed, designing quality control measures and reducing cost of seed production can help to improve performance of semiformal system. Studies have proved that farmer seed systems promote distribution and dissemination of seed from the centralized multipliers (Coomes *et al*., 2015; Rajendran *et al*., 2016). CSPMAE are profitable investment for farmer. Farmers are capable of producing *clean seed* if well equipped with technical support (Demo *et al*., 2016).

2.4.3 Informal seed potato sector

Informal seed system is the predominant system supplying about 95% of the seeds used by the smallholder farmers. It constitutes its own farm-saved potato tubers, seed tubers from neighbours, and tubers bought from the local markets. Seed potatoes from this sector are highly degenerated due to the recycling of propagules for many generations. They are characterized by high infection of seed-borne diseases such as bacterial wilt and viral diseases hence highly susceptible to diseases (Gildemacher *et al*., 2011; Kaguongo *et al*., 2014). Farmers renew their seed stock by buying from local markets or neighbours mostly when they want new variety or experience loss of crop due to diseases or natural calamities such as drought and floods.

Previous studies in Kenya show that most smallholder farmers lack information and awareness about certified seed and *clean seed* and the need to renew their seed stock (Muthoni *et al*., 2010). Inadequate supply of certified seed and high cost of seed has been emphasized as key obstacles to utilization of certified seed by farmers in remote rural areas.

2.5 Application of trans-theoretical model in entrepreneurship and adoption studies

Klonek *et al*. (2015) propose the need for policymakers and projects advocating entrepreneurship to understand why individuals are hesitant to exploit entrepreneurship opportunities. Entrepreneurship involves dynamic change processes, starting with the pre-contemplation stage where an individual has no intention to become an entrepreneur, such an individual undergoes contemplation, preparation and finally the action stage to become entrepreneurs (Klonek *et al*., 2015). Previous agricultural research surveys have used nominal classification in adoption studies. Such binary classification does not capture the willingness or intention of the respondent to adopt a technology. It only reflects the respondent's current opinion on the best choice (Lemken *et al*., 2017).

The TTM proposed by Prochaska and Velicer, (1977) is commonly applied in health studies to track personal changes of deeply rooted behavior such as smoking and is suitable for stage-matched interventions. TTM accounts for gradual adoption tendencies and such multiple adoption stages enlarge the statistical variance. Although TTM was designed to track personal changes related to health behavior change, its framework has been effectively used in entrepreneurship to explore individual ambivalence towards entrepreneurship (Klonek *et al*., 2015). The focusing overall process of becoming an entrepreneur is vital for identification and understanding of hurdles that deter potential entrepreneurs from venturing into businesses. Identification of respondents in the contemplation and preparation stages of adoption can be targeted by projects for entrepreneurial capacity building. Lemken *et al*. (2017) also used the TTM in conservation agriculture to analyze the adoption tendencies of legume cropping mixtures.

The semiformal seed system for vegetatively propagated crops needs to collaborate with the formal system to outcompete the informal system (Almekinders *et al*., 2019). However, the decentralized CSPMA has experienced subtle growth and the diffusion of this technology is still at an infancy stage. Even though salient adoption research has been done on the use of agricultural technologies, little has been done on the adoption of the semi-formal seed potato sector. Identification and profiling of early adopters hold considerable value for the

diffusion of innovation as they can help to optimize the technology and enhance efficient implementation nationwide (Kislev & Shchori, 1973).

2.6 Commercialization of seed potato from the three systems in Kenya

Agricultural commercialization encompasses an increase in agricultural production and market participation (Adeoti *et al*., 2014). Studies on commercialization use household commercialization index, input market participation index, rural economy commercialization index, and cash economy integration index to measure the degree of commercialization (Martey *et al*., 2012). Commercialization involves the transition from subsistence-oriented to market-oriented production with aim of profit maximization. It is driven by increased investment, which occurs in presence of marketing opportunities (Martey *et al*., 2012). Although there is high potential for the rural farmers to generate incomes and improve their food security from market-oriented agriculture, they face challenges in accessing markets for acquiring inputs and selling output. Previous studies have shown that some socio-economic, institutional, market, and external factors such as political instability and natural calamities can affect market participation decision and intensity simultaneously (Adeoti *et al*., 2014; Kimei *et al*., 2017; Martey *et al*., 2012; Rabbi *et al*., 2017). The establishment of an efficient market system that maintains low transaction costs, minimal risks, and asymmetric flow of information to all actors is essential for increased commercialization.

A study conducted on determinants of commercialization and its impacts on the welfare of smallholder rice farmers in Malakand Pakistan found out that market participation is affected by socio-economic factors such as gender, age of the farmers, household size, off-farm income, and experience (Rabbi *et al*., 2017). Institutional factors such as group membership, access to extension services, access to information, access to markets, contract arrangements, infrastructure, and ownership of transport were found to influence market participation. Ownership of assets that reduce transaction costs such as smartphones and own means of transport has been used as a proxy for transaction cost since transaction cost affects the degree of commercialization. In a study done in Ethiopia by Chindi *et al*. (2017) on participatory seed potato production, it was evident that farmers were willing to invest in the production of *clean seed* potato. The majority of them had adopted and commercialized their seed potato business after receiving the training. Demo *et al*. (2016), in their study on strategies to improve seed potato quality and supply in SSA, recommends the need for collaboration of farmers with other value chain actors and organizations for efficient dissemination and uptake of technologies.

2.7 Networking capability

Networking capability (NC) is the ability of a firm or entrepreneur to initiate, maintain and utilize inter-organizational relationships and to gain access to resources held by other actors (Parida *et al.,* 2017). It is essential for improving firm performance and entrepreneurial orientation by allowing access to network resources at a low transactional cost as postulated by Ajayi (2016). Studies have shown that firms and entrepreneurs with high NC can identify strategic partners and maintain a close relationship and linkages within networks and gain access to resources which are critical for business growth (Ajayi, 2016; Bengesi & Roux, 2014; Maina *et al.,* 2016; Parida *et al.,* 2017). Networking capability is multidimensional and has been previously studied concerning a firm's performance, innovativeness, and competitive advantage, little has been done to study NC concerning individual entrepreneurs.

The dimensions of NC have been conceptualized differently by various authors, hence there is no consensus on the uniformity of NC dimensions. However, the aspects of social networking are prominent in NC dimensions (Gliga, 2016). Bengesi & Roux (2014) operationalized NC into four dimensions namely; coordination, relational skills, partner knowledge, and internal communication. Ajayi (2016) conceptualized NC as network characteristics, network orientation, and network resources. Maina *et al.* (2016) considered NC in terms of network intensity and network range. In most of the studies, networking is linked with the strength of relationships among partners and benefits attained therein. The benefits of NC rely on individual or firm relational skills, trust, and confidence among partners. Networking capability emphasis is on the creation and sustaining relationship to access and complement resource requirement. Ajayi (2016) posits that networking capability is an essential entrepreneurial attribute that can alleviate mortality rate and staggered growth among emerging SMEs in an economy.

Bengesi and Roux (2014) in their study on the Influence of Dimensions of networking capability in SMEs Performance hypothesized the influence of each NC dimension of firm's performance. Partner knowledge was found to have a positive influence on SMEs' performance. Firms or managers with good partner knowledge can identify partners with relevant capabilities and resources to complement their needs for better performance of their enterprises. They can also avoid enterprise instability resulting from partnership disputes through proper governance structures. Good relational skills can positively influence the performance of enterprises through the development of a sustainable relationship that is mutually beneficial to the networking partners. Relational skills strengthen trust and confidence among partners hence enhancing their willingness to share core competitive resources. Internal

communication involves the incorporation and sharing of crucial strategic information and agreement with employees in an enterprise to improve beneficial synergies for better performance of the enterprise. Acquisition, dissemination, and utilization of external information can enhance enterprise performance. Coordination is an essential dimension of networking capability that necessitates effective allocation and utilization of scattered and fragmented resources to the most feasible operations of an enterprise (Bengesi & Roux, 2014).

2.8 Theoretical framework

This study is anchored on Roger's (1983) theory of diffusion of innovation and Kislev and Shchori (1973) process of an innovation cycle. Rogers postulates that diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system whereas innovation is an idea or practice perceived as new by an individual. Mass media and interpersonal communication (networking) are paramount in the diffusion process. Kislev and Shchori (1973) theorize that adoption is determined by comparative advantage considerations. Skilled and practicing entrepreneurs adopt an innovation first, then diffuse the skills to others. If an innovation affects supply substantially, prices may drop and eliminate profits hence the early adopters may exit from the affected line of production leading to an innovation cycle. The theory posits that technological change is affected by distribution as well as the average level of skills.

The goal of seed sector regulators is to ensure that all smallholder farmers embrace the use of certified seed. However, this needs a gradual transition from a lower stage (using poor quality seed) to a middle stage (*clean seed*) and eventually a higher stage (adoption of certified seed). Therefore, about 95% of farmers who are using poor quality seed could transition gradually and start using *clean seed*. Instantaneous transition by all smallholder farmers to use certified seed potato is not feasible since the supply is insufficient. Potential ware potato producers are anticipated to venture into CSPMAE whereas those currently engaged in CSPMAE and have the potential are anticipated to become certified seed producers.

Diffusion of information, innovation and technology of seed potato production among farmers and other stakeholders in the potato value chain is paramount in ensuring the successful transition of farmers from the lower stage of adoption (pre-contemplation) to the highest stage of adoption (action). Rogers (1983) theory of diffusion of innovation and Kislev and Shchori's (1973) process of an innovation cycle can play a key role by ensuring diffusion of information and skills hence contributing towards the uptake of CSPMAE among potato farmers in Nakuru County. The Improved supply and utilization of quality seed by smallholder farmers are

inevitable with this approach. Possession of networking capability and an enabling institutional environment in which the entrepreneur can pursue business is necessary. Determination of factors influencing uptake and extent of commercialization of CSPMAE is thus essential as it informs interventions on entrepreneurship among smallholder potato farmers.

2.9 Conceptual framework

This research is based on the perception that uptake and commercialization of decentralized CSPMA can lead to an improved supply of *clean seed* potato at a lower cost hence leading to improved potato yields. However, the adoption and commercialization of agri-enterprises depend on certain individual abilities such as NC capability, socio-economic characteristics, and conducive institutional environment. Networking can lead to the establishment of beneficial linkages with the other value chain actors hence enabling the smallholder farmers to acquire productive resources that would improve the performance of their CSPMA. It is therefore key to address the influence of such factors on CSPMA and share the information with respective stakeholders for supportive policies to be implemented. These can empower CSPMA thus resulting in enhanced supply and access to *clean seed* by smallholder potato farmers. Consequently, potato yields can improve and enhance food security. The conceptual framework for this study is shown in Figure (1).

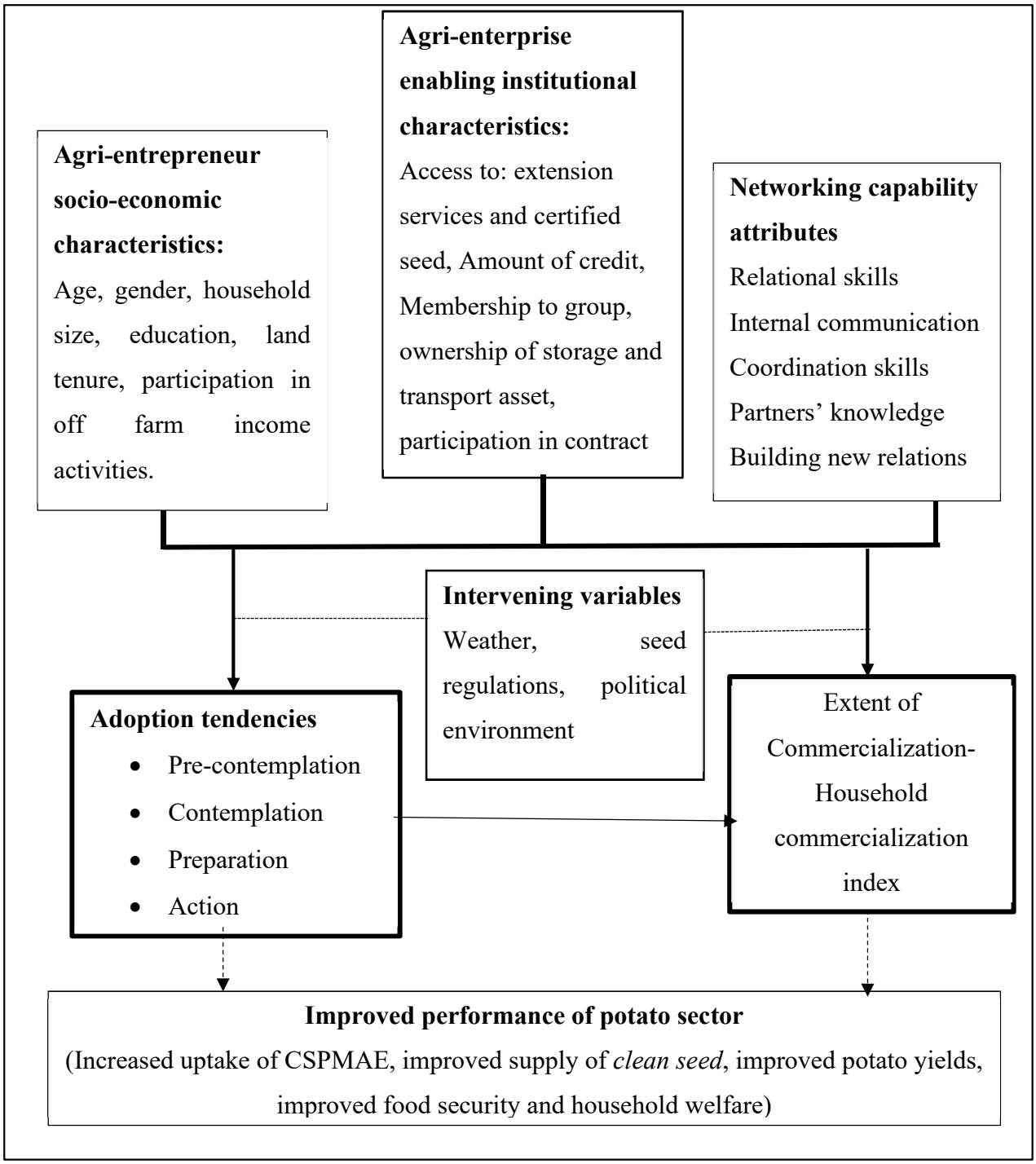

Figure 1: Conceptual framework

CHAPTER THREE
METHODOLOGY

3.1 Study area

The study was conducted in Nakuru County, one of the forty-seven Counties located within the central rift valley region in Kenya. Nakuru County is located between Longitude 35º 28` and 35º 36` East and Latitude 0º 13` and 1º 10` South, at about 1848 to 2700 meters above sea level (CIDP, 2018). It is about 150 km northwest of Nairobi, the capital city of Kenya. It is approximately 7,498.8 km^2 in size with a population of 2,162,202 according to the year 2019 census report (KPHC, 2019). The major economic activities include; agriculture, tourism and financial services. Agriculture is the mainstay of its economy as 70% of the county's land which is about 5, 039.40 km^2 is arable and highly productive land. The main crops grown include maize, wheat, barley, potatoes, beans, peas, vegetables, pyrethrum, sunflower, and, carrots that are consumed locally regionally and internationally. Nakuru rainfall is characterized by a bimodal pattern with short rains from October to December and long rains from April to August. The county has eleven administrative sub-counties and fifty-five wards. The eleven sub-counties include Nakuru West, Nakuru East, Njoro, Molo, Gilgil, Naivasha, Kuresoi North, Kuresoi South, Subukia, Rongai, and Bahati (CIDP, 2018).

