EFFECT OF ENTREPRENEURIAL COMPETENCY AND AGRIENTERPRISE FARM CAPABILITY ON PERFORMANCE OF SMALLHOLDER IRISH POTATO FARMERS IN NYANDARUA COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Master of Science Degree in Agribusiness Management of Egerton University

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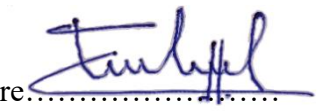
DECLARATION AND RECOMMENDATION

This thesis is my original work and has not been presented in this university or any other for the award of a degree.

Signature  ..... Date: 16/09/2024

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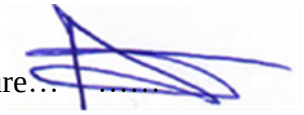
Signature  ..... Date: 16/09/2024

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DEDICATION

This thesis is dedicated to my lovely parents, siblings, all my friends and mentors for their support and prayers.

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ABSTRACT

Increase in agricultural productivity and profits are some of the key drivers in Irish potato farming and therefore is a clear priority for smallholder farmers. Yet little is known about how entrepreneurial competencies and agrienterprise farm capabilities may be linked with Irish potato productivity. Thus, this study sought to fill this knowledge gap by; exploring the levels and determining factors influencing entrepreneurial competencies and agrienterprise farm capabilities of smallholder Irish potato farmers in Nyandarua County, Kenya. The study also sought to determine the effect of entrepreneurial competencies and agrienterprise farm capabilities on farm performance. Data was collected through multistage sampling by cross sectional survey using a sample of 249 smallholder Irish potato farmers. The three objectives were analysed using Principal Component Analysis, Multivariate Multiple Regression and Structural Equation Modelling. Based on the findings, entrepreneurial competencies that were found to be exhibited by the farmers ranked from the highest to lowest in terms of levels possessed are as follows; personal strength competency (83%), relationship competency (73%), strategic competency (69%) and finally, opportunity competency (47%). It can be concluded that most farmers were not opportunity driven. With regards to profiling farmers' farm capabilities ranked from the highest to lowest in terms of levels possessed; the highest exhibited capability was networking capability (71%) followed by, technology management capability (60%) followed by, market linking capability (53%) and finally, technology integration capability (47%) and marketing capability (47%). It can be concluded that farmers did not adopt new technologies in Irish potato production and were not proactive in marketing. Findings identified factors that influence development of entrepreneurial competencies as; attending entrepreneurship trainings, produce price, accessing government extension, accessing private extension, mechanizing production and, direct selling of produce at local market and non-local market. Finally, the results reveal that agrienterprise farm capabilities; technology management, market linking and, technology integration fully mediate the relationship between entrepreneurial competencies and performance. The study recommended offering agribusiness capacity building and support services to smallholder Irish potato farmers which emphasise on marketing, technology adoption and mechanization.

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Over 800,000 farmers, mostly smallholder farmers, cultivate Irish potatoes in Kenya (National Potato Council of Kenya, 2021). Thus, Irish potatoes are regarded as a very important crop in Kenya because its production provides a source of livelihood to a large number of rural households as it directly employs many smallholder farmers in addition to farm workers. The main focus of majority of potato producers is selling it for cash (Kwambai et al., 2023). Twenty of Kenya's 47 counties—located on the slopes of Mount Kenya, the Aberdare ranges, the Mt. Kilimanjaro region, the Rift valley, and certain areas of Nyanza, the western region, and the coastal regions—grow potatoes (Muthoni *et al*., 2017). According to USAID-KAVES (2015), Kenya's top potato-producing counties are Nyandarua, Meru, Nakuru, Narok, Bomet, Bungoma, West Pokot, and Elgeyo Marakwet. Irish potatoes are heavily commercialized along the entire value chain and because of this, Irish potato production also provides innumerable auxiliary employment opportunities since it generates employment for approximately 3.3 million people (Ministry of Agriculture, Livestock and Fisheries, 2016).

The relevance of Irish potatoes in Kenya is further attributed to the crucial role the crop plays in food security. According to Mwakidoshi *et al.* (2021), to reduce food insecurity in underdeveloped nations like Kenya, Irish potato is seen to be the most practical crop. In addition to acting as a vital food crop cooked in Kenyan households, the popularity of the crop is induced by its versatility, because it provides raw materials for diverse industries. This is seen through many large manufacturing enterprises entering the market to process crisps and other value-added products. According to estimates, Kenya has 200 local processors with a daily capacity of more than 217.7 tonnes of Irish potatoes (Wakaba *et al.*, 2022).