Nakuru County was purposively selected for the study mainly because this research was embedded in a seed potato project at Egerton University whose focus was Nakuru County. Nationally, the county ranks second with 18.9% of potato production after Nyandarua with 29.8%. Small-scale farmers whose major challenge was a shortage of quality seed potato dominated potato farming in Nakuru County. The dominant variety was Shangi and there were only three registered formal certified seed producing merchants namely; ADC Molo, Agrico East Africa and Charvi (Kibe *et al*., 2018). Kuresoi North, Kuresoi South, and Molo sub-counties of Nakuru County were purposively selected for the study due to their dominance in potato farming. Mau Narok, and Mauche wards of Njoro Sub-County were used for piloting because of their agricultural similarity with the selected area of study. The study was conducted in 10 wards of the selected sub-counties, that is; Molo, Turi, Elburgon, and Marioshoni in Molo Sub County, Nyota, Sirikwa, Kiptororo, and Kamara in Kuresoi North Sub-County, Keringet and Tinet in Kuresoi south Sub-County as depicted in the map in Figure 2.

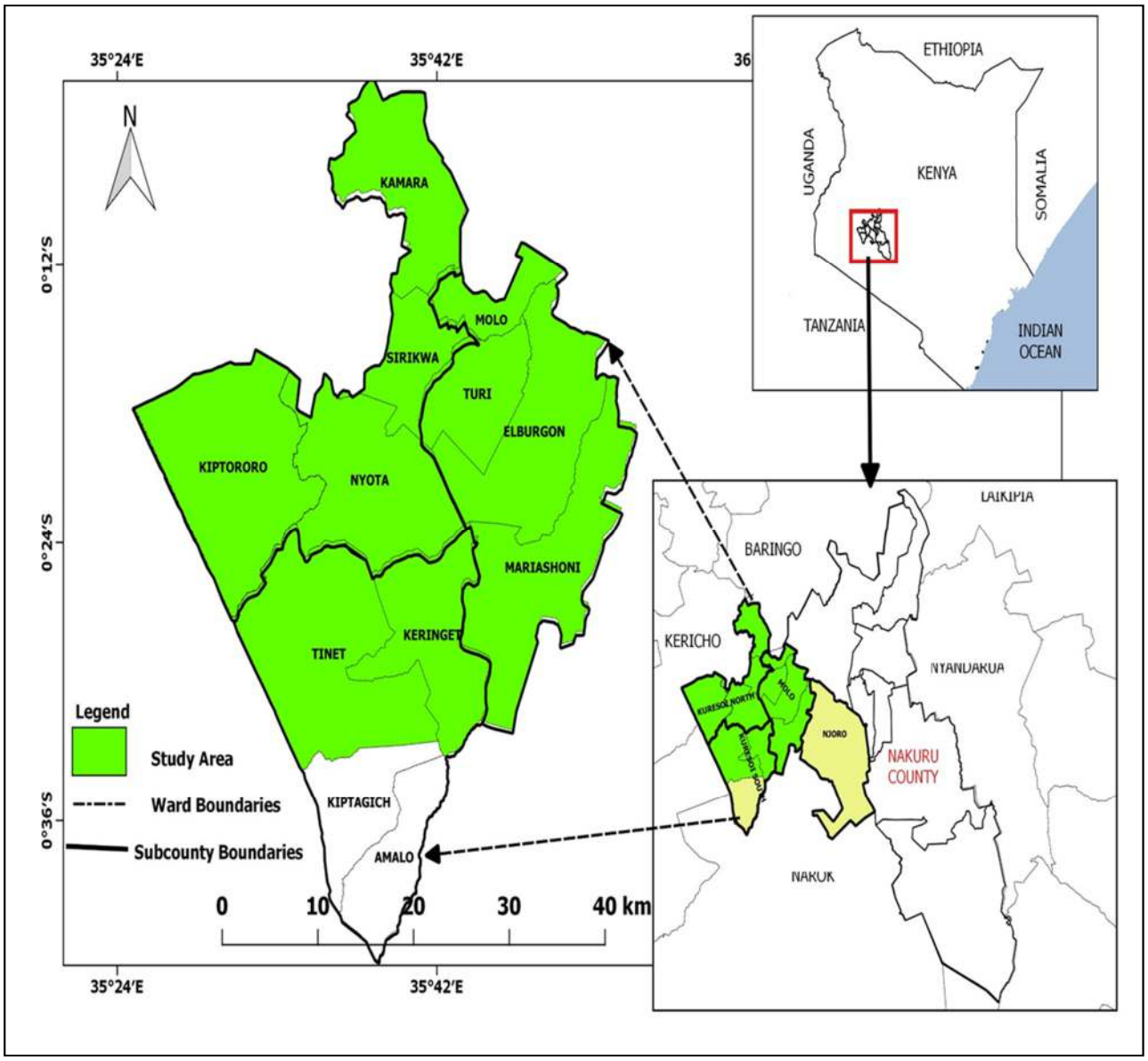

Figure 2: Map of the study area (CIDP, 2018)

3.2 Sample size determination

Previous literature on sample size determination provides various approaches to sample side determination such as using a sample size of a previous similar study, a census for a small population, use of published tables, and use of formulas (Al-Subaihi, 2003; Israel, 1992; Singh and Masuku, 2014). Israel (1992) and Al-Subaihi (2003) postulates that when using Cochran's (1963) formulae for an unknown population the sample size can be adjusted based on the desired confidence level, desired precision, and the degree of variability of attributes of interest in the population. This study used Cochran's formulae shown in (equation 1) to determine the sample size due to the lack of reputable documentation on the exact population of the targeted respondents in the study area. Israel (1992) and Singh and Masuku (2014) provides suggestion

for adjustment of the degree of variability or proportion. They recommend a proportion (*p*) of 80% in situations where the majority in the population have the desired attributes and (*p*) of 20% in cases where the majority in the population lack the desired attributes. This study adopted a (*p)* of 20% or 0.2 on assumptions that only a small proportion of the population had the desired attributes because only a few individuals in a population engaged in seed potato multiplication agri-enterprises. A proportion of 50% or 0.5 which is commonly used is only applicable when there is maximum variability in the population (Al-Subaihi, 2003; Israel, 1992; Singh & Masuku, 2014).

$$n = \frac{Z^2.p.q}{e^2} \quad \ldots\ldots (1)$$

$$n = \frac{1.96^2 \times 0.2 \times 0.8}{0.05^2} = 245.8 \cong 246 \ldots\ldots (2)$$

Where n is the desired sample size in the target population, is the standard normal deviate at the required confidence level of 95% (Z = 1.96). P is the proportion in the target population estimated to have the desired characteristics (p=0.2). q is the proportion in the target population estimated not to have characteristics being measured (q = (1-p) = 0.8), and is the acceptable margin of error (e = 0.05).

3.3 Sampling procedure

The study targeted farmers who were engaged in CSPMAE and potential CSPMA who were producing ware potato. The list of CSPMA was obtained from MoALFI in collaboration with the Nakuru association of smallholder farmers (NASFA) for the respective wards. A multistage sampling technique was used whereby the three Sub-Counties Molo, Kuresoi North, and Kuresoi were purposively selected in the first stage. The 10 wards: Molo, Turi, Elburgon Marioshoni Nyota, Sirikwa, Kiptororo, Kamara, Keringet, and Tinet were purposively selected in the second stage. In the third stage, only 54 out of the anticipated 62 farmers engaged in CSPMAE as shown in (Table 1) were drawn from the total sample size (246). through census technique. The remaining 192 non CSPMA farmers were disproportionately drawn from each of the 10 wards through simple random sampling as shown in (Table 1). The disproportional distribution of the 192 respondents was derived from the distribution of the 54 CSPMA in each of the 10 wards.

Table 1: Disproportionate distribution of the sample size in the area of the study

Sub Counties	Wards	CSPMA	Calculated Non CSPMA	Respondents per ward
Molo	Molo	7	25	32
	Elburgon	2	7	9
	Turi	3	11	14
	Marioshoni	6	21	27
Kuresoi North	Sirikwa	12	43	55
	Kamara	4	14	18
	Nyota	8	28	36
	Kiptororo	1	4	5
Kuresoi South	Keringet	9	32	41
	Amalo	2	7	9
Total		54	192	246

Source: Nakuru Association of Smallholder Farmers' (NASFA) 2017 unpublished report

3.4 Data collection

An introductory letter was obtained from the board of postgraduate studies of Egerton University, which was then used to process a research permit (appendix 2) from the National Commission of Science, Technology, and Innovation (NACOSTI). The agricultural officers in charge of the three sub-counties referred the researcher to the agricultural extension officers for each ward. With guidance from agricultural extension officers and lead farmers, the researcher commenced house-to-house data collection using a researcher-administered questionnaire. A pilot study was conducted in Mau-Narok and Mauche wards of Njoro Sub-County among 30 randomly selected respondents to pre-test the questionnaire's reliability and validity before final data collection. These wards were selected for piloting because Njoro was the fourth leading Sub-County in potato production in Nakuru County and its agricultural characteristics were similar to the selected area of study. The primary data was collected through a cross-sectional survey using researcher-administered questionnaires. The questionnaires had questions on selected agri-entrepreneur socio-economic characteristics, agri-enterprise enabling institutional characteristics, and NC variables that would help to achieve the desired objectives.

3.5 Data analysis and analytical framework

This section provides a discussion on different approaches that were used in data entry and analysis. The collected raw data was coded and cleaned using the statistical package for social science version 22.0 (SPSS) and analyzed using the STATA version 15.0 and LISREL version 8.8 software.

3.5.1 Comparison of networking capability between clean seed CSPMA and Non-CSPMA

Comparison of the networking capability between the CSPMA and non-CSPMA was analyzed using two-tailed t-test mean scores. The networking capability was measured by five latent variables; Partner Knowledge (PK), Relational skills (RS), Internal Communication (IC), Coordination Skills (CS), and Building New Relations (BNR). Each latent variable had three measurement items developed by Walter (2006) and adopted by Bengesi and Roux (2014) and Parida *et al*. (2017). Partner knowledge items were used to capture the level at which the respondent understands the other partners/stakeholders in the potato value chain. Relational skills items were used to measure the ability of the respondent to strengthen close ties with other partners. Internal communication is intended to measure how the respondent acquires information and shares it with employees. Coordination skills aimed at assessing the level of planning and controlling of enterprise activities with other partners whereas building new relationship construct was expected to measure the flexibility of the respondent towards new partners and new ideas. Each of the five dimensions had three measurable indicators as shown in the questionnaire in appendix one. The indicators were measured on a five Likert scale ranging from strongly disagree valued 1, disagree valued 2, neither agree nor disagree valued 3, agree valued 4, and strongly agree valued 5.

The five constructs of networking capability were subjected to confirmatory factor analysis (CFA) to test their unidimensionality, reliability, validity, and the goodness of fit after which the weighted score was generated for each of the latent variables. Confirmatory factor analysis is a special form of structural equation modeling used to test the consistency of the latent variable indicators by use of maximum likelihood estimation. Unidimensionality is achieved when the measuring items have acceptable factor loading for the respective latent variable. Convergent validity and discriminant validity were conducted to get the best fit model.

The convergent validity is achieved when the Average Variance Extracted (AVE) is greater than 0.5 as suggested by Harun and Ahmad (2016). The reliability of NC constructs

was assessed through AVE which should be greater than 0.5 and composite reliability (CR) greater than 0.6 as recommended (Harun & Ahmad, 2016). The goodness of fit of the model can be assessed through the absolute fit index, incremental fit index, or parsimonious fit index. The absolute fit index includes the root mean square error approximation (RMSEA), the goodness of fit index (GFI), or discrepancy chi-square. The incremental fit index includes the adjusted goodness of fit index (AGFI), comparative fit index (CFI), Tucker Lewis index (TLI), or normal fitness index. This index should be greater than 0.9. The parsimonious fit is the chi-square over the degree of freedom and should be less than 5. This study chooses one index from each category.

3.5.2 Factors influencing adoption tendency of CSPMAE in Nakuru County

To determine the influence of networking capability, socio-economic and institutional characteristics on adoption tendencies of CSPMAE in Nakuru County, the ordered logistic regression model was used. Previous research on adoption had used the binary logistic and probit regression models due to the binary nature of response variable. However, such binary response models do not capture the gradual intention of the respondent to adopt a technology but only reflects the respondent current opinion on best choice (Lemken *et al*., 2017). Multinomial logit or conditional logit could also have been used but they are suitable in cases where the dependent variable choices do not have clear ordering (Greene & Hensher, 2010).

In this study, the ordinal logistic regression was preferred because the dependent variable was categorical with four clearly ordered categories of willingness to try CSPMA. These categories included; pre-contemplation stage (coded one), contemplation stage (coded two), preparation stage (coded three) and action stage (coded four), the categories represented increasing levels of contemplating behaviour change. These stages captured the gradual attitude in adoption decision (Lemken *et al*., 2017). The trans-theoretic model is particularly essential in studies seeking stage matched interventions (Prochaska & Velicer, 1997). In this study, identification of potential farmers who could join CSPMAE was key for projects seeking to recruit and train farmers to become CSPMA (Klonek *et al.,* 2015).

The questionnaire had specific questions that guided the researcher as well as the respondent in selecting their respective stage of change (adoption tendency). For instance, farmers in the pre-contemplation stage constituted all respondents who reported to have no information about *clean seed*, and had never used it to produce their ware potatoes. Such farmers had no motivation to change, hence were not willing to take up CSPMAE. The

contemplation stage constituted all respondents who reported to know *clean seed* potatoes; they had used it to produce their ware potatoes and further considered *clean seed* potato multiplication as an entrepreneurial opportunity due to inadequate supply and access of certified and *clean seed* at planting season. However, they had no plans of taking up the CSPMAE in the short run due to perceived costs involved.

The farmers in the preparation stage involved all respondents who reported to know *clean seed* and had used it to produce their ware potatoes. They also considered *clean seed* potato multiplication as a beneficial business opportunity and had access to sufficient information, resources and plans for taking up the CSPMAE in the short run (less than six month). The action stage constituted all farmers who had taken up the *clean seed* potato multiplication agri-enterprise and were recognized as *clean seed* potato agri-preneurs by their fellow farmers and Sub-County agricultural officers. Given the four choices, a respondent selected a stage based on description of their stage of adoption as shown in Table 2.

Table 2: The categories of dependent variable for adoption tendencies of CSPMA

(Y) rank	Stage	Concept	Operationalization
Y1	Pre-contemplation	The respondent has no intention to change, lacks information and motivation to change	Respondent not willing to try CSPMA
Y2	Contemplation	The respondent has intention to change though still considering associated costs and benefits	The respondent is generally willing to try CSPMA in long run
Y3	Preparation	The respondent has intention to change with concrete plan of action	The respondent willing to try CSPMA in short run
Y4	Action	Behaviour change	The respondent is already practicing CSPMA

The explanatory variables for this objective were socio-economic factors, institutional factors and networking capability factors shown in Table 3.

The ordered logistic regression model is based on a latent regression expressed in (equation 3).

$$Y^* = X'\beta + \varepsilon \quad \text{.....(3)}$$

Where, β was unknown parameters to be estimated. X′ was a set of measurable factors that determine the intensity of feeling on adoption stage of the respondent. Ɛ was the error term representing unobservable factors. Given the assumption that the error term has a mean of zero and a variance of one, the following probabilities for each stage are shown in (equation 4, 5, 6 and 7) (Greene & Hesher, 2010).

$$\Pr(y=0|x)=\Phi(-X'\beta) \quad \text{(4)}$$

$$\Pr(y=1|x)=\Phi(\mu_1-X'\beta)-\Phi(-X'\beta) \quad \text{(5)}$$

$$\Pr(y=2|x=)\Phi(\mu_2 X'\beta)-\Phi(-X'\beta) \quad \text{(6)}$$

$$\Pr=(y=f|x)=1-\Phi(\mu_j-1-X'\beta) \quad \text{(7)}$$

The marginal effect of change in the adoption tendencies were expressed as shown in equation 8, 9 and 10.

$$\frac{\partial \Pr(y=0|x)}{\partial x}=\phi(X'\beta)\beta \quad \text{(8)}$$

$$\frac{\partial \Pr(y=1|x)}{\partial x}=\phi[(-X'\beta)-\phi(\mu-X'\beta)]\beta \quad \text{(9)}$$

$$\frac{\partial \Pr(y=2|x)}{\partial x}=\phi(\mu-X'\beta)\beta \quad \text{(10)}$$

The respondent choose one option based on the outcome that described their most appropriate stage of adoption. Operationalization of the four stages was adopted from a study by Lemken *et al.* (2017) and Tobler *et al*. (2011) as shown in (Table 2).