In contrast to the elaborated significance of Irish potatoes in Kenya, the smallholder farmers engaged in Irish potato production are persistently encumbered with challenges that limit the performance of the crop. For instance, Kenya produced 1.5 million tons of potatoes in 2017; by 2021, that amount had climbed by 40% (Machangi *et al*., 2016). In recent years, there has been a drop of six to ten metric tons per hectare in the yield per unit area, despite an increase in total production (Machangi *et al*., 2016). In the same way, even though the nation's total potato output has increased, there is a mismatch between the supply and demand for potatoes grown for processing. Kenya's domestic demand is approximately 3.1 million tons, while there are 2.8 million tons accessible for use (Wakaba *et al*., 2022).

Taiy *et al*. (2017), attributes the low production to various agronomic, institutional and marketing causes. Poor husbandry techniques are used by Irish potato growers, including poor-quality seed which limits productivity and tolerance to shocks, and lack of adequate technical knowledge on Irish potato management (Kwambai *et al*., 2023). Production is predominantly rain fed leading to supply and demand fluctuations due to bimodal rainfall patterns in the majority of Irish potato growing regions. Despite this seasonal output, there is a lack of on-farm Irish potato storage (Taiy *et al*., 2017). Farmers also contend with decline soil fertility, high incidence of pests and diseases, a disorganized marketing system, inadequate packing regulations and outdated technologies (Gebru *et al*., 2017). This causes supply to be unstable, which in turn leads to cyclic prices. Low prices then translate into low profits, huge losses, all of which result in intentional reduced production among Irish potato farmers (Chepkoech, 2022).

Focusing on enhancing Irish potato farmers' entrepreneurial competency, provides a plausible pathway to addressing the challenges facing Irish potato farmers and thus improving performance. Agbolosoo (2021) asserts that the failure of smallholder farmers to adopt improved seed varieties can be directly attributed to their lack of entrepreneurial skills and willingness to take the risk of experimenting with better combinations and production methods otherwise referred to as agrienterprise farm capabilities. Instead, these farmers prefer to use their farmer-saved seeds, which frequently result in low yields and increased pest and disease infestation. Little is known about the entrepreneurial competency of smallholder Irish potato farmers in Kenya, since previous research has hardly linked the poor performance of Irish potato farming to entrepreneurial attitude and abilities (Agbolosoo, 2021). In light of this, the present study sought to fill this gap in knowledge by appraising the nexus of entrepreneurial competency, agrienterprise firm capability and, performance of smallholder Irish potato farmers.

Competency refers to the capacity to reliably solve problems under a variety of conditions, and this capacity is based on attitudes, knowledge, and skills (Tittel & Terzidis, 2020). Entrepreneurs must react promptly to any changes in the business environment in order to lessen the negative effects of difficult business situations and in achieving this, entrepreneurial competencies are crucial (Adeyonu *et al.,* 2022; Sher *et al.,* 2019) reports that farmers' entrepreneurial competency is crucial for improving performance in terms of possible market location and quick delivery of food commodities. Farmers' entrepreneurial competency is essential for increasing their output in sustainable agricultural development through increased household food and financial security (Opolot *et al*., 2018). This is because

farmers with entrepreneurial skills are empowered to have better access to markets and may sell their crops for higher prices, which boosts their revenue (Arellano & Reyes, 2019). According to several studies (Donkor *et al*., 2018; Eikelenboom & De Jong, 2019; Maldonado-Guzmán *et al*., 2019), there is evidence that there is a strong and positive association between firm capabilities and firm performance. Additionally, the resource-based view (RBV) extension theory known as dynamic capabilities claims that business owners' and/or managers' entrepreneurial competency play a crucial strategic role in building firm capacities and enhancing performance (Ringov, 2017; Teece, 2014). Hence, entrepreneurial competency is essential for building firm capabilities, which afterwards translates to better performance (Eisenhardt & Martin, 2000).