3.5.3 Factors influencing the extent of *clean seed* potato commercialization in Nakuru County

To determine the factors influencing the extent of commercialization of CSPMAE in Nakuru County. The extent of commercialization was captured as HCI which was abounded response ranging from 0 to 1. Previous research involving bounded response variables was analysed using the logit and probit regression which estimates the probability of occurrence of an event (Adeoti *et al*., 2014; Kimei, *et al*., 2017; Martey *et al*., 2012; Rabbi *et al*., 2017). These models however rely on the strong assumption that the dependent variable follows a normal or binomial distribution and involve ad hoc transformation such as the log odds ratio and Inverse Mills Ratio (IMR) to allow for traceability of values at the extreme ends of a

bounded response (Maddala, 2009). For instance, the Heckman two-stage model has been used widely in commercialization studies although the non-participants in the second stage are considered as omitted variables in the selected sample hence leading to selection bias. The estimates from Logit and Probit are consistent but not efficient as those generated by the maximum likelihood method (Gallani *et al*., 2015).

The censored and truncated regression are used to model the response variable that is bounded either below or above. Two limit procedures and joint equation approach can be used to modify the estimation model in cases where the bounded dependent variable pile at one k2corner or both corners respectively. Although these models yield better fits to empirical observations, they are prone to sample selection bias. For instance, in truncated regression, any observation that is outside the desired range is ignored whereas Tobit which is used in the censored sample is sensitive to heteroscedasticity which causes inconsistency and invalidity of test statistics (Gallani *et al*. 2015; Maddala, 2009). Tobit model further assumes a given set of explanatory variables has the same effect on market participation decision and intensity of participation. These models, therefore, could not produce reasonable statistically sound parameters with fractional values within an interval of zero and one.

Because of the highlighted weakness of previous models, this study used the fractional logistic response model (FRM) proposed by Papke and Wooldridge (1996) to determine the factors influencing the extent of commercialization computed as (HCI). The HCI index measured the extent to which a household crop production was oriented towards the market. Values of zero reflected a total subsistence household while values that are closer to one showed a higher level of commercialization. The HCI measures the ratio of the gross value of all crop sales to the gross value of all crops produced per year per household. This study however used a crop-specific HCI for *clean seed* potato produced by a household in the year 2018 and was computed as expressed in (equation 11).

$$y \approx \frac{\Sigma x_t}{\Sigma x_T} \quad \text{.....(11)}$$

Where

y is the Household commercialization index (HCI)

$\Sigma \chi_t$ Is the total amount of clean seed potato sold from own production

$\Sigma \chi_T$ Is the total amount of all clean seed produced on the farm

The FRM accounts for the proportionate nature of the dependent variable although its application is common in economics and finance research (Ansah &Tetteh, 2016; Gallani *et*

al., 2015). The parameters of FRM were estimated by the quasi maximum likelihood estimation (QMLE) method which produces robust and efficient estimates under the generalized linear models (GLM) assumptions (Papke & Wooldridge, 1996). FRM does not require any correction of the observed values at the bounds and it accounts for non-linearity in parameters.

The fractional regression is expressed in equation (12).

$$E\left(Y\middle|Z\right)=G\left(x\beta\right)+\mu \quad \text{..... (12)}$$

Where, Y was the dependent variable (HCI), Z was a matrix of selected explanatory variables, β was a vector of coefficients to be estimated, G (•) is a nonlinear function satisfying (0≤G (•) ≥1) and μ was the error term that accounts for unmeasured variables. G (•) can be specified as any cumulative distribution function such as logit, probit, loglog or cloglog functional forms. The logit functional form is as shown in equation (13) and its partial effects in Equation (14)

$$\log G(Z\beta)=\frac{e^{Z\beta}}{1+e^{Z\beta}} \quad \text{..... (13)}$$

$$\frac{\partial E\left(Y\middle|Z\right)}{\partial Z}=\beta_i g(Z\beta) \quad \text{..... (14)}$$

The model assumes non-linear distribution where estimation of parameters is performed through maximization of the Bernoulli log likelihood function. Equation (13) can therefore be estimated by QMLE based on Bernoulli log likelihood function as shown in equation (15).

$$L_i(b)\equiv Y_i\log\left[G\left(x_i b\right)\right]+(1-y_i)\log\left[1-G(x_i b)\right] \quad \text{..... (15)}$$

Bernoulli is a member of linear exponential family hence QML estimator of β is defined by equation (16) and is consistent and asymptotically normal regardless of the true distribution of y_i conditional on Z_i provided that E $(Y_i \mid Z_i)$ is correctly specified.

$$\hat{\beta}=\arg Max\sum_{i=1}^{N}L_i(\beta) \quad \text{..... (16)}$$

The explanatory variables for this objective were selected based on related past empirical studies on factors influencing intensity of market participation and networking capability (Adeoti *et al*., 2014; Ajayi, 2016; Bengesi &Roux, 2014; Kimei, *et al*., 2017; Martey *et al*., 2012; Parida *et al*., 2017; Rabbi *et al*., 2017). These factors were categorized into socio-

economic, institutional, and networking capability and their measurement and hypothesized relationships on dependent variable are depicted in (Table 3).

Table 3: Selected independent variables for objective two and three

Variable	Variable definition and measurement	Expected sign
	Agri-preneur socio-economic characteristics	
Gender	Gender of the HHH, (1= male, 0 = otherwise).	+/-
Age	Age of the household head (HHH) in years (continuous).	+/-
HHsize	Number of dependants in the household. (continuous)	+/-
Educat	Number of years of schooling of the HHH (continuous)	+
Ldtn	Type of land ownership (1=Own with title deed, 0=otherwise).	+
TtLsize	Total land size owned by the household in hectares (continuous).	+
LsizPtto	Proportion of land allocated for potato by household (continuous).	+/ -
OffIncm	Participate in off farm income activities (1= participate, 0 = otherwise).	+/-
QntPtto	Number of potato bags harvested by household (continuous).	+
QntPtto	Number of potato bags sold by household.(continuous)	+
	Agri-enterprise enabling institutional characteristics	
Qcrdt	Amount of credit accessed by the household. (KES).(continuous)	+
Grmship	Membership of HHH to potato related group, 1 = yes, 0 = otherwise	+
AccExt	Number of interactions with extension services providers (continuous)	+
PFContr	Participation in potato contract farming. 1 = yes, 0 = otherwise	+
AccSeed	Access to certified seed potato. 1 = yes, 0 = otherwise	+
OnStrge	Ownership of storage facility by household, 1= yes, 0 = otherwise	+
OnTspt	Ownership of transport means by household, 1 = yes, 0 = otherwise	+
Selling	Selling outlet 1=market, 0=farm gate (dummy)	+/-
	Entrepreneurial Networking capability related factors	
RS	Relational skills of the HHH with other value chain actors*	+
PK	Partner knowledge of the HHH*	+
IC	Internal communication of the HHH with employees*	+
CS	Coordination skills of the HHH with partners and employees*	+
BNR	Ability of the HHH to build new relationships*	+

Note: 1 Each of the five NC dimension (*) had three measurable variables/indicators measured on five likert scale as shown in the questionnaire in Appendix 1

CHAPTER FOUR
RESULTS AND DISCUSSION

Chapter four provides results and discussion based on the three objectives of the study. The first section provides sample descriptive statistics for the variables that were used in the study. Second section presents results and discussion on networking capability of *clean seed* potato multiplication agri-preneur (CSPMA). The third section presents results and discussion on the role of networking capability, socio-economic and institutional characteristics on adoption tendencies of *clean seed* potato multiplication agri-enterprises (CSPMAE). The last section presents results and discussion on the factors influencing the extent of commercialization of CSPMAE in Nakuru County.

4.1 Agri-preneur and enterprise characterisation

4.1.1 Agri-preneur socio-economic characteristics

Agri-preneur's socio-economic statistics for selected continuous variables are depicted in Table 4. The overall mean of households' head age was 47 years with CSPMA and non-CSPMA having a mean age of about 46 years and 47 years respectively. The statistically insignificant two-tailed t-test results for age between the CSPMA and non-CSPMA show` an equal distribution of age among the CSPMA and non CSPMA.

Table 4 : Agri-preneur socio-economic characteristics for continuous variables

	Mean			t-ratio	Sig
Variable	Overall	CSPMA	non CSPMA		
Age (Years)	46.912	45.889	47.203	0.626	0.532
Household size (Number)	5.598	5.111	5.734	1.768*	0.078
Education (Years)	10.963	12.500	10.531	-3.279***	0.001
Potato land (proportion)	0.397	0.404	0.395	-0.241	0.809
HCI (proportion)	0.623	0.654	0.614	-0.349	0.349

Note: * and *** means significant at 10% and 1% significant level respectively

The average household size for CSPMA was about five dependents whereas that of non-CSPMA was around six members. The two-tailed t-test results show that household size was statistically significant at 10%. This finding is contrary to the prior expectation that larger household size could promote CSPMAE adoption due to the provision of family labor.

Possibly, households with less household size adopted CSPMAE due to a lower dependency ratio associated with a decrease in consumption unit and other responsibilities, thus saving more financial resources for CSPMAE. On the contrary, households with large family sizes are likely to shy away from cost-intensive technologies due to limited financial ability to purchase inputs as reported by Kwarteng *et al*. (2019) in their study on factors influencing the adoption of maize technologies in Ghana.

Overall, household heads had spent an average of 11 years at school with a mean of about 13 years and 11 years between CSPMA and non-CSPMA respectively. Years of schooling were statistically significant at 1% from a two-tailed t-test indicating that CSPMA were more educated compared to their counterparts. The association between years of schooling and adoption of CSPMAE could imply that household heads who spent more years at school gained more education hence increasing their knowledge and understanding of CSPMAE and consequently its adoption. Mmbado and Baiyegunhi, (2016) found that educated farmers were over eight times likely to adopt improved maize varieties in Tanzania.

On average, sampled households allocated 39.7% of their land for potato production as shown by the mean of 0.397 for potato land ratio. Both CSPMA and non-CSPMA allocated about 40% of their land for potatoes as shown by the mean of 0.404 and 0.395 for CSPMA and non-CSPMA respectively. The two-tailed t-test result for potato land ratio was statistically insignificant implying that the proportion of land allocated for potatoes was equally distributed for CSPMAE adopters and non-adopters.

Concerning market participation, the mean for household commercialization index (HCI) was 0.6542 for CSPMA and 0.6135 for non-CSPMA. However, the two-tailed t-test results for HCI were statistically insignificant implying that the level of potato commercialization was equally distributed among CSPMA and non-CSPMA hence HCI did not play a major role in the adoption of CSPMAE.

Table 5 presents descriptive statistics for socio-economic categorical variables. The overall sample constituted 67% male and 33% female household heads. The majority (72.22%) of the CSPMA households were male-headed while 27.78% were female-headed. Among the non-CSPMA, 66.15% were male while 33.85% were female household heads. The chi-square results for gender were statistically insignificant implying an equal distribution of gender between the CSPMA and non-CSPMA.

About 61% of the overall sampled household heads had acquired titled deeds hence legal ownership for their land while 39.43% did not possess title deeds. Approximately 65% of the CSPMA had acquired title deeds and about 35% did not have. Amongst the non-CSPMA,

59.38% indicated to have legal land ownership while 40.63% did not. The statistically insignificant chi-square results for land tenure between the CSPMA and non-CSPMA show an equal distribution of title deeds among the CSPMA and non-CSPMA in Nakuru County.

The majority (70.73%) of the overall sampled household heads participated in other off-farm income-generating activities whereas 29.27% were involved in crop farming. Among the CSPMA, 70.37% participated in other off-farm income generating activities with 29.63% specializing in crop farming. Likewise, 70.83% of non-CSPMA had other off-farm activities with 29.17% specializing in crop farming. The chi-square results for participation in off-farm income generating activities were statistically insignificant between CSPMA and non-CSPMA indicating that their level of participation in off-farm income generating activities was similar.

Table 5: Agri-preneur socio-economic descriptive statistics for categorical variables

Characteristic	Category	Percentage			Chi – square	Sig
		Overall	CSPMA	non CSPMA		
Gender	Male	67.48	72.22	66.15		
	Female	32.52	27.78	33.85		
	Total	100.00	21.95	78.05	0.7097	0.400
Land ownership	With title	60.57	64.81	59.38		
	Without title	39.43	35.19	40.63		
	Total	100.00	21.95	78.05	0.5222	0.470
Off farm income participation	Yes	70.73	70.37	70.83		
	No	29.27	29.63	29.17		
	Total	100.00	21.95	78.05	0.0044	0.945

4.1.2 Agri-preneurship enabling institutional characteristics

Statistics for the selected agri-preneurship enabling institutional continuous variables are presented in Table 6. The CSPMA had interacted with agricultural extension providers about thrice annually compared to twice per annum among the non-CSPMA (Table 6). Additionally, tk8he mean for frequency of interaction with agricultural extension providers was statistically significant at 1% between the CSPMA and non-CSPMA as shown by the two-tailed t-test results. This shows that CSPMA interacted with agricultural extension officers more times compared to non-CSPMA hence indicating the existence of a relationship between access to agricultural extension services and adoption of CSPMAE. Extension services are an

important source of disseminating technical information to farmers as posited by Mmbado and Baiyegunhi (2016), in their study, farmers who had access to extension services were over six times more likely to adopt improved maize varieties compared to their counterparts. Consistently, Kalibwani *et al.* (2017) and Lasway *et al.* (2020) found a positive effect of access to extension services on the adoption of soil and water conservation technologies.

On average, the overall sampled households obtained the credit of about KES.14, 000 with CSPMA getting about KES 44,625 (Table 6). Contrastingly, non-CSPMA obtained an average of KES. 5,310, much lower compared to their counterparts. This is further depicted by the statistically significant two-tailed t-test results for the amount of credit accessed between CSPMA and non-CSPMA at a 1% significant level. The association between the amount of credit accessed and CSPMAE adoption could mean that access to credit aids in mitigating the financial requirements for operating the *clean seed* multiplication agri-enterprises. Kwarteng *et al*. (2019) reported that Ghanaian farmers who had access to credit were more likely to adopt maize production technologies due to improved purchasing power for production inputs hence stating the importance of access to credit on the adoption of agricultural technologies.

Table 6: Agri-preneur enabling institutional characteristics for continuous variables

	Mean			t-ratio	p-value
Variable	Overall	CSPMA	non CSPMA		
Extension service (number)	1.91	3.0	1.9	-4.968***	0.0000
Credit accessed (amount)	13940.04	44624.5	5310.0	-7.011***	0.0000

Note: ** and*** means significant at 5% and 1% confidence level respectively.

Table 7 presents the statistics for the institutional categorical variables that were used in the study. Only about 9.35% of the overall sampled households owned a transportation asset. Ownership of transport assets was 22.22% among CSPMA and 5.73% among non-CSPMA. The chi-square results for owning a transport facility were statistically significant between CSPMA and non-CSPMA at a 1% significance level indicating that ownership of transport asset was more among CSPMA compared to non-CSPMA. This may suggest that owning a transportation asset can increase the probability of a household participating in CSPMAE.

Approximately half of the overall sampled households owned a storage facility for their potatoes. Most (77.78%) of the CSPMA households owned a storage facility. Similarly,

roughly 42.19% of the non-CSPMA, owned a storage facility. Consequently, the chi-square results for ownership of storage facility between CSPMA and non-CSPMA was statistically significant at 1% implying that more CSPMA owned storage facilities than non-CSPMA.

In terms of membership to potato related group, about 36.18% of the overall sampled households belonged to such a group. About 62.96% of households practicing CSPMAE belonged to a potato group compared to approximately 28.65% of the non-CSPMA. The chi-square results for membership to potato group between the CSPMA and non-CSPMA were statistically significant at 1% revealing that membership to potato related group was high among the CSPMA. This shows the association between membership to potato-related groups and the adoption of CSPMAE. Membership to such collective groups can facilitate access to training and other production resources such as financial support in form of credits, which are essential in CSPMAE. Kwarteng *et al.* (2019) reported that membership to the farmer-based organization was likely to increase awareness among farmers hence the adoption of new technologies.

Table 7: Agri-preneur enabling institutional characteristics for categorical variables

Characteristic	Category	Percentage			Chi square	Sig
		Overall	CSPMA	Non CSPMA		
Own transport	Yes	9.35	22.22	5.73		
	No	90.65	77.78	94.27		
	Total	100.00	21.95	78.05	13.527***	0.00
Own storage	Yes	50.00	77.78	42.19		
	No	50.00	22.22	57.81		
	Total	100.00	21.95	78.05	21.354***	0.00
Membership to	Yes	36.18	62.96	28.65		
potato group	No	63.82	37.04	71.35		
	Total	100.00	21.95	78.05	21.496***	0.00
Participation in	Yes	16.67	33.33	11.98		
contract	No	83.33	66.67	88.02		
	Total	100.00	21.95	78.05	13.837***	0.00
Access to	Yes	16.26	42.59	8.85		
certified seed	No	83.74	57.41	91.15		
	Total	100.00	21.95	78.05	35.233***	0.00
Selling outlet	Market	14.23	25.93	10.94		
	Farm gate	77.14	70.37	79.17		
	Didn't sell	8.54	3.70	9.90		
	Total	100.00	21.95	0.3734	32.193***	0.00

Note: *** means significant at 1% significance level

Only a few (16.67 %) of the sampled household heads participated in potato contract farming. Comparatively, about 33.33% and 11.98% of CSPMA and non-CSPMA participated in contract farming respectively.

The chi-square results for participation in potato contract farming between CSPMA and non-CSPMA were statistically significant at 1% indicating that the level of participation in potato contract farming among the CSPMA was higher than non-CSPMA. This could imply that participation in contract farming plays a significant role in the adoption of CSPMAE.

Approximately 42.59% and 16.26% of CSPMA and non-CSPMA, respectively accessed certified seed potato. The chi-square results for access to certified seed between

CSPMA and non-CSPMA were statistically significant at 1% implying that majority of CSPMA had access to certified seed potato than their counterparts. Probably, the access to certified seed potato, which is scarce, yet a key input in *clean seed* potato production could have motivated the CSPMA to adopt CSPMAE.

In terms of potato selling outlets, majority 77.14% of the overall sampled households sold their potatoes at the farm gate, 14.23% sold at the market while 8.54% did not sell their potato produce. Among the CSPMA, about 70.37% sold their *clean seed* at the farm get, 25.93% at the market, and 3.7% reserved for their use. Among the non-CSPMA, roughly 79.17% sold their potatoes at the farm gate, 10.94% at the market, and 9.9% did not sell. The chi-square results for selling outlets between CSPMA and non-CSPMA were statistically significant at 1% implying that selling place influenced the adoption of CSPMAE.

The results for adoption tendencies (Figure 3) indicate that majority (53%) of the households were in the pre-contemplation stage hence not willing to try CSPMAE with 15% in the contemplation stage. Nearly 10% of the interviewed households were willing to take up the CSPMAE in the short-run (preparation stage) while the remaining 22% of the farmers were practicing CSPMAE hence in the action stage.

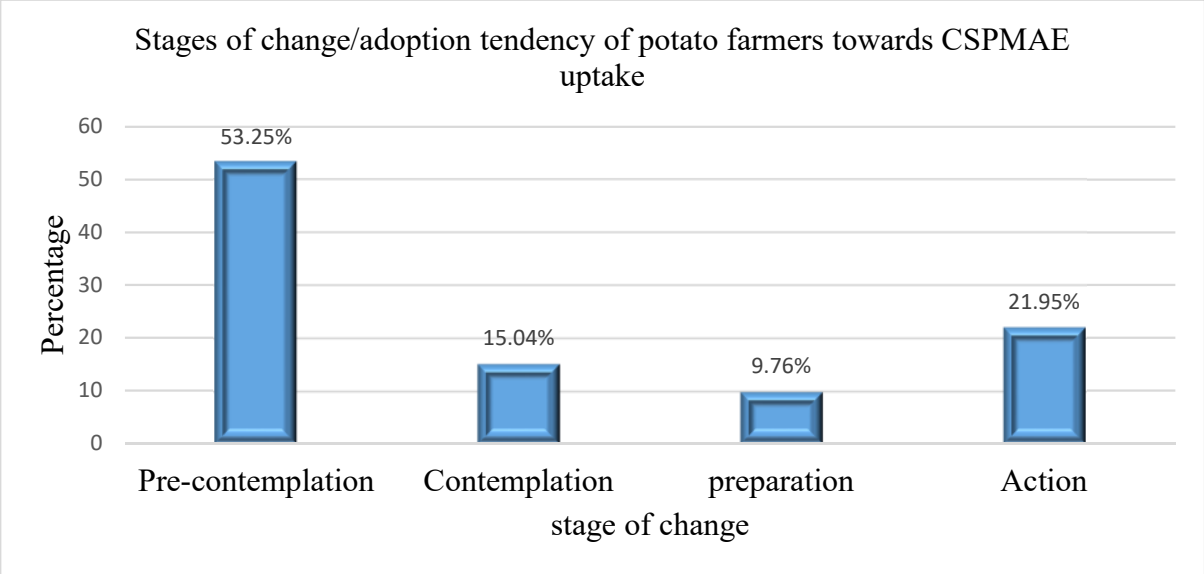

Figure 3: Stages of change for sampled potato farming households in Nakuru County

4.2 Comparison of networking capability of *clean seed* potato multiplication agri-preneurs and non-clean seed potato agri-preneurs

The statistical mean difference for entrepreneurial networking capability (NC) constructs between CSPMA and non-CSPMA was statistically significant at 1%. These

indicate a possible influence of NC constructs; partner knowledge (PK), relational skills (RS), internal communication (IC), Building new relations (BNR), and coordination skills (CS) on the adoption of CSPMAE (Table 10).

4.2.1 Confirmatory factor analysis of networking capability latent variables

Confirmatory factor analysis was used to test consistency of the NC latent construct indicators by use of maximum likelihood estimation. The five latent constructs; PK, RS, IC, CS and BNR were used to measure the respondent's networking capability. Before CFA, the NC data was analyzed to test sample adequacy using Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. Yong and Pearce (2013) suggest a KMO greater than 0.5 for satisfactory factor analysis. A significant Bartlett's Test value indicates that there is some relationship between the variables included in the analysis. The NC data had an overall KMO measure of sample adequacy of 0.903, scale reliability coefficient (α) of 0.8983 and, a significant Bartlett's Test value of 0.000 as shown in Table 8. This was adequate for subjecting the data to CFA.

Table 8: KMO and Bartlett's Test of sample adequacy

Scale reliability coefficient		0.8983
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.903
Bartlett's Test of Sphericity	Approx. Chi-Square	1735.754
	Degree of freedom	105
	Significance	0.000

Post-estimation psychometric assessment was carried out using LISREL Version 8.8 to check the reliability and validity of the selected NC constructs. The confirmatory factor analysis indicated a good fit of the model with $\chi 2$= 123.84, DF =80, p =0.00122, RMSEA =0.047 and GFI of 0.94. Harun and Ahmad (2016) recommend an RMSEA less than 0.08 and GFI greater than 0.90. Factor loading score is an indicator of how best the selected items account for a construct/ dimension (Yong & Pearce, 2013). The factor loading values for the 15 indicator variables ranged from 0.434 to 0.825 (Table 9). The five constructs of NC had Composite Reliability (CR) and Average Variance Extracted (AVE) values ranging between 0.551 and 0.811 and 0.292 and 0.589 respectively (Table 9). There was a satisfactory indicator for convergent validity and reliability of the constructs except for the construct relational skills which had a low AVE of 0.292 and CR of 0.551 that was lower than the recommended AVE>0.5 and CR>0.6 (Harun & Ahmad, 2016).

The scores for each of the latent variable were generated using the weighted means in order to compare the difference in networking capability between the *clean seed* potato multiplication agri-preneur (CSPMA) and non-CSPMA using two tailed t-test. The weighed mean was scaled as; extremely high with mean score of 4.21-5.00, very high (3.41-4.20), high (2.61-3.40), somewhat high (1.81-2.6 and not high (1.00-1.80). The results are shown in Table 10.

Table 9: Factor analysis of networking capability constructs (PK, RS, IC, BNR, and CS)

Variables	Factor loadings	CR	AVE
Partner Knowledge (PK)		0.808	0.585
I know my partner markets	0.7943		
I know my partner products and services	0.8068		
I know my partner strength and weakness	0.6889		
Relational skills (RS)		0.551	0.292
I have ability to build good personal relationship with my business partners	0.5285		
I can deal flexibly with my partners	0.6020		
I solve problems constructively with my partners	0.4838		
Internal communication		0.811	0.589
I hold regular meetings with my employees	0.7786		
My employees develop contacts among themselves	0.8112		
I and my employees often give feedback to each other	0.7088		
Building new relationships		0.807	0.584
I am constantly open to new relationships with new partners	0.7024		
I have ability to initiate mutual relationship with new partners	0.8250		
I have my eyes open to new partners	0.7594		
Coordination skills		0.705	0.444
I analyze what I would like and desire to achieve with each partner	0.6552		
I develop relationship with each partner based on what they can contribute	0.6847		
I discuss regularly with my partner how we can support each other	0.6577		

Note: CR and AVE denotes Composite reliability and Average Variance Extracted respectively.

Table 10: T-test comparison of means for farmers networking capability constructs

Variable	Mean			t-ratio	P-value
	All sample	CSPMA	Non CSPMA		
Partner Knowledge	3.383	4.122	3.176	-7.859***	0.0000
Relational skills	4.114	4.537	3.995	-4.869***	0.0000
Internal communication	3.826	4.236	3.711	-3.592***	0.0004
Building New Relations	4.231	4.456	4.167	-2.648***	0.0086
Coordination Skills	4.303	4.611	4.216	-3.725***	0.0002

Note: * means significant at 1% confidence level**

The two-tailed t-test analysis results in Table 10 indicate that all the means for the five constructs of networking capability were significantly different between the CSPMA and non-CSPMA at a 1% significant level. Partner knowledge mean was 4.122 for CSPMA and 3.176 for non-CSPMA at a 1% significance level. This suggests that CSPMA had very high partner knowledge as compared to non-CSPMA. Probably, this enabled CSPMA to identify partners with relevant capabilities and resources in the potato value chain to complement their needs hence enabling them to manage the CSPMAE. This corroborates with Bengesi and Roux's (2014) study which found a positive influence of partner knowledge in the performance of Tanzanian SMEs. This empirical finding signifies the vital role of partner knowledge attribute among entrepreneurs in the seed potato sector.

The relational skills for CSPMA were high with a mean score of 4.537 as compared to non-CSPMA who had a score of 3.995 implying possession of relatively high relational skills among households involved in *clean seed* potato agri-enterprise as compared to their counterparts. This could have enabled the CSPMA to develop effective and sustainable mutual relationships with other partners in the potato value chain hence enabling them to run the seed potato multiplication agri-enterprise as compared to non-CSPMA who had relatively lower relational skills. Bengesi and Roux (2014) suggest that relational skills are crucial in the development of long-term partnership which consequently leads to improved performance of SMEs.

Consistently, the internal communication for the CSPMA was high and significant at 1% with a mean of 4.236 whereas that of non-CSPMA was 3.711. The CSPMA were, therefore, more likely to share crucial strategic information and agreement with their employees hence enabling the effective running of the seed potato agri-enterprises.

The ability to build new relationships was high (4.456) and significant at 1% for the CSPMA as compared to non-CSPMA (4.167). The high ability to build new relationships by CSPMA possibly enabled them to flexibly interact with new partners in the potato sector hence enabling them to acquire new knowledge and skills of seed potato entrepreneurship.

Both the CSPMA and non-CSPMA had extremely high coordination skills with a mean score of 4.611 and 4.216 respectively although that of CSPMA was significantly different at 1% as shown by the two-tailed t-test results. Possession of extremely high coordination skills between CSPMA and non-CSPMA may imply that coordination skills did not contribute much towards the uptake of *clean seed* multiplication agri-enterprise. These results are in line with Bengesi and Roux's (2014) study which found a negative influence of coordination skills on the performance of SMEs in Tanzania.

4.3 Role of networking capability, socio-economic and institutional characteristics on adoption tendencies of *clean seed* potato agri-entrepreneurs in Nakuru County

4.3.1 Statistical and specification diagnostic tests for ordered logit regression model

Before running ordered logistic regression analysis, the data were subjected to multicollinearity, Heteroskedasticity, and proportional odds diagnostic tests. Multicollinearity was tested using pair-wise correlation and Variance Inflation Factor (VIF) for the categorical and continuous explanatory variables respectively. The mean VIF was 1.35, not exceeding 5.0 as shown in Table 11 implying the absence of correlation among the explanatory variables (Jamal, 2017). Harun and Ahmad (2016) postulate that correlation >0.85 indicates high correlation. The pair-wise correlation for the categorical independent variable did not exceed 0.85 as shown in Table 12 signifying the absence of correlation.

Table 11: VIF test for continuous independent variables in Ordered Logistic Regression model

Variable	VIF	1/VIF
Coordination skills (CS)	2.02	0.4959
Building new relation (BNR)	1.82	0.5487
Internal communication (ICM)	1.65	0.6073
Partner knowledge (PKW)	1.34	0.7453
Number of extension interaction	1.22	0.8197
Age of household head	1.17	0.8517
Level of education of the household head	1.1	0.9070
Household size	1.09	0.9196
Amount of credit accessed	1.06	0.9415
Potato land ratio	1.04	0.9625
Mean VIF	1.35	

Table 12: Pair- wise correlation coefficients for categorical variables used in ordered logistic regression

	Gender	Land tenure	Offfam income	Own trnsport	Own storage	Group membr	Partici Contrct	Access to seed
Gender	1.000							
Land tenure	0.079	1.000						
Off farm income	-0.027	0.103	1.000					
Own transport	-0.045	0.002	0.115	1.000				
Own storage	0.087	-0.025	-0.018	0.042	1.000			
Group member	-0.109	-0.016	-0.018	0.107	0.042	1.000		
Participate in contract	-0.016	0.048	0.000	0.119	0.142	0.344	1.000	
Access to seeds	-0.023	0.0714	0.0105	0.1763	0.008	0.352	0.244	1.000

The Cameron and Trivedi's decomposition white test for Heteroskedasticity results in Table 13 had insignificant p-value (0.5200) indicating that the variance of the error term for the variables was constant hence no Heteroskedasticity (Williams, 2020).

Table 13: Heteroskedasticity white for the independent variables

Source	Chi2	Df	P
Heteroskedasticity	179.38	181	0.5200
Skewness	61.85	17	0.0000
Kurtosis	0.02	1	0.8797
Total	241.26	200	0.0245

The parallel regression or proportional odds assumption requires that the beta coefficients should be constant across all the ordinal stages when using ordered logistic regression. Violation of this assumption leads to a biased estimate of parameters and identification issues (Fullerton, 2009). This assumption was tested using the Brant test as suggested by Agresti (2010), Castillo *et al.* (2015), and Lemken *et al.* (2017), a significant test statistic indicates a violation of the parallel assumption. The insignificant overall chi-square value (p>chi2=0.995) for the Brant test in Table 14 indicated that the proportional odds assumption was not violated hence qualifying the data for ordered logistic regression (Williams, 2019).