Therefore, entrepreneurial competency and agrienterprise farm capability can play a strategic role in alleviating the challenges of smallholder farmers in the Irish potato value chain. In spite of this, entrepreneurial competency and agrienterprise firm capability have received limited research focus in the context the Kenyan Irish potato value chain. In consideration of this knowledge gap, this study evaluated the effect of entrepreneurial competency and agrienterprise farm capability on performance measured in form of annual productivity of smallholder Irish potato farmers. Specifically, the study focused on Nyandarua County which contributes about 33% of the total Irish potato produced in Kenya (Nyandarua County Government, 2017).

In Nyandarua County, potatoes are a major industry that make significant contributions to employment, income generation, and food security. In Nyandarua County, the potato value chain provides direct and indirect livelihood to 131,697 farming families. The value of the potatoes grown in the County is more than KES 7.0 billion. The crop, which is the county's second-most important agricultural commodity after dairy, is confronted with numerous constraints across its value chain, which has caused average yields to be just 8 to 10 tons per hectare, far less than the achievable levels of 20 to 40 tons per hectare.

The primary obstacles are as follows: systems for seed potatoes with minimal functionality that restrict the availability of high-quality seed potatoes, inadequate methods of production for potatoes, both in seed and ware potatoes, prevalence of diseases and pests, Reduced labour availability combined with minimal mechanization Poor or non-existent grading sheds, collecting centres, rural access roads, marketplaces, and storage facilities are examples of inadequate infrastructure development, Poor policy and low levels of regulatory implementation throughout the value chain, particularly in relation to manufacturing and marketing. Furthermore, because of the Shangi variety's early maturation, brief dormancy,

and market preference among conventional customers, it has become the dominant variety and there is an established overreliance on it. This, however, prevents farmers from selling to other premium market outlets, including fast food chains, who favour different varieties (Nyandarua County Government, 2017).

1.2 Statement of the Problem

In Kenya, the productivity of Irish potato growers is crucial to the development of jobs, food security, and the reduction of poverty. Numerous initiatives have been launched in an attempt to boost the rural Irish potato agribusiness's productivity. These ranges from improved planting materials to training on improved agronomic practices. However, smallholder farmers are still facing challenges related to marketing of their Irish potatoes. Improved entrepreneurial competency and agrienterprise farm capability could enhance the performance of smallholder Irish potato farmers. Previous studies have shown an association between entrepreneurial competency and agrienterprise farm capability on performance, whereby these attributes increase the profitability of farmers. Nevertheless little of this research, principally in smallholder Irish potato farmers' context, has been conducted in Kenya. Hence, this study sought to bridge this knowledge gap by evaluating the effect of entrepreneurial competency and agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya

1.3 General Objective

To contribute to improved food security through showing the contribution entrepreneurial competency and farm capability of smallholder Irish potato farmers in Nyandarua County, Kenya.

1.3.1 Specific Objectives

i. To explore the entrepreneurial competencies and agrienterprise farm capabilities of smallholder Irish potato farmers in Nyandarua County, Kenya.
ii. To identify factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya
iii. To determine the effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya.

1.4 Research Questions

i. What are the entrepreneurial competencies and agrienterprise farm capabilities among smallholder Irish potato farmers in Nyandarua County, Kenya?
ii. What are the factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya?
iii. What is the effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya?

1.5 Justification of the Study

Focus on the Irish potato agricultural sector is pertinent due to the immense role and potential is has in food security, rural poverty reduction, employment creation and industrialization. Thus, achievement of the national goals of Vision 2030 of improving nutritional security enhancing food security, generating employment, and raising incomes, can be considerably aided by the production of Irish potatoes. However, the Irish potato sector is encumbered with institutional, agronomic and marketing challenges that inhibit the optimal exploitation of production and industrialization potential of the sector. Enhanced farmer entrepreneurial competency and firm capabilities have been established to empower farmers in addressing their production challenges as well as in exploring alternative more lucrative marketing strategies. In this regard, evaluating smallholder Irish potato farmers' entrepreneurial competency and firm capabilities is relevant to the development of the Irish potato sector. This is because through enhancing farmers' entrepreneurial competency and firm capability, farmers will be empowered to adopt improved agronomic practices, such as the use of quality planting materials which translate to increased effectiveness and efficiency of their farm and market activities. Moreover, the entrepreneurial farmers will understand the importance of value chain collaboration and thus they are better poised to conduct collective marketing. Further, the importance of focusing on farmers' entrepreneurial competency and firm capabilities is amplified by the Kenya National Irish potato Strategy 2021-2025 which places emphasis on; post-harvest management, value addition and marketing, enhancing import, export and trade of Irish potato and its value-added products and, making the industry more vibrant, innovative and commercially oriented. By focusing on improving smallholder Irish potato farmers' enhanced profitability, the study was in line with Kenya's Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019-2029. The Agricultural Sector Transformation and Growth Strategy has three anchors to drive Kenya's 10-year

transformation which include; Boosting household food resilience, Increasing small-scale farmer incomes' and, increasing agricultural output and value addition,. This study also contributes in the achievement of UN sustainable development goals (SDGs) of poverty reduction by focusing on increasing smallholder Irish potato farmer profitability. The agriculture sector is key to Sustained reduction in poverty in developing countries. Consequently, the agriculture sector's expansion and development are essential to reaching the poverty eradication objectives (SDG 1: No poverty and SDG 8: Decent Work and Economic Growth). The focus of the study on improved smallholder farmer profitability was also in line with the Comprehensive African Agricultural Development Programme (CAADP) Agenda 2063. Through agriculture-led development, the CAADP is a continental effort that seeks to help African nations reduce poverty and end hunger by boosting economic growth.

1.6 Scope and Limitations of the Study

This study focused on the effect of entrepreneurial competency and agrienterprise farm capability on performance of smallholder Irish potato farmers. The study relied on recall because the majority of smallholder farmers did not maintain agricultural records. To overcome the recall limitation, the study only collected data on potato production and marketing from the previous production year.

1.7 Operational Definition of Terms

Agrienterprise farm capability - a specific set of behaviours, procedures, and routines which can be possessed by organizations that are intended to investigate, incorporate, and take advantage of untapped business prospects within a defined market setting. This study specifically focused on the following indicators of agrienterprise farm capability; Technology management capability, Technology integration capability, Networking capability, Market linking capability and Marketing capability.

Entrepreneurial competency - a broad range of attitudes, knowledge, and skills that enable an individual to identify and pursue agribusiness possibilities. This study focused on the following indicators of entrepreneurial competency; Opportunity competencies, Relationship competencies, Strategic competencies and Personal strength competencies.

Irish potato productivity – kilogrammes of Irish potato harvested per acre

Market attributes – market conditions in which the agrienterprise operates

Market linking capabilities - abilities in maintaining consumers, building strong partnerships with wholesalers and retailers, and managing and creating long-lasting relationships with customers and suppliers.

Marketing capabilities capacity to include understanding of the company's target market and clients, integrating marketing efforts, segmenting and targeting expertise, and pricing and market research efficacy.

Networking capabilities – ability to continuously share information between individuals with similar interests and incorporation information communication technology in the process.

Opportunity competency – the capacity to identify the products and services that consumers want, to recognize their unmet needs, to seize true opportunities, and to provide the greatest value to consumers

Organizational attributes – characteristics of the agrienterprise farm

Performance – Result from Irish potato production activities. This study will consider Irish potato productivity as a non-financial performance indicator.

Personal attributes – characteristics of the smallholder Irish potato farmer

Personal strength competencies – the capacity for self-motivation, self-evaluation and self-driven personal development.

Relationship competency - the ability to manage an organization's many internal and external resources, including its financial, technological, human, and physical assets, while also creating teams, leading and directing employees, and training and managing persons

Smallholder Irish potato farmer – farmer producing Irish potatoes between 0.5 and 5 hectares of land

Strategic competency - the capacity to bring into line current activities with business goals and to forecast future directions and aligning plans based on how the changes may affect the organization

Technological integration capabilities – abilities in adoption and development of new working methods to facilitate process effective production and marketing

Technological management capabilities – abilities in adaption of new working methods to facilitate process effective production and marketing

CHAPTER TWO
LITERATURE REVIEW

Introduction

This chapter presents literature review on trends, production systems and productivity of Kenya Irish potato Agricultural sub-sector, concept of entrepreneurial competency, concept of agrienterprise farm capability, the integrative relationship of entrepreneurial competencies on performance as mediated by agrienterprise farm capabilities and factors Influencing entrepreneurial competency. The chapter also discusses the theoretical underpinning of the study and presents the study's conceptual framework.