Table 14: Test for parallel regression assumption for ordered logistic regression model

	Chi 2	P > Chi2	Df
All	17.96	0.995	34
Gender	4.18	0.124	2
Age household head	3.54	0.171	2
Household size	1.87	0.392	2
Potato land ratio	3.15	0.207	2
Land ownership type	0.68	0.713	2
Level of education	1.52	0.467	2
Off farm income participation	6.96	0.031	2
Own transport	5.07	0.079	2
Own storage	11.24	0.004	2
Amount of credit accessed	21.81	0.000	
Group membership potato	2.34	0.331	2
Participation in contract farming	8.24	0.016	2
Number of interaction with extension service provider	1.73	0.421	2
Access to certified seed	21.81	0.000	2
Internal communication (ICM)	0.02	0.990	2
Partner knowledge (PKW)	6.76	0.034	2
Building new relations (BNR)	2.45	0.294	2
Coordination skills (CS)	0.36	0.834	2

4.3.2 Ordered logistic regression results

To determine the role of networking capability, socio-economic and institutional characteristics on adoption tendencies of CSPMA in Nakuru County, the ordered logit model was used. The ordered logistic model fitness results presented in the panel of Table 15 show a good model fit with McFadden's Pseudo R-squared (Pseudo R2) of 0.3388 indicating that the explanatory variables were able to account for 33.88% of the variation in the dependent variable. The LR chi-square test was significant at 1% indicating that the explanatory variables jointly determined the response variable hence a good model fit. The results in Table 15 indicate that nine of the explanatory variables included in the model significantly influenced the adoption tendency of *clean seed* potato multiplication agri-enterprise (CSPMAE). They include gender, household size, potato land ratio, years of schooling of the household head,

ownership of transport, ownership of storage facility, access to extension services, access to certified seed, and partner knowledge.

Gender of the household head positively and significantly influenced the adoption tendency of CSPMAE at a 10% significance level. Results imply that the likelihood of male farmers being in the higher adoption tendency stage of CSPMA is 1.8 times higher compared to female farmers' *ceteris paribus* (Table 15). Possibly, men tend to control commercial crops whereas women control subsistence food crops hence prompting more men to adopt CSPMAE than women. Alternatively, social-cultural values and norms give men authority over decision-making and control of productive resources as postulated by Rola-Rubzen *et al.* (2020). This could have enhanced their adoption of seed multiplication agri-enterprise as compared to women. Additionally, society defines gender roles, whereby male gender are less confined to domestic chores, hence giving them the freedom to participate in several meetings and training as postulated by Wang *et al.* (2017). Such meetings could involve the dissemination of useful information, which probably enhanced their uptake of CSPMAE. These findings are consistent with Wang *et al.* (2017) whose study found a positive influence of male gender on the adoption of hybrid maize in Kenya. Mwangi and Kariuki (2015) in their review on factors determining adoption of new agricultural technology by smallholder farmers in developing countries also cited several findings of a positive influence of male gender on adoption. These empirical findings indicate a significant role of gender in the adoption tendency of CSPMAE. Amendment of gender equity and equality is, therefore, necessary for enhancing women empowerment and consequently the uptake of CSPMAE by female farmers.

The number of household dependents had a negative significant influence on the adoption tendency of CSPMAE at a 5% significance level. An increase in the number of dependents by one member led to a 0.16 decrease in log odds of being in a higher stage of adoption tendency. These findings are contrary to the prior expectation that households with large family sizes are likely to provide family labour hence prompting the uptake of CSPMAE.

Table 15: Ordered logit regression results on factors influencing adoption tendencies (stage of change) of *clean seed* potato multiplication agri-enterprises

Stage of change	Odds Ratio	Std. Err.	P>z
Agri-preneur socio-economic characteristics			
Gender of the household head	1.8239*	0.6282	0.0810
Age of household head	1.0000	0.0125	0.9970
Household size	0.8489**	0.0619	0.0250
Security of tenure to land	1.1246	0.3682	0.7200
Proportion of land to potatoes production	3.2280*	2.1886	0.0840
Level of education of the household head	1.1669***	0.0484	0.0000
Off farm income participation	1.2725	0.4561	0.5010
Institutional characteristics			
Ownership of transportation equipment	3.4987**	1.9156	0.0220
Ownership of storage facility	2.7557***	0.8988	0.0020
Access to certified seed	10.1382***	3.8758	0.0000
Amount of credit accessed	1.0407	0.0365	0.2550
Membership to potato group	1.8060*	0.6208	0.0850
Participation in potato contract farming	0.8458	0.3730	0.7040
Annual Number of interaction with extension services	1.1260	0.1107	0.2270
Agri-preneur networking capability			
Internal communication (ICM)	0.7447	0.1616	0.1740
Partner knowledge (PKW)	4.0581***	1.0332	0.0000
Building new relations (BNR)	0.8178	0.2615	0.5290
Coordination skills (CS)	1.1958	0.3822	0.5760
Log likelihood =-192.001	Prob > chi2 =	0.0000	
Number of observation = 246	Pseudo R2 =	0.3388	
LR chi2 (17) = 196.75			

Note: ***, ** and * means 1%, 5% and 10% significant level

Households with larger household sizes may be hesitant to take up *clean seed* potato multiplication agri-enterprises due to higher food requirements and other costs in the households thus limiting the financial resources that could have been used in CSPMAE. This finding corroborates with Kwarteng *et al. (*2019) whose study found a negative effect of

household size on the adoption of maize technologies in Northern Ghana. They attributed their findings to the fact that larger households are burdened with financial needs which deters their decision to invest in cost-intensive technologies. With other factors constant, the provision of adequate financial resources could improve the uptake of CSPMAE by households with large household sizes.

The proportion of land allocated for potato production significantly influenced the adoption tendency of CSPMAE ($p<10\%$) (Table 15). This means that a 1% increase in the proportion of land allocated for potatoes *ceteris paribus,* is associated with a 3.27 times higher likelihood of being in a higher stage of CSPMAE adoption tendency. The land is a crucial resource for specialization in *clean seed* potato multiplication (KEPHIS, 2016). A large farm size facilitates crop rotation, which helps to uphold the quality of seed against diseases such as bacterial wilt (Wasilewska-Nascimento *et al.,* 2020). Farmers with large land parcels, therefore, had relatively sufficient resources mandatory for participation in CSPMAE compared to farmers with lower land acreage. Ownership of resourceful assets such as land was, therefore an incentive to adopt agri-entrepreneurial opportunities such as *clean seed* potato multiplication. Studies by Onyeneke (2017) and Kapalasa *et al.* (2019) consistently found a positive significant influence of farm size in their adoption studies. Therefore consideration of farmers with larger land acreage is key for projects seeking to recruit farmers into CSPMAE rather than targeting all farmers. This finding suggests the significant role of land in the adoption tendency of *clean seed* agri-enterprises in Nakuru County.

The level of education of the household head influenced the uptake stage of CSPMAE at a 1% significance level (Table 15). Results suggest that with other factors kept constant, an increase in the number of schooling years by one increases the likelihood of a household head to be in higher stages of CSPMAE adoption tendency by 1.17 times. More educated farmers tend to have comparatively greater access to information than their less-educated counterparts, thus increasing their level of awareness of new technologies and entrepreneurial opportunities. Awareness can enhance the adoption of CSPMAE (Mwangi & Kariuki, 2015). This is consistent with the results of Wang *et al.* (2017) who observed that farmers with more years of schooling, college, and higher education levels had a higher probability of adopting hybrid maize and concluded that educated farmers were more likely to purchase hybrid seed and observe agronomic practices. Consequently, enhancement of capacity building among interested farmers in lower stages of adoption tendency and selection of educated farmers is a crucial intervention for engaging in CSPMAE.

Ownership of a storage facility positively and significantly influenced the stages of change of CSPMAE at 1% significance levels. Owning a storage facility by a household was associated with a 2.76 times higher probability of being in the next higher stage of adoption tendency for CSPMAE. The storage facility is a vital requirement in maintaining the quality of seed potato (Muthoni *et al*. 2015). It aids in the prevention of post-harvest losses associated with storage such as rotting, greening, and unnecessary sprouting of tubers due to short dormancy (Muthoni *et al*. 2015). Farmers who owned storage facilities were, therefore, more likely to be in the action stage of adoption tendency of CSPMAE as compared to those without stores. Moreover, buyers are sensitive to the quality of seed, hence making storage facility a crucial requirement for CSPMAE. Ownership of storage facility, therefore, plays a vital role in the adoption tendency of *clean seed* multiplication agri-enterprises (Kibe *et al*., 2019). Targeting farmers with such a profile could increase the uptake of *clean seed* potato entrepreneurial opportunities.

Similarly, ownership of transport facility influenced the uptake stages of CSPMAE positively at p<5% (Table 15). Farmers who owned a transport facility were 3.5 times more likely to be in the next higher stage of adoption tendency for CSPMAE *ceteris paribus.* This means that farmers who owned transport had a higher probability of adopting *clean seed* potato multiplication agri-enterprise than those who did not own such infrastructure. Ownership of transportation assets such as motorcycles, lorry, car, or donkey cart facilitates efficient and effective mobility of farm inputs and outputs between the farm and the markets. This helps to reduce transaction costs incurred by the farmers. Due to the bulky nature of seed potatoes and their high demand during planting season, farmers who own transportation facilities were more likely to be in higher stages of adoption tendency of CSPMAE as compared to farmers who did not have their transport means. Additionally, CSPMAE requires an investment of bulky inputs such as certified seed and fertilizer hence ownership of transport facilitates easy transportation from the market to remote areas as well as distribution of *clean seed* to other farmers (Muthoni *et al*., 2013). Conclusively, ownership of transport plays a significant role in the adoption tendency of CSPMAE hence a crucial trait when profiling farmers to participate in CSPMAE.

Membership to a potato-producing group influenced the adoption tendency of CSPMAE positively at a 10% significance level. Being a member of a potato-producing group increased the probability of being in the next higher stage of CSPMAE adoption tendency by 1.81 times. This could be possible because information on new agricultural technologies and opportunities is mostly disseminated through organized farmer groups. Farmers belonging to

such groups are more likely to access information from change agents such as agricultural extension officers as compared to farmers who do not belong in a potato group. Such change agents are useful human capital in the dissemination of agricultural information and instilling confidence among farmers (KEPHIS, 2016). Farmers who interacted frequently with such change agents through groups seem to have gained more valuable information about *clean seed* potato multiplication, hence motivating them to take up the entrepreneurial opportunity. Kalibwani *et al.* (2017) and Lasway *et al.* (2020) consistently found a positive effect of membership to a group on the adoption of soil conservation technologies. These social ties could have increased the awareness of farmers concerning the prevailing challenges such as the inadequate supply of seed hence motivating them to take up the *clean seed* multiplication agribusiness. Moreover, farmers in groups are more likely to get access to training and finances among other productive resources.

Access to certified seed positively influenced the uptake of CSPMAE at a 1% significant level (Table 15). Farmers who had access to certified seed potato were 10.14 times more likely to be in a higher stage of adoption tendency. Farmers who got access to certified seed had a higher propensity of taking up CSPMAE as compared to those without access to certified seed *ceteris paribus.* Certified seeds are a scarce but crucial requirement in the production of *clean seeds* (Wasilewska-Nascimento *et al.,* 2020). Due to its scarcity, farmers who interact with certified seed producers frequently are likely to get access to certified seed hence gaining an advantage to participate in CSPMAE as compared to farmers without interaction with certified seed producers. Since certified seed plays a significant role in the adoption tendency of CSPMAE, the formal sector should increase their production capacity for the enhanced supply of certified seed among the potential *clean seed* potato multiplication agri-preneurs.

Partner knowledge of the household head, a construct of networking capability, positively influenced the adoption tendency of CSPMAE at a 1% significance level (Table 15). An increase in the score of partner knowledge was associated with a 4.06 times higher likelihood of being in the next higher stage of CSPMAE adoption tendency. Partners' knowledge is among the necessary networking capability attributes that enable an individual to identify partners with relevant capabilities and resources to complement their needs for better performance of their enterprises as postulated by Bengesi and Roux (2014). Entrepreneurs with better partner knowledge attributes can also avoid enterprise instability resulting from partnership disputes. Therefore, farmers with stronger partner knowledge have better networks and linkages with other actors in the potato value chain hence enhancing their capacity to be in

a higher stage of CSPMAE. This was consistent with previous studies' findings of the positive impact of entrepreneur networking capability on SMEs' performance.

4.4 Factors influencing the extent of commercialization of *clean seed* potato multiplication agri-enterprises in Nakuru County

4.4.1 Fractional logistic regression results

The fractional response model (FRM) was used to determine the factors influencing the extent of *clean seed* potato commercialization. The FRM fitness results presented in the panel of Table 16 show a good model fit with Log pseudo-likelihood of -29.2845, Wald chi2 (18) of 71.04, a significant probability (Prob>chi2 0.000), and Pseudo R2 of 0.2175. The Wald chi-square test was significant at 1% indicating that the explanatory variables jointly determined the response variable. Also, the Pseudo R square of 0.2175 implies that the model was good in that the explanatory variables were able to explain about 22% of the variation in the dependent variable. The FRM results (Table 16) show that age of the household head, household size, level of education in years of schooling, selling place, access to certified seed, and the amount of credit accessed by the household had a significant effect on the extent of *clean seed* potato commercialization.

Age of the household head had a positive significant influence on the extent of *clean seed* potato commercialization at a 10% significant level. With all other factors held constant, a unit increase in the age of a farmer by one year increased the intensity of *clean seed* potato commercialization by 0.6%. This is explained by the fact that older farmers possess experience in potato production. They may be well acquainted with potato production skills and aware of the challenges faced by ware potato farmers such as the scarcity of seed at planting. This could be a possible motivation for them to engage in *clean seed* potato production agri-enterprise. These findings corroborate studies by Kumilachew (2016) and Rabbi *et al*. (2017) whose studies found a positive influence of age on commercialization and concluded that aged farmers possess farming experience as compared to the young generation who prefers white-collar employment. Based on these empirical findings, the motivation of youth to engage in entrepreneurial agricultural opportunities such as *clean seed* potato multiplication is key for the sustainable commercialization of CSPMAE.

Likewise, household size significantly and positively influenced the extent of *clean seed* potato commercialization at a 5% significant level. The level of *clean seed* potato commercialization increased by 3.3% for a unit increase in the number of dependents in a household who participated in farming. Production of *clean seed* is done following strict labor

intensive agronomic practices through supervision by agricultural extension providers. The household size was used as a proxy for labor availability, meaning that if other factors are kept constant, households with more members were more likely to access adequate work force required in the production of *clean seed* potato.

Table 16: Factors influencing the extent of *clean seed* potato commercialization in Nakuru County

HCI	Dydx	Coef.	Std. Err.	P>z
Socio-economic characteristics				
Gender of the household head	-0.0574	-0.2298	0.0791	0.4680
Age household head	0.0060	0.0240*	0.0034	0.0780
Household size	0.0330	0.1321**	0.0146	0.0230
Level of education (years)	0.0242	0.0968**	0.0110	0.0270
Security of tenure to land	-0.0521	-0.2088	0.0952	0.5840
Proportion of land to potato	0.1652	0.6609	0.2215	0.4560
Off farm income participation	0.1202	0.4839	0.0960	0.2100
Institutional characteristics				
Selling outlet	-0.3309	-1.3237***	0.0978	0.0010
Ownership of transport equipment	-0.2425	-1.0432	0.1778	0.1730
Ownership of storage facility	0.0171	0.0683	0.0798	0.8310
Member to potato group	-0.1492	-0.6058	0.1138	0.1900
Access to certified seed	0.1675	0.6765*	0.0930	0.0720
Amount of credit accessed	-0.0272	-0.1088**	0.0130	0.0360
Networking capability attributes				
Internal communication (ICM)	0.0170	0.0681	0.0779	0.8270
Partner knowledge (PKW)	-0.0240	-0.0959	0.0601	0.6900
Building new relations (BNR)	-0.1132	-0.4529	0.0741	0.1260
Coordination skills (CS)	0.1647	0.6590	0.1136	0.1470
Number of observation = 54		Pseudo R2	=	0.2175
Log pseudo likelihood = -29.2845		Wald chi2 (18)	=	71.04
Prob>chi2 = 0.000				

Note: ***, **,* means 1%, 5% and 10% significant level respectively

These findings are consistent with Rabbi *et al*. (2017) and Kahenge *et al*. (2019) who argued that large household size provides labor and reduces transaction costs hence contributing to the increased commercialization of agricultural produce. Alternatively, a household with a large household size tends to have more financial obligations; this could motivate them to engage in agricultural commercialization to mitigate their financial needs. These findings, however, contradict Awotide *et al.* (2016) whose study found a negative influence of the household size on the level of rice market participation. They concluded that household size also represents the consumption unit hence a larger dependency ratio, which reduces the marketable surplus, especially for grain crops. Given that *clean seed* potato production is labor-intensive and requires skilled personnel; larger households should embrace it and provide incentives at the household level to encourage more production and consequently increase the level of commercialization.