2.1 Trends, Production Systems and Productivity of Kenya Irish potato Agricultural Sub-sector

In Kenya, Irish potatoes are regarded as a particularly significant crop since it provides a direct source of livelihood for many rural households. In the country, Irish potatoes are grown by over 800,000 farmers, most of whom are smallholder farmers (National Potato Council of Kenya, 2021). Indirectly, 3.3 million people are employed in the Kenyan Irish potato value chain (Ministry of Agriculture, Livestock and Fisheries, 2016), including market agents, transporters, vendors, processors and retailers (Ogola & Ouko, 2021). Irish potatoes are the second-most eaten staple crop in Kenya after maize, with an average annual production of 2-3 million tonnes valued at Ksh. 40–50 billion (Ministry of Agriculture, Livestock and Fisheries, 2016). The crop also provides raw material for various industries with the country having an estimated 200 local processors with a daily capacity of more than 217.7 tons of Irish potatoes (Wakaba *et al.*, 2022). Due to its nutritional and productivity advantages, Irish potato is a perfect complement to maize, which is the main crop used for food security and farmer livelihood in Kenya. Because of its short production cycle of between three to four months Irish potatoes can be produced all year long with at least two production cycles per year (Mburu *et al*., 2020).

Due to the rapid decline in arable land caused by population increase and urbanization, a significant demand exists for crops that can yield more food, nutrients, and profit per unit area and time (Kaguongo *et al*., 2013). As Irish potatoes produce more food, within a short period of time, on small land sizes than many other important food crops, they are best suited to meet this current requirement of food crop specifications (Gibson & Kurilich, 2013).

Irish potato farming in Kenya, is centred in high-altitude areas of Central, Eastern, and Rift valley regions of the country with altitude of 1500-3000 meters above sea level. In such areas, it is more advantageous to grow Irish potatoes than other crops like maize (Janssens *et al*., 2013). Production of the crop in the country is characterized by small holder production and rapid and large changes in supply and demand due to bimodal rainfall patterns in the majority of Irish potato growing areas since most Irish potato production is rain fed (Muthoni & Mbiyu, 2017). Long rains occur in March to July while the short rains are received in October to December with off-season Irish potato production being limited to a few areas with irrigation facilities.

Irish potato growers employ poor husbandry practices, such as us of low-quality planting materials and without sufficient technical expertise in Irish potato management (Kwambai *et al*., 2022). The bulk of Irish potato-growing regions are rain-fed, which causes supply and demand fluctuations due to bimodal rainfall patterns. Despite this seasonal output, there is not enough Irish potato storage on the farm (Taiy *et al*., 2017). Additionally, farmers struggle with declining soil fertility, a disjointed marketing structure, a high prevalence of pests and illnesses, a lack of clear packaging regulations, and outdated technology (Gebru *et al*., 2017). Because of the resulting unstable supply, prices are low. Poor pricing then results in low revenues, enormous losses, and lesser produce, all of which have a negative impact on Irish potato farmers' ability to produce (Chepkoech, 2022).

A logical strategy to address the issues faced by Irish potato producers to subsequently enhance their performance is to concentrate on strengthening their entrepreneurial skills. Shadbolt *et al*. (2013) claim that agripreneurial competency can improve agripreneurial resilience, which is defined by Evans and Wall (2019) as an entrepreneur's ability to overcome obstacles in their firm and retain profitability. However, the current body of literature has predominantly focused on the poor performance of Irish potato farmers without relating it to entrepreneurial attitude and skills, thus little is known about the entrepreneurial competencies of smallholder Irish potato growers in Kenya (Agbolosoo, 2021). This study therefore sought to address this knowledge gap by establishing the effect of entrepreneurial competencies and agrienterprise farm capabilities on the performance of smallholder Irish potato farmers in Kenya.

2.2 Concept of Entrepreneurial Competency

Bird (1995) defines entrepreneurial competencies as the underlying differences in personality, goals, knowledge, social positions, abilities, and self-perceptions that lead to new