The level of education of a house household head positively influenced *clean seed* commercialization at a 5% significant level (Table 16). An increase in the years of schooling by one increased the extent of *clean seed* potato commercialization by 2.5%. Education is likely to enhance the ability of farmers to interpret and understand information. Understanding market information especially on customer preference and prices can motivate educated households to produce surplus desirable *clean seed* potatoes for commercialization. These findings are consistent with Ahmed *et al*. (2016) and Kumilachew (2016) whose study found a positive association between education and market participation. Similarly, Adeoti *et al*. (2014) and Awotide *et al*. (2016) studies found a positive influence of years of formal education on maize and rice commercialization and concluded that education enriches household head understanding of market dynamics thus improving their decision on production for market purposes.

The selling place had a significant negative influence on the level of commercialization for CSPMAE. Selling at the market as opposed to the farm gate reduced the extent of *clean seed* commercialization by 33.1%. Probably when a farmer decides to sell at the market, they intend to sell a smaller percentage of the output due to higher transactional costs involved such as transportation. Additionally, seed potatoes are bulky hence transporting them to the market for sale with the poor condition of feeder roads could lead to a decrease in the extent of commercialization. Possibly, due to the decentralized and the bulky nature of seed potatoes, *clean seed* potato agri-preneurs in remote areas prefer selling to their fellow farmers at the farm gate rather than transporting their produce to the market. This finding corroborates with Edossa *et al*. (2019) whose study found a negative association between the distance to the

market and choice of potato market outlet. They concluded that producers prefer selling potatoes at the farm gate to avoid the extra transaction cost that is incurred in transporting potatoes to the market.

Access to certified seed had a positive effect on the extent of *clean seed* potato commercialization at a 10% significant level (Table 19). Access to certified seed potato by farmers increased the extent of *clean seed* potato commercialization by 16.7%. These findings are consistent with Okello *et al.* (2017) study, which found a positive influence of planting certified seed potato on potato yields. These empirical results imply that increasing the capacity of certified seed production by the formal sector is likely to enhance access to certified seed by CSPMA thereby increasing commercialization of *clean seed* potato.

The amount of credit accessed by the household head negatively influenced the extent of *clean seed* potato commercialization at a 5% significant level (Table16). A unit increase for credit accessed by the household head by one shilling reduced the extent of *clean seed* potato commercialization by 2.7%. These findings are contrary to the prior expectation but corroborate with Kahenge *et al*. (2019) whose study found a negative influence of credit access on soya beans commercialization in Zambia and concluded that farmers tend to divert the credit accessed to other prospective activities. Probably, the amount of credit accessed by farmers was not adequate for purchasing the required inputs such as certified seed, fertilizers, and agro-chemicals in optimal quantities for *clean seed* potato production. This could lead to low output, which consequently affects the level of commercialization. In addition, majority of lenders tend to be cautious in funding crop production agri-enterprises due to the risks and uncertainties involved. Therefore, the credit accessed by the potato farmers could have been used on other activities rather than *clean seed* potato production.

CHAPTER FIVE
CONCLUSION AND POLICY RECOMMENDATION

5.1 Conclusion

The following conclusions are drawn from the empirical findings of this study;

i. The CSPMA had comparatively high networking capability compared to non-CSPMA as revealed NC attributes. Networking capability could therefore be an important entrepreneurial attribute among the *clean seed* potato multiplication agri-entrepreneurs in Nakuru County.

ii. Networking capability, socioeconomic and institutional characteristics influenced agri-preneurs adoption tendencies of *clean seed* production. Gender of the household head, literacy level of the household head, and the proportion of land allocated for potato production had a positive significant influence on the uptake of *clean seed* potato multiplication agri-enterprises whereas household size had a negative effect. Additionally, the entrepreneurship enabling institutional factors such as ownership of storage and transport assets, access to certified seed potato and membership to potato related group positively influenced the uptake of CSPMAE. The uptake of CSPMAE in Nakuru County was also positively and significantly influenced by the household's head partner knowledge, the other NC attributes also had positive but insignificant influence on adoption tendency of CSPMAE.

iii. The extent of *clean seed* potato commercialization in Nakuru County was positively influenced by the age of the household head, household size, years of schooling of the household head, and access to certified seed. The choice of selling outlet and the amount of credit accessed by the household had a negative influence on the commercialization of *clean seed* potato in the County.

5.2 Recommendation for policy

Based on the empirical findings, the study draws the following recommendations to the County government of Nakuru and the stakeholders in Nakuru seed potato sector especially investors and the projects seeking to recruit farmers for decentralized entrepreneurial seed multiplication.

i. The County government through MoALF should consider the organization of more inclusive farmers, potato seed clinics at Sub-County and ward levels. This would bring the seed sector stakeholders to grass root level hence enabling the potato farmers to

interact and learn more to build and enhance their networking capability skills. Farmers with stronger NC can become better *clean seed* potato merchants.

ii. To improve the uptake of decentralized CSPMAE in Nakuru County, the County government should consider offering the capacity building to potato farmers. This can be achieved by organizing willing farmers into groups and facilitating more agricultural extension service providers to offer training to farmer groups in remote areas. Engendered sensitization programs would also empower the female farmers to participate in CSPMAE. Additionally, the construction of storage facilities by *clean seed* producers, enhancement of transport infrastructure by the County, and increasing the supply of certified seed potatoes by the formal sector can motivate the non-CSPMA especially those in preparation stage to adopt CSPMAE. Also, the formation of collective potato groups and sensitization of farmers to join would enhance the adoption of CSPMAE. The profile of CSPMA can be used by the donor community and projects to select and recruit new *clean seed* producers instead of recruiting unwilling farmers who lack the necessary traits.

iii. To increase the commercialization of CSPMAE, the amount of *clean seed* potato output should be increased. Dissemination of information on good agricultural practices by agricultural service providers to potato farmers through field days and demo plots can enhance their literacy and skills hence improving the productivity of *clean seed* and consequently its commercialization. Furthermore, the financial service providers should consider offering training on loan utilization and adequate loans to enable the *clean seed* producers to purchase sufficient inputs for optimal *clean seed* productivity and commercialization. Since certified seed potato is a key input in *clean seed* production, the formal seed potato sector should increase its production capacity and prioritize the orders made by CSPMA. This would help the CSPMA to increase its output and commercialization. The extent of *clean seed* potato commercialization can further be improved through the legalization of *clean seed* agri-enterprises in remote areas among trained farmers.

In conclusion, adoption tendency, which is based on the transtheoretical model of behaviour change, is paramount in profiling adopter characteristics which can then be used by projects in identification and selection of individuals with desirable traits rather than targeting all individuals. Additionally, the classification of individuals into their respective stages of change

(pre-contemplation, contemplation, preparation and action) can aid projects in delivering stage-matched entrepreneurial interventions.

5.3 Recommendation for further research

This study focused on the role of networking capability, socio-economic factors, and institutional factors on adoption tendency and commercialization of clean seed potato multiplication agri-enterprises in Nakuru County. The researcher proposes the following areas for further research.

i. Consideration of time series survey instead of cross-section survey is critical in organizing follow up and administering of stage-matched interventions to households in pre-contemplation and preparation stages of adoption tendency.

ii. There is also a need for further studies to consider the influence of agronomic factors, market factors, and individual entrepreneurial attributes on the adoption tendency of CSPMAE. This would provide a broad view of factors influencing CSPMAE adoption and commercialization hence conclusive guidance when making policy reviews and recommendations.

iii. Profitability studies to access the costs and benefit and gross margin of CSPMAE would also help to substantiate the feasibility of CSPMAE hence providing solid evidence that would motivate the uptake of CSPMAE among ware potato farmers.

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APPENDICES

Appendix A: Questionnaire

My name is Mercyline Jerusa, a student at Egerton University. This questionnaire is part of my research work that leads to the award of a Master of Science degree in Agri-enterprise Development. You are among the farmers I selected to participate in this study. The aim of this questionnaire is to collect information for examining "**Networking capability, adoption tendencies and commercialization of decentralized *clean seed* potato multiplication agri-enterprise in Nakuru County".** Your response for this questionnaire is strictly confidential. Your name and contacts will not appear in any stage of research analysis or report. The research findings will be made available if you desire. You are therefore kindly requested to provide your responses that will be used in this study for academic purpose and in confidence. Thank you for your contribution and support for the study.

Date ……/…../ 2019	Enumerator name	Mobile contact

SECTION A: Socio-economic information of the household (Please **tick or cycle** the appropriate box or write in the space provided.

Respondent name	**Mobile contact**	**Sub- County Code**	**Ward Code**

1. Position of respondent in the household: [1].Household head [2].Spouse [3].Adult child [4]. Relative [6] Employee [7] Others

2. Gender of the house hold head 1=Male, 0=Female **3.** Age of household head in full years [ ] **4** What is your household size? [ ] **5.** What is the type of land ownership of your main plot? 1=own with title deed 0= own without title deed **6.** Total farm size owned in acres in 2018 [ ]	**7.** Did you rent in any land since 2018? 1= Yes,0=No **7.1** If yes, what amount of land did you rent in 2018? [.] **8.** Did you rent out any land since 2018? 1= Yes,0=No **8.1** If yes, what amount of land did you rent out in 2018? [ ] **9.** What size of land did you allocate for potato production in 2018?[ ]acres **10.** How many years have you been growing potato? [ ]	**11.** What is your highest level of education? 1= None 2= Primary 3= Secondary 4= College/University **12.** Do you participate in off farm income activities? Yes=1, No=0

SECTION B: Information of the household on *clean seed* potato farming and commercialization. NB:

1 Do you grow *clean seed* potato? Yes = 1, No = 0 (***If no move to question 3 and ask all questions with respect to ware potato, if the farmer is seed producer ask with respect to seed)***

2 How many years have you grown *clean seed* potato? [ ]

3 How many times do you grow *clean seed* or ware potato in a year? [….]

4. How many acres of *clean seed* or ware potato did you plant in 2018? [ ]

5. How many bags of *clean seed* or ware did you harvest from last season? [ ]

6. For what purpose do you grow seed or ware potato? 1=Selling, 2=Own use, 3=Donating

7. How many bags of your potato harvest did you sell as seed or ware? [ ]

Compute. HCI $\frac{\text{Total value of } \textit{clean seed} \text{ potato sold from own production (Q7)}}{\text{Total value of all } \textit{clean seed} \text{ produced on the farm(Q5)}}$

8. Where did you sell your *clean seed* potato? 1=Market, 2=Neighbors, 3=farm gate

9. How is the condition of your feeder road? 1= Good, 0= Bad

10. Do you have your own means of transport? Yes = 1, No = 0

11. 1 If no, how much does it cost you or brokers charge per bag to transport your potato to the market? KES [ ]

12. Do you own a storage facility for seed/ware potato? Yes = 1, No = 0

13. Did you use certified seed to produce your *clean seed*/ware potato? Yes = 1, No = 0

14. If yes**,** where did you get your certified seed? 1= ADC Molo 2= Cooperatives

3=.Neighbors 4= Self 5=. Not applicable

15 If no in Q13, what are the reasons you did not use certified seed?

1=Certified seed was expensive, 2=Certified seed was not available

3=Lack information……....4k2=others

16. Do you belong to any group related to potato production? Yes = 1, No = 0

17. How many other groups do you belong to? [.....]

18. Did you think of or consider borrowing credit for potato production last year? Yes =, No=0

19. If yes, did you access it? Yes =, No=0

20. How much loan did you get in last one year? KES [.....]

21. Have you participated in any contract farming for potato? Yes=1, No=0

22. If yes, which type of contract farming have you engaged in? 1=formal, 2=informal

23. How can you rank the demand of *clean seed* potato**?**

5= very high, 4=high, 3=moderate, 2=low, 1=very low

SECTION C: *Clean seed* potato multiplication agri-enterprise adoption tendencies of the household

1.0 Do you know or have you heard about *clean seed* potato? Yes = 1, No = 0

2.0 If yes, have you used it to grow your ware potato? Yes=1 No=0

2.1 If yes, do you always get enough quantity of *clean seed* potato when you need them?

Yes=1 No=0

2.2 If you don't get enough, do you think these shortage of *clean seed* potato can be a business opportunity for you? Yes =1 No=0

2.3 If yes, do you have any intention of taking up *clean seed* potato multiplication enterprise? Yes=1 No=0

2.4 If yes, how soon do you think you can begin *clean seed* potato multiplication enterprise?

1= Not very soon/long run, 2= Very soon/short run

2.5 If you said very soon, do you have any plans and information on *clean seed* potato production?

Yes = 1

No = 0

For researcher use only: Select the stage of adoption for the respondent based on information provided by respondent above.

Stage	**Concept**	**Operationalization**
Pre-contemplation (**Answers no in Q. 1.0 and 2.0)**	The respondent has no intention to change, lacks information and motivation to change	Respondent not willing to try CSPMA
Contemplation (**Answers 1 in Q. 1, 2.2, 2.3 and 2.4)**	The respondent has intention to change though still considering associated costs and benefits	The respondent is generally willing to try CSPMA in long run
Preparation (**Answers 1 in Q. 1, 2.2, 2.3, 2.5 and 2 in Q 2.4)**	The respondent has intention to change with concrete plan of action	The respondent willing to try CSPMA in short run
Action (**Answers 1 in Q. 1 Section B)**	Behaviour change	The respondent is already practicing CSPMA

SECTION D: Networking Capability

1.0 Have you engaged or worked with other partners in the potato industry?
Yes = 1

No = 0

2. If yes, how many times have you interacted with the following partners since last year?

(**Tick the appropriate box**)

	Partner	**Number of interactions**					
		0	**1**	**2**	**3**	**4**	**>5**
1	Ministry of agriculture (extension officers)						
2	Research e.g. KALRO,						
3	Certified seed producers e.g. ADC, cooperatives						
4	Other farmer groups						
5	Traders/Middlemen/brokers						
6	NGOs/projects						
7	Input providers e.g. fertilizer, agrochemicals						
8	Universities/colleges eg Egerton, Baraka						
9	Service providers e.g. microfinance,, mechanization, and insurance						
10	Potato Industry regulators e.g. KEPHIS, NPCK etc.						

8.4 How did you benefit from the relationship with other partners? (Use the key of benefits provided)

Key of the benefits

1=Accessed timely information
2=Market linkage and collective marketing
3=Accessed financial resources
4=Subsidized input supply
5=Asset investments e.g. storage, equipment
6=Research, training and technical assistance
7=Exchange visits
8=Others
(……..)

9.0 Having interacted with other partners in potato sector, how do you agree with the following statements about your partner knowledge, relational skills, internal communication, coordination and ability to build new relationships with your employees and partners?

1=Strongly Disagree, 2=Disagree, 3= Neutral, 4=Agree, 5= Strongly Agree

Partner knowledge	5 (SA)	4(A)	3 (N)	2(D)	1(SD)
I know my partner markets					
I know my partner products and services					
I know my partner strength and weakness					
Relational skills					
I have ability to build good personal relationship with my business partners					
I can deal flexibly with my partners					
I solve problems constructively with my partners					
Internal communication					
I hold regular meetings with my employees					
My employees develop contacts among themselves					
I and my employees often give feedback to each other					
Building new relationships					
I am constantly open to new relationships with new partners					
I have ability to initiate mutual relationship with new partners					
I have my eyes open to new partners					
Coordination skills					
I analyze what I would like and desire to achieve with each partner					
I develop relationship with each partner based on what they can contribute					
I discuss regularly with my partner how we can support each other					

Thank you so much for your contribution and support towards my stud

Appendix B: Research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **772411**

Date of Issue: **16/March/2020**

RESEARCH LICENSE

This is to Certify that Ms.. Mercyline Jerusa Ong'ayo of Egerton University, has been licensed to conduct research in Nakuru on the topic: NETWORKING CAPABILITY, ADOPTION TENDENCIES AND COMMERCIALIZATION: CASE OF DECENTRALIZED CLEAN SEED POTATO MULTIPLICATION AGRI-ENTERPRISES IN NAKURU COUNTY, KENYA for the period ending : 16/March/2021.

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Appendix C: Raw results

Descriptive statistics for the explanatory variables used in the study

```
. sum Gender Age_hhh HH_Size Landownershiptype Level_of_education Off_farm_income_parti Own_transp
> ort Costof_transport Own_storage Group_membership_potato Participation_contract_farming logbagsh
> arvested lnAmoutcreditaccessed potatoslandratio accessseed ICM PKW RSK BNR CS
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Gender	246	.6747967	.4694058	0	1
Age_hhh	246	46.91463	13.6177	17	80
HH_Size	246	5.597561	2.299209	1	14
Landowners~e	246	.6056911	.4896981	0	1
Level_of_e~n	246	10.96341	3.974752	0	18
Off_farm_i~i	246	.7073171	.4559217	0	1
Own_transp~t	246	.0934959	.2917197	0	1
Costof_tra~t	246	118.0935	83.92336	0	500
Own_storage	246	.5	.5010194	0	1
Group_memb~o	246	.3617886	.4814977	0	1
Participat~g	246	.1666667	.3734378	0	1
logbagshar~d	239	3.450104	1.195905	0	7.090077
lnAmoutcre~d	246	2.641929	4.547559	0	12.61154
potatoslan~o	246	.3969425	.2273163	0	1
accessseed	246	.1626016	.3697541	0	1
ICM	246	3.826418	.9706268	1	5
PKW	246	3.383482	.8733742	1	5
RSK	246	4.114039	.7554394	2	5
BNR	246	4.230761	.715367	1	5
CS	246	4.302756	.7070547	1.670755	5

T-test statistics results for continuous explanatory variables used in the study

```
. ttest Age_hhh , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	47.20313	1.003417	13.90376	45.22392	49.18233
1	54	45.88889	1.71699	12.61725	42.44504	49.33273
combined	246	46.91463	.8682326	13.6177	45.20448	48.62479
diff		1.314236	2.100214		-2.822628	5.4511

```
    diff = mean(0) - mean(1)                                      t =   0.6258
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7340         Pr(|T| > |t|) = 0.5321          Pr(T > t) = 0.2660

. ttest HH_Size , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	5.734375	.1619186	2.24361	5.414997	6.053753
1	54	5.111111	.3329837	2.446921	4.44323	5.778992
combined	246	5.597561	.1465922	2.299209	5.308819	5.886303
diff		.6232639	.352634		-.0713313	1.317859

```
    diff = mean(0) - mean(1)                                      t =   1.7675
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9608         Pr(|T| > |t|) = 0.0784          Pr(T > t) = 0.0392

. ttest Level_of_education , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	10.53125	.2949275	4.086635	9.949517	11.11298
1	54	12.5	.4252265	3.124764	11.6471	13.3529
combined	246	10.96341	.253421	3.974752	10.46425	11.46258
diff		-1.96875	.6004194		-3.151417	-.7860834

```
    diff = mean(0) - mean(1)                                      t =  -3.2790
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0006         Pr(|T| > |t|) = 0.0012          Pr(T > t) = 0.9994
```

T-test statistics results for continuous explanatory variables used in the study

```
. ttest potatoslandratio , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	.3950853	.0163691	.2268168	.3627979	.4273727
1	54	.4035461	.031449	.2311023	.3404673	.4666249
combined	246	.3969425	.0144932	.2273163	.3683955	.4254896
diff		-.0084609	.0350822		-.0775635	.0606418

```
    diff = mean(0) - mean(1)                                      t =  -0.2412
Ho: diff = 0                                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.4048         Pr(|T| > |t|) = 0.8096          Pr(T > t) = 0.5952

. ttest Bags_harvested , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	48.58333	6.151605	85.23914	36.44953	60.71714
1	54	140.7963	31.44703	231.0875	77.72154	203.8711
combined	246	68.8252	8.713883	136.6719	51.66152	85.98889
diff		-92.21296	20.25256		-132.1051	-52.32081

```
    diff = mean(0) - mean(1)                                      t =  -4.5532
Ho: diff = 0                                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

. ttest HCI , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	.6135052	.0210141	.2911795	.5720558	.6549547
1	54	.6542593	.0335908	.2468412	.5868846	.7216339
combined	246	.6224512	.0179843	.2820721	.5870277	.6578747
diff		-.0407541	.0434597		-.1263582	.0448501

```
    diff = mean(0) - mean(1)                                      t =  -0.9377
Ho: diff = 0                                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1747         Pr(|T| > |t|) = 0.3493          Pr(T > t) = 0.8253
```

T-test statistics results for continuous explanatory variables used in the study

```
. ttest Costof_transport , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	124.1146	6.240721	86.47396	111.805	136.4242
1	54	96.68519	9.63353	70.7917	77.36277	116.0076
combined	246	118.0935	5.350758	83.92336	107.5541	128.6329
diff		27.4294	12.83404		2.149745	52.70905

```
    diff = mean(0) - mean(1)                                      t =   2.1372
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9832         Pr(|T| > |t|) = 0.0336          Pr(T > t) = 0.0168

. ttest Times_of_interaction_with_extent , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	1.604167	.1325097	1.836108	1.342796	1.865537
1	54	3	.2422813	1.780396	2.514045	3.485955
combined	246	1.910569	.121794	1.910265	1.670672	2.150466
diff		-1.395833	.2809835		-1.949296	-.8423705

```
    diff = mean(0) - mean(1)                                      t =  -4.9677
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

. ttest Amout_credit_accessed , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	5310.031	1063.658	14738.47	3212.007	7408.056
1	54	44624.5	9923.564	72923.01	24720.35	64528.65
combined	246	13940.04	2538.81	39819.68	8939.358	18940.71
diff		-39314.47	5607.236		-50359.23	-28269.7

```
    diff = mean(0) - mean(1)                                      t =  -7.0114
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

T-test statistics results for networking capability

```
. ttest ICM, by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	3.711292	.068577	.9502311	3.576027	3.846558
1	54	4.235754	.127827	.939333	3.979365	4.492142
combined	246	3.826418	.0618849	.9706268	3.704524	3.948312
diff		-.5244617	.1460061		-.8120548	-.2368686

```
    diff = mean(0) - mean(1)                                      t =  -3.5921
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0002         Pr(|T| > |t|) = 0.0004          Pr(T > t) = 0.9998

. ttest PKW , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	3.175722	.0620078	.8592055	3.053414	3.29803
1	54	4.12218	.0532817	.3915386	4.015311	4.22905
combined	246	3.383482	.0556843	.8733742	3.2738	3.493163
diff		-.946458	.1204216		-1.183656	-.7092595

```
    diff = mean(0) - mean(1)                                      t =  -7.8595
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

. ttest BNR , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	4.167483	.0531596	.7366016	4.062628	4.272338
1	54	4.455751	.0798393	.5866968	4.295614	4.615888
combined	246	4.230761	.0456101	.715367	4.140923	4.320599
diff		-.2882679	.1088642		-.5027014	-.0738344

```
    diff = mean(0) - mean(1)                                      t =  -2.6480
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0043         Pr(|T| > |t|) = 0.0086          Pr(T > t) = 0.9957
```

T-test statistics results for networking capability

```
. ttest CS , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	4.215947	.0535228	.7416337	4.110376	4.321519
1	54	4.611408	.0615341	.4521812	4.487986	4.734829
combined	246	4.302756	.0450802	.7070547	4.213962	4.39155
diff		-.3954603	.1061572		-.6045618	-.1863589

```
    diff = mean(0) - mean(1)                                      t =  -3.7252
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0001         Pr(|T| > |t|) = 0.0002          Pr(T > t) = 0.9999

. ttest RSK , by(CSPM)

Two-sample t test with equal variances
```

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	192	3.99507	.0552553	.7656406	3.886081	4.104059
1	54	4.537037	.0735301	.540334	4.389554	4.68452
combined	246	4.114039	.0481651	.7554394	4.019168	4.208909
diff		-.5419666	.1113209		-.7612391	-.3226941

```
    diff = mean(0) - mean(1)                                      t =  -4.8685
Ho: diff = 0                     degrees of freedom =      244

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

.
```

Chi square statistics results for categorical explanatory variables used in the study

```
. tabulate Gender CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

GNDR	CSPM 0	1	Total
female	65 33.85	15 27.78	80 32.52
Male	127 66.15	39 72.22	166 67.48
Total	192 100.00	54 100.00	246 100.00

Pearson chi2(1) = 0.7091 Pr = 0.400

```
.
.
. tabulate Landownershiptype CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

TYPELNDOWNSHIP	CSPM 0	1	Total
Own without title dee	78 40.63	19 35.19	97 39.43
Own with title deed	114 59.38	35 64.81	149 60.57
Total	192 100.00	54 100.00	246 100.00

Pearson chi2(1) = 0.5222 Pr = 0.470

```
. tabulate Off_farm_income_parti CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

OFFINCOME	CSPM 0	1	Total
No	56 29.17	16 29.63	72 29.27
Yes	136 70.83	38 70.37	174 70.73
Total	192 100.00	54 100.00	246 100.00

Pearson chi2(1) = 0.0044 Pr = 0.947

Chi square statistics results for categorical explanatory variables used in the study

```
. tabulate Own_transport CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

TSPOTOWN	CSPM 0	1	Total
No	181	42	223
	94.27	77.78	90.65
Yes	11	12	23
	5.73	22.22	9.35
Total	192	54	246
	100.00	100.00	100.00

Pearson chi2(1) = 13.5269 Pr = 0.000

```
. tabulate Own_storage CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

STRGEOWN	CSPM 0	1	Total
No	111	12	123
	57.81	22.22	50.00
Yes	81	42	123
	42.19	77.78	50.00
Total	192	54	246
	100.00	100.00	100.00

Pearson chi2(1) = 21.3542 Pr = 0.000

```
. tabulate Group_membership_potato CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

GRPMEMBER	CSPM 0	1	Total
No	137	20	157
	71.35	37.04	63.82
Yes	55	34	89
	28.65	62.96	36.18
Total	192	54	246
	100.00	100.00	100.00

Pearson chi2(1) = 21.4962 Pr = 0.000

Chi square statistics results for categorical explanatory variables used in the study

```
. tabulate accessseed CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

accessseed	CSPM 0	1	Total
0	175 91.15	31 57.41	206 83.74
1	17 8.85	23 42.59	40 16.26
Total	192 100.00	54 100.00	246 100.00

```
          Pearson chi2(1) =  35.2332   Pr = 0.000

. tabulate Participation_contract_farming CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

CNTRCTFMPAT	CSPM 0	1	Total
No	169 88.02	36 66.67	205 83.33
Yes	23 11.98	18 33.33	41 16.67
Total	192 100.00	54 100.00	246 100.00

```
          Pearson chi2(1) =  13.8375   Pr = 0.000

. tabulate Selling_place CSPM, chi2 column matcell(percentage)
```

Key
frequency *column percentage*

SELLPOINT	CSPM 0	1	Total
Market	21 10.94	14 25.93	35 14.23
Neigbours	12 6.25	15 27.78	27 10.98
Farmgate	140 72.92	23 42.59	163 66.26
N/A	19 9.90	2 3.70	21 8.54
Total	192 100.00	54 100.00	246 100.00

```
          Pearson chi2(3) =  32.1932   Pr = 0.000

.
```

Factor analysis reliability test

```
.alpha            PK_know_partner_markets            PK_know_partners_services_and_pr
PK_know_patner_weaknessand_strenRS_haveability_tobuild_re>lationsRS_deal_flexible_w
ith_partnersRS_solve_problems_with_patnersIC_holds_regular_meetings_with_eIC_employ
ees_devel>op_contacts_amIC_often_givefeedback_toemployeeBNR_can_constantly_opento_n
ew_reBNR_haveability_tointiate_mutualBNR_hav>e_eyes_opento_newpatnersCS_analyses_wh
atyou_want_toachieCS_develop_relationship_basedon_   CS_discuss_regularlywith_partn>
er

Test scale = mean(unstandardized items)
Average interitem covariance:     .3367353
Number of items in the scale:           15
Scale reliability coefficient:      0.8983

.factortestPK_know_partner_marketsPK_know_partners_services_and_pr
PK_know_patner_weaknessand_stren                                  RS_haveability_tobui>
ld_relationsRS_deal_flexible_with_partnersRS_solve_problems_with_patnersIC_holds_re
gular_meetings_with_eIC_employees_>develop_contacts_amIC_often_givefeedback_toemplo
yeeBNR_can_constantly_opento_new_reBNR_haveability_tointiate_mutualBN>R_have_eyes_o
pento_newpatnersCS_analyses_whatyou_want_toachieCS_develop_relationship_basedon_
CS_discuss_regularlywith_> partner
Determinant of the correlation matrix
Det                =     0.001
Bartlett test of sphericity
Chi-square         =          1735.754
Degrees of freedom =               105
p-value            =             0.000
H0: variables are not intercorrelated
Kaiser-Meyer-Olkin Measure of Sampling Adequacy
KMO                =     0.903
```

Pair-wise correlation test

```
. corr PK_know_partner_markets PK_know_partners_services_and_pr PK_know_patner_weaknessand_stren RS_haveability_tobuild_rel
> ations RS_deal_flexible_with_partners RS_solve_problems_with_patners IC_holds_regular_meetings_with_e IC_employees_develo
> p_contacts_am IC_often_givefeedback_toemployee BNR_can_constantly_opento_new_re BNR_haveability_tointiate_mutual BNR_have
> _eyes_opento_newpatners CS_analyses_whatyou_want_toachie CS_develop_relationship_basedon_ CS_discuss_regularlywith_partne
> r
(obs=246)
```

	PK_kno~s	PK_kno~r	PK_kno~n	RS_hav~s	RS_dea~s	RS_sol~s	IC_hol~e	IC_emp~m	IC_oft~e	BNR_ca~e	BNR_ha~l	BNR_ha~s
PK_know_pa~s	1.0000											
PK_know_pa~r	0.5939	1.0000										
PK_know_pa~n	0.4041	0.4895	1.0000									
RS_haveabi~s	0.4357	0.3506	0.2823	1.0000								
RS_deal_fl~s	0.4144	0.3662	0.3233	0.5352	1.0000							
RS_solve_p~s	0.3499	0.3569	0.1878	0.4721	0.5644	1.0000						
IC_holds_r~e	0.2949	0.3405	0.2471	0.2892	0.3175	0.3427	1.0000					
IC_employe~m	0.2254	0.2077	0.2430	0.3473	0.3710	0.3464	0.5653	1.0000				
IC_often_g~e	0.2389	0.2732	0.2651	0.2973	0.4084	0.3823	0.5099	0.5979	1.0000			
BNR_can_co~e	0.2379	0.2755	0.2670	0.3633	0.3770	0.3022	0.3036	0.3226	0.4051	1.0000		
BNR_haveab~l	0.3568	0.3543	0.2417	0.4082	0.5215	0.4317	0.3055	0.3430	0.4435	0.6870	1.0000	
BNR_have_e~s	0.2346	0.2456	0.1633	0.3429	0.4604	0.3938	0.3484	0.3834	0.4998	0.5464	0.6704	1.0000
CS_analyse~e	0.2833	0.3077	0.2381	0.4572	0.4589	0.4304	0.3858	0.4817	0.5128	0.4004	0.5194	0.5696
CS_develop~_	0.2970	0.3038	0.2548	0.4863	0.4630	0.3920	0.3431	0.4060	0.4833	0.4006	0.5255	0.4872
CS_discuss~r	0.3189	0.2502	0.2835	0.4549	0.5204	0.3371	0.3292	0.4093	0.4524	0.4055	0.5198	0.4329

	CS_ana~e	CS_dev~_	CS_dis~r
CS_analyse~e	1.0000		
CS_develop~_	0.6530	1.0000	
CS_discuss~r	0.5549	0.6672	1.0000

Factor rotation and loadings