venture creation, venture sustainability, and performance. This definition is reinforced by Barazandeh *et al*. (2015) who considered entrepreneurial competency as the internal resources that are needed for successful running of an enterprise. On the other hand, Khalid and Bhatti (2015) describe entrepreneurial competency in terms of the managerial capacity to develop and convey a strategic vision for organizing organizations' systems for improved performance. Thus, entrepreneurial competency can be categorized into knowledge, characteristics and skills (Mojab *et al*., 2011). The competencies approach emphasizes that having competencies does not automatically make one entrepreneurial, but rather that one's actions and choices can help one perform more effectively in domains that actually matter (Man *et al*., 2002). Man (2001) categorized entrepreneurs based on ten competencies, although only six out of these ten are frequently cited as being crucial in literature (Nieuwoudt *et al*., 2017). Commitment, opportunity, organizing, relationship, strategic and learning competencies are the six competencies frequently cited in literature. The competencies framework is seen to be helpful in evaluating an entrepreneur's capacity to successfully carry out their task. Hence, entrepreneurial competencies are the fundamental traits that enable entrepreneurs to accomplish tasks more effectively than others, leading to higher performance.

In order to assure sustained growth and success of a venture in a competitive business climate, entrepreneurial competency is a vital component of achieving excellence in performance (Arellano & Reyes, 2019). This is because the pursuit of opportunities and resources for improved business performance is fuelled by entrepreneurial competencies (Colombo & Grilli, 2005; Vijay & Ajay, 2011). The positive and considerable impact of entrepreneurial competencies on business success is supported by a wealth of empirical data, such as that provided by Ng *et al*. (2016). Similar arguments about the relationship between entrepreneurial competencies and total firm performance were advanced by Khalid and Bhatti (2015).

The manager's entrepreneurial ability, which translates into production efficiency, is crucial for any farming business to achieve its goals (Nasuredin *et al*., 2016). Farmers also face problems that necessitate judgment calls and actual use of managerial abilities (Norton *et al*., 2014). It is therefore evident that farmers require entrepreneurial competency in order to make wise farming decisions that could lead to increased production. According to Sher *et al*. (2019), farmers' entrepreneurial abilities are crucial components needed for improved performance in terms of possible market placement and fast delivery of food commodities. Farmers with entrepreneurial skills have better access to markets and may sell their crops for

higher prices, hence boosting their revenue (Arellano & Delos Reyes 2019; Opolot *et al*., 2018). According to Sinyolo and Mudhara (2018), certain degrees of entrepreneurship competency could potentially increase farming households' production output, which would have an impact on food security. However, there is limited empirical evidence of entrepreneurial competencies and its effect on performance in the Kenyan agricultural context. Thus, this study sought to fill this knowledge gap by examining the impact of entrepreneurial competencies on the productivity of smallholder Irish potato farmers in Kenya.

Entrepreneurial Competency Framework

Entrepreneurial competencies have been extensively developed, tested and modified in the current body of literature (Man, 2001; Man & Lau, 2005; Nieuwoudt *et al*., 2017; Sakib *et al*., 2022). One of the most recent developments of the entrepreneurial competencies framework was conducted by Sakib *et al*. (2022) who synthesized six entrepreneurial competencies from the original 10 entrepreneurial competencies of Man (2001). The competencies are; relationship, organizing and leading, learning, opportunity, strategic, and commitment competencies.

Relationship Competency

Relationship competency refers to the ability of an individual to handle an organization's multiple internal and external resources, including physical, human, financial, and technical resources, as well as to establish teams, lead and direct employees, and train and manage individuals (Idris & Abu Bakar, 2020). Man (2001) asserts a connection between relational competency and SMEs' success. Moreover, entrepreneurs are viewed by Jenssen and Greve (2002) as the creators of reliable connections with vendors, customers, employees, competitors, public officials, and other stakeholders (Ahmad *et al*., 2017). There is strong evidence that demonstrates how dependent small enterprises are on a reliable network of partners, including the government, lawyers, accountants, and consultants (Kornelius *et al*., 2020). Hansen and Ostermeier (2001) added that business owners use this relationship competency to secure funding to expand their operations. Excellent interpersonal communication and relationship-building skills are essential for entrepreneurs (Ahmad *et al*., 2017; Idris & Abu Bakar, 2020; Kornelius *et al*., 2020).

Organizing and Leading Competency

The ability of entrepreneurs to organize and lead can be seen in the creation of plans, the allocation of resources to carry out the plans, the organization and delegation of tasks, the motivation, direction, and leadership of employees, the coordination and collaboration of

activities, and finally the maintenance of the organization's smooth operation (Atei *et al*., 2020; Idris & Abu Bakar, 2020). In his research, Man (2001) found a strong correlation between SMEs' performance and organizing skills. He divided organizational competency into two categories: operational and human competency. Since managing a SME business requires entrepreneurs to do a variety of linked organizing and leading tasks, literature examines organizing and leading competence as a separate category (Al mamun *et al*., 2019; Atei *et al*., 2020; Sakib *et al*., 2022).

Learning Competency

According to Bird (2019), learning competency is described as actively learning practical behaviours, learning from a variety of materials and methodologies, staying current, and eventually putting learned knowledge into practice. Park *et al*. (2019) contend that learning competency is necessary for entrepreneurs to assist them become competent in their surroundings. Mancinelli and Mazzanti (2009) assert that the key competency of the entrepreneurial process is learning competency since it results in entrepreneurs' knowledge, which reduces possible risks and uncertainties and enhances business performance.

Opportunity Competency

The capacity of entrepreneurs to recognize a variety of market possibilities utilizing diverse tools, strategies, and techniques is referred to as their "opportunity competency" (Kabir *et al*., 2017; Mohammed & Mohammed, 2017; Shin *et al*., 2021). Opportunity competency is the ability to identify the products and services that consumers want, to recognize their unmet needs, to seize true opportunities, and to provide the greatest value to consumers (Bird, 2019). According to Omsa *et al*. (2017), what sets entrepreneurs apart from others is their ability to see opportunities among obstacles. Opportunity competence, according to Tehseen and Ramayah (2015), is thus ability of an entrepreneur to recognize, develop, and assess real market opportunities.

Strategic Competency

The qualities that Man (2001) lists as constituting strategic competency are as follows: (a) the ability to predict future directions and how change may affect the organization; (b) the ability to prioritize activities in light of business objectives; (c) the ability to restructure the company to better achieve its goals; (d) the ability to align current activities with business objectives; and (e) the ability to design the firm to meet the firm's objectives. Evidence supporting the idea that an entrepreneur's strategic competency is crucial to the growth of SMEs was presented by Subagyo (2020). The performance of SMEs

and entrepreneur strategic competency have been strongly correlated in numerous research (Kornelius *et al*., 2020).

Commitment Competency

The capacity to effectively manage a business while being devoted to or driven far beyond the vision of achieving the organization's goals and objectives is reflected in an entrepreneur's level of entrepreneurial commitment competency (Zainol & Mamun, 2018). Man (2001) discovered a connection between entrepreneur commitment and SME performance. Man (2001) assessed an entrepreneur's level of commitment by looking at their ability to: (a) have a strong internal drive for success; (b) not allow the business to fail; (c) have a strong commitment to ensuring the business operates profitably; and (d) have long-term business goals that demonstrate a positive relationship with the performance of the business.

Businesses are mostly unaware of the crucial role that competencies play in company performance, despite research showing an important relationship between competencies and business performance (Barazandeh *et al*., 2015). For instance, according to Arellano and Reyes (2019), there is still scepticism about the entrepreneurial competency of farmers. Furthermore, according to Nieuwoudt *et al*. (2017), there has been little to no study done to demonstrate a connection between farmers' performance and their entrepreneurial competencies. Therefore, this study was a timely answer to the call for research on the relationship between entrepreneurial competencies and business performance (Orobia *et al*., 2020; Tehseen *et al*., 2019).

2.3 Concept of Agrienterprise Farm Capability

According to Eisenhardt and Martin (2000), a firm's capabilities are its methods for integrating, reconfiguring, acquiring, and releasing resources to keep up with or spur market developments. Santos-Vijande *et al*. (2012) postulated that organizational capabilities reflect a complicated set of skills needed to carry out a firm's activities effectively and methodically while using a variety of organizational resources in concert. A capability, in essence, relates to the knowledge, expertise, and skills needed to complete a task as well as the intricate arrangements of collaboration and coordination between people and resources (Schulze, 1994)

Numerous research have demonstrated a favourable and significant relationship between company capabilities and performance (Al Mamun *et al*., 2016; Arshad & Arshad, 2019; DeSarbo *et al*., 2007; Pucci *et al*., 2017). Furthermore, a survey of recent studies

demonstrates that different firm capabilities have a positive impact on a range of performance dimensions, including firm capability and export performance (Krammer *et al*., 2018), networking capability and SME performance (Eikelenboom & de Jong, 2019), dynamic capabilities and export performance (Ribau *et al*., 2017), brand capability and general SME performance (Odoom *et al*., 2017), innovative capability and financial performance (Donkor *et al*., 2018; Ribau *et al*., 2017).