```
Factor analysis/correlation                       Number of obs    =        246
    Method: principal-component factors           Retained factors =          3
    Rotation: orthogonal varimax (Kaiser on)      Number of params =         42

    ------------------------------------------------------------------------------
         Factor  |      Variance   Difference        Proportion   Cumulative
    -------------+----------------------------------------------------------------
        Factor1  |       4.29872      1.77422            0.2866       0.2866
        Factor2  |       2.52450      0.18624            0.1683       0.4549
        Factor3  |       2.33826            .            0.1559       0.6108
    ------------------------------------------------------------------------------
LR test: independent vs. saturated: chi2(105) = 1743.01 Prob>chi2 = 0.0000
```

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
PK_know_pa~s	0.2125	0.7943	0.0642	0.3197
PK_know_pa~r	0.1633	0.8068	0.1308	0.3053
PK_know_pa~n	0.0785	0.6889	0.1913	0.4826
RS_haveabi~s	0.5285	0.4605	0.1099	0.4966
RS_deal_fl~s	0.6020	0.4278	0.1603	0.4288
RS_solve_p~s	0.4838	0.3718	0.2202	0.5792
IC_holds_r~e	0.1419	0.2620	0.7786	0.3051
IC_employe~m	0.2691	0.1128	0.8112	0.2569
IC_often_g~e	0.4138	0.1056	0.7088	0.3152
BNR_can_co~e	0.7024	0.1252	0.1170	0.4773
BNR_haveab~l	0.8250	0.1935	0.0942	0.2731
BNR_have_e~s	0.7594	0.0216	0.2547	0.3580
CS_analyse~e	0.6552	0.1422	0.4081	0.3839
CS_develop~_	0.6847	0.1757	0.3084	0.4052
CS_discuss~r	0.6577	0.1935	0.2802	0.4515

Ordered logistic regression

VIF results for continuous variables used in ordered logit regression

Variable	VIF	1/VIF
CS	2.05	0.487420
BNR	1.92	0.521000
ICM	1.82	0.550092
accesseed	1.62	0.619050
PKW	1.59	0.628152
Times_of_i~t	1.52	0.659869
Group_memb~o	1.39	0.718728
Participat~g	1.28	0.780524
Age_hhh	1.21	0.825262
lnAmoutcre~d	1.19	0.839637
Level_of_e~n	1.18	0.847643
HH_Size	1.14	0.879014
Own_storage	1.12	0.893349
Off_farm_i~i	1.11	0.897695
Own_transp~t	1.11	0.902437
Landowners~e	1.10	0.907181
Gender	1.10	0.909230
potatoslan~o	1.08	0.924166
Mean VIF	1.36	

Pair-wise correlation for variables used in ordered logit regression

```
. pwcorr Gender Landownershiptype Off_farm_income_parti Own_transport Own_stora
> ge Group_membership_potato Participation_contract_farming accesseed
```

	Gender	Landow~e	Off_fa~i	Own_tr~t	Own_st~e	Group_~o	Partic~g
Gender	1.0000						
Landowners~e	0.0791	1.0000					
Off_farm_i~i	-0.0270	0.1026	1.0000				
Own_transp~t	-0.0453	0.0020	0.1145	1.0000			
Own_storage	0.0868	-0.0250	-0.0179	0.0419	1.0000		
Group_memb~o	-0.1094	-0.0157	-0.0177	0.1069	0.0423	1.0000	
Participat~g	-0.0155	0.0484	-0.0000	0.1186	0.1418	0.3443	1.0000
accesseed	-0.0234	0.0714	0.0105	0.1763	0.0081	0.3516	0.2436

	access~d
accesseed	1.0000

White test for Heteroskedasticity for ordered logit regression

```
. imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(181)     =    179.38
         Prob > chi2   =    0.5200

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	179.38	181	0.5200
Skewness	61.85	18	0.0000
Kurtosis	0.02	1	0.8797
Total	241.26	200	0.0245

Brant test of parallel regression assumption for ordered logit regressi

Brant test of parallel regression assumption

	chi2	p>chi2	df
All	17.96	0.995	36
Gender	4.18	0.124	2
Landownershiptype	0.68	0.713	2
Off_farm_income_parti	6.95	0.031	2
Own_transport	5.07	0.079	2
Own_storage	11.24	0.004	2
Group_membership_potato	2.34	0.311	2
Participation_contract_farming	8.24	0.016	2
accesseed	7.91	0.019	2
potatoslandratio	3.15	0.207	2
lnAmoutcreditaccessed	21.81	0.000	2
CS	0.36	0.834	2
BNR	2.45	0.294	2
PKW	6.76	0.034	2
ICM	0.02	0.990	2
Age_hhh	3.54	0.171	2
HH_Size	1.87	0.392	2
Level_of_education	6.42	0.040	2
Times_of_interaction_with_extent	1.73	0.421	2

A significant test statistic provides evidence that the parallel regression assumption has been violated.

Ordered logit regression results (odds ratio)

```
. ologit Stage_of_change Gender Age_hhh HH_Size Landownershiptype potatoslandratio Level_
> of_education Off_farm_income_parti Own_transport Own_storage accesseed lnAmoutcreditacc
> essed Group_membership_potato Participation_contract_farming Times_of_interaction_with_
> extent ICM PKW BNR CS,or

Iteration 0:   log likelihood = -290.37832
Iteration 1:   log likelihood = -199.59993
Iteration 2:   log likelihood = -192.15072
Iteration 3:   log likelihood = -192.00133
Iteration 4:   log likelihood = -192.00101
Iteration 5:   log likelihood = -192.00101

Ordered logistic regression                     Number of obs     =        246
                                                LR chi2(18)       =     196.75
                                                Prob > chi2       =     0.0000
Log likelihood = -192.00101                     Pseudo R2         =     0.3388
```

Stage_of_change	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Gender	1.82391	.6281571	1.75	0.081	.9286422	3.58227
Age_hhh	1.000042	.0124551	0.00	0.997	.975926	1.024754
HH_Size	.8489084	.0619122	-2.25	0.025	.7358365	.9793554
Landownershiptype	1.124562	.3681964	0.36	0.720	.5919548	2.136377
potatoslandratio	3.228012	2.188626	1.73	0.084	.8546961	12.19154
Level_of_education	1.16694	.0484377	3.72	0.000	1.075763	1.265844
Off_farm_income_parti	1.272494	.4561131	0.67	0.501	.6303054	2.56898
Own_transport	3.498732	1.915636	2.29	0.022	1.19635	10.23206
Own_storage	2.755723	.89878	3.11	0.002	1.454172	5.22222
accesseed	10.13816	3.875848	6.06	0.000	4.792283	21.44746
lnAmoutcreditaccessed	1.040668	.0364529	1.14	0.255	.971619	1.114624
Group_membership_pot~o	1.80599	.6207563	1.72	0.085	.9207456	3.542346
Participation_contra~g	.8458457	.3730406	-0.38	0.704	.3563597	2.007677
Times_of_interaction~t	1.126048	.1106555	1.21	0.227	.9287744	1.365223
ICM	.7447227	.161592	-1.36	0.174	.4867417	1.139438
PKW	4.058105	1.033222	5.50	0.000	2.463776	6.684135
BNR	.8178127	.261483	-0.63	0.529	.4370139	1.530426
CS	1.195772	.3822099	0.56	0.576	.6391091	2.237287
/cut1	7.875164	1.572606			4.792913	10.95742
/cut2	9.137286	1.608246			5.985182	12.28939
/cut3	10.19028	1.641187			6.973614	13.40695

Note: Estimates are transformed only in the first equation.

Ordered logit regression results (coefficients)

```
. ologit Stage_of_change Gender Age_hhh HH_Size Landownershiptype potatoslandratio Level_
> of_education Off_farm_income_parti Own_transport Own_storage accesseed lnAmoutcreditacc
> essed Group_membership_potato Participation_contract_farming Times_of_interaction_with_
> extent ICM PKW BNR CS

Iteration 0:   log likelihood = -290.37832
Iteration 1:   log likelihood = -199.59993
Iteration 2:   log likelihood = -192.15072
Iteration 3:   log likelihood = -192.00133
Iteration 4:   log likelihood = -192.00101
Iteration 5:   log likelihood = -192.00101

Ordered logistic regression                     Number of obs     =        246
                                                LR chi2(18)       =     196.75
                                                Prob > chi2       =     0.0000
Log likelihood = -192.00101                     Pseudo R2         =     0.3388
```

Stage_of_change	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Gender	.6009825	.3444014	1.75	0.081	-.0740317	1.275997
Age_hhh	.0000421	.0124546	0.00	0.997	-.0243685	.0244527
HH_Size	-.163804	.0729316	-2.25	0.025	-.3067473	-.0208607
Landownershiptype	.1173933	.3274133	0.36	0.720	-.524325	.7591116
potatoslandratio	1.171867	.6780104	1.73	0.084	-.1570093	2.500742
Level_of_education	.1543847	.0415083	3.72	0.000	.0730299	.2357395
Off_farm_income_parti	.240979	.3584402	0.67	0.501	-.4615508	.9435089
Own_transport	1.2524	.547523	2.29	0.022	.179275	2.325526
Own_storage	1.01368	.3261504	3.11	0.002	.3744367	1.652923
accesseed	2.316307	.3823028	6.06	0.000	1.567007	3.065606
lnAmoutcreditaccessed	.0398629	.0350284	1.14	0.255	-.0287916	.1085173
Group_membership_pot~o	.5911089	.3437208	1.72	0.085	-.0825715	1.264789
Participation_contra~g	-.1674183	.4410267	-0.38	0.704	-1.031815	.6969782
Times_of_interaction~t	.1187141	.0982689	1.21	0.227	-.0738894	.3113177
ICM	-.2947433	.2169828	-1.36	0.174	-.7200217	.1305351
PKW	1.400716	.2546071	5.50	0.000	.9016953	1.899737
BNR	-.2011219	.3197346	-0.63	0.529	-.8277902	.4255463
CS	.178792	.3196345	0.56	0.576	-.4476801	.805264
/cut1	7.875164	1.572606			4.792913	10.95742
/cut2	9.137286	1.608246			5.985182	12.28939
/cut3	10.19028	1.641187			6.973614	13.40695

Fractional Regression Results

Fractional regression results (coefficients)

```
. fracreg logit HCI Gender Age_hhh HH_Size Level_of_education Landownershiptype potatosla
> ndratio Off_farm_income_parti logbagsharvested Selling_place Own_transport Own_storage
> Group_membership_potato accesseed lnAmoutcreditaccessed ICM PKW BNR CS

Iteration 0:   log pseudolikelihood = -35.887237
Iteration 1:   log pseudolikelihood = -29.461942
Iteration 2:   log pseudolikelihood = -29.284937
Iteration 3:   log pseudolikelihood = -29.284482
Iteration 4:   log pseudolikelihood = -29.284482

Fractional logistic regression                  Number of obs     =         54
                                                Wald chi2(18)     =      71.04
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -29.284482               Pseudo R2         =     0.2175
```

HCI	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
Gender	-.2297905	.3172657	-0.72	0.469	-.8516199	.392039
Age_hhh	.023958	.0136152	1.76	0.078	-.0027272	.0506432
HH_Size	.1321243	.0581796	2.27	0.023	.0180943	.2461542
Level_of_education	.0967634	.0438434	2.21	0.027	.010832	.1826949
Landownershiptype	-.2087702	.3817267	-0.55	0.584	-.9569409	.5394004
potatoslandratio	.6609459	.8860689	0.75	0.456	-1.075717	2.397609
Off_farm_income_parti	.4838876	.3900804	1.24	0.215	-.280656	1.248431
logbagsharvested	.9940302	.3639052	2.73	0.006	.2807891	1.707271
Selling_place	-1.323702	.3910151	-3.39	0.001	-2.090078	-.5573269
Own_transport	-1.043165	.8827911	-1.18	0.237	-2.773404	.6870739
Own_storage	.0682921	.3192832	0.21	0.831	-.5574915	.6940757
Group_membership_pot~o	-.6058127	.4766495	-1.27	0.204	-1.540029	.3284032
accesseed	.6764895	.3836783	1.76	0.078	-.0755062	1.428485
lnAmoutcreditaccessed	-.1087726	.0519678	-2.09	0.036	-.2106275	-.0069176
ICM	.0681149	.3114927	0.22	0.827	-.5423996	.6786294
PKW	-.0958948	.2405455	-0.40	0.690	-.5673554	.3755658
BNR	-.4528911	.2962625	-1.53	0.126	-1.033555	.1277728
CS	.6589888	.4544852	1.45	0.147	-.2317858	1.549763
_cons	-2.090039	1.869821	-1.12	0.264	-5.75482	1.574742

Fractional regression results (marginal effects)

```
. mfx

Marginal effects after fracreg
      y  = Conditional mean of HCI (predict)
         =  .49926158
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
Gender*	-.0573845	.07906	-0.73	0.468	-.212336	.097567	.518519
Age_hhh	.0059895	.0034	1.76	0.078	-.000681	.01266	51.2593
HH_Size	.033031	.01455	2.27	0.023	.004521	.061541	5.7963
Level_~n	.0241908	.01096	2.21	0.027	.002709	.045673	9.92593
Landow~e*	-.0521432	.09517	-0.55	0.584	-.238663	.134377	.574074
potato~o	.1652361	.22152	0.75	0.456	-.268943	.599415	.320196
Off_fa~i*	.1202201	.09598	1.25	0.210	-.067889	.308329	.648148
logbag~d	.248507	.09097	2.73	0.006	.070212	.426802	1.96264
Sellin~e	-.3309249	.09777	-3.38	0.001	-.522549	-.139301	3
Own_tr~t*	-.2424718	.17784	-1.36	0.173	-.591039	.106095	.055556
Own_st~e*	.0170713	.0798	0.21	0.831	-.139327	.17347	.425926
Group_~o*	-.1492339	.11376	-1.31	0.190	-.372196	.073728	.222222
a~esseed*	.1674794	.09304	1.80	0.072	-.014866	.349825	.444444
lnAmou~d	-.0271931	.01299	-2.09	0.036	-.052658	-.001728	1.43371
ICM	.0170287	.07787	0.22	0.827	-.135597	.169654	3.76554
PKW	-.0239736	.06014	-0.40	0.690	-.141843	.093896	3.18576
BNR	-.1132225	.07406	-1.53	0.126	-.258382	.031937	4.11752
CS	.1647468	.11362	1.45	0.147	-.057953	.387447	4.24775

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix D: Publication

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ROLE OF NETWORKING CAPABILITY, SOCIO-ECONOMIC AND INSTITUTIONAL CHARACTERISTICS ON ADOPTION TENDENCIES OF *CLEAN SEED* POTATO AGRI-ENTERPRISES IN CENTRAL RIFT VALLEY, KENYA

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ABSTRACT

Even though quality of seed is a major yield determinant in potato (*Solanum tuberosum* L.) production and global food security, inadequate availability of and access to high quality (certified) seed is a major challenge to potato producers in Sub-Saharan Africa. The objective of this study was to examine farmer's adoption tendency towards decentralised *clean seed* potato multiplication agri-enterprise (CSPMAE) in Central Rift Valley, Kenya, which aids in implementation of stage matched entrepreneurial interventions. A cross-sectional survey was conducted using a semi-structured questionnaire on 54 seed potato producers and 192 non-seed potato producers, through multistage sampling. Ordered logistic regression analysis, based on the trans-theoretical model, revealed that household head, partner knowledge, gender, land size allocated for potato production, level of education, ownership of transport and/or storage facilities, frequency of interaction with certified seed potato producers and agricultural extension officers influenced adoption tendencies of CSPMAE, positively and significantly. Seed potato value chain stakeholder platforms, development workers and donors should prioritise their support for *clean seed* agri-enterprises to farmers with such traits. This is likely to lead to increased supply of access to *clean seed,* thereby improving potato yields in Kenya.

Key Words: *Solanum tuberosum,* stakeholder platforms, Sub-Saharan Africa