Because of this, it is thought that managers or owners who make changes to their organizational capabilities—such as marketing, market linking, and management capabilities—will also improve worker well-being, worker behaviour, and worker efficiency, all of which will eventually lead to increased customer acquisition and profitability (DeSarbo *et al*., 2007). These tangible and intangible resources and assets are viewed as a "vehicle" for putting ideas into practice as well as rent-producing assets that assist organizations in generating better returns than average (Barney *et al*., 2011; Mithas *et al*., 2011; Odoom *et al*., 2017). However, there is little to no information on the firm capabilities of smallholder farmers in Kenya and the role the capabilities play on performance. In this regard, this study investigated the integrative Effect of entrepreneurial competencies and agrienterprise farm capabilities on performance of smallholder Irish potato farmers in Kenya.

Agrienterprise Farm Capability Framework

Agrienterprise farm capability framework has been suitably authenticated in preceding research studies (Desarbo *et al*., 2007) and from the studies, five major firm capability areas have been established. These capability dimensions are; management capability, information technology capability, technology capability, market linking capability and marketing capability. Market connecting capabilities, according to Desarbo *et al*. (2007), include the capacity to forge and maintain enduring bonds with suppliers, retain customers, and build strong bonds with wholesalers and retailers. Competitiveness, consistency in delivery, cost reduction, and process efficiency are all correlated with technological skills. According to Desarbo *et al*. (2007), aptitudes in new product development, manufacturing processes, technology development, technological change prediction, production facilities, and quality control are significant components of technological competencies. Marketing capabilities are defined by Conant *et al*. (1990) as the firm's understanding of its target market and customers, the integration of its marketing efforts, its proficiency with segmentation and targeting, and the success of its pricing and advertising strategies.

Capabilities related to information technology are those that assist a company in developing technical and market knowledge and facilitating cross-functional collaboration. These skills include the company's information technology (IT) systems' capacity to support internal and external communication, to enable cross-functional integration, and to facilitate the generation of technical and market knowledge (Desarbo *et al*., 2007). Desarbo *et al*. (2007) describes management capabilities as the abilities of the manager to integrate logistics systems, controlling costs, managing financial and human resources, forecasting revenues, and managing marketing planning. However, despite the proved influence of the various dimensions of firm capabilities on firm performance, there is little to no information on the relationship between agrienterprise firm capability and performance. Nabeel-Rehman and Nazri (2019) stated that there aren't many studies in developing nations that look at the relationship between SMEs and IT from the standpoint of IT capabilities.

2.4 Entrepreneurial Competencies, Agrienterprise Farm Capabilities, and Performance

According to Hwang *et al*. (2020), due to the greater influence of the direct link of management abilities on company performance, the relationship needs to be investigated indirectly through firm capabilities. This is supported by DeSarbo *et al*. (2007) who stipulated that despite the fact that firm capabilities including marketing, market connecting, and managerial capabilities determine business performance, they are prejudiced by entrepreneurial competency (Man *et al*., 2002; Monteiro *et al*., 2019). Thus, developing a firm's capabilities requires having the necessary leadership, control, monitoring, organization, and development skills for both internal and external resources from many fields (Man, 2001; Vijay & Ajay, 2011). This indirect effect through firm capabilities has been tested by Kisubi *et al*. (2022) who postulated the maiden evidence that the relationship between entrepreneurial competencies and SME performance is mediated by a firm’s capabilities. This study adds onto Kisubi *et al*. (2022) findings by investigating the entrepreneurial competency, agrienterprise firm capability and performance in the context of smallholder agriculture in a developing country.

2.5 Factors Influencing Entrepreneurial Competency

In order to analyse the elements affecting the development of employee and student entrepreneurial competencies, Pesha's (2022) systematic evaluation of literature provided the framework for factors influencing entrepreneurial competency. Pesha (2022) identifies groups of factors influencing entrepreneurial competency and within the groups are specific

key factors. The groups of factors identified to influence entrepreneurial competency include; global factors, national factors, education, organizational factors and personal factors. The Table 2.1 below provides a summary of the group factors and specific key factors.

Table 2.1 Factors influencing entrepreneurial competencies

Group of factors	**Specific Key Factors**
Global	Digitization and Globalization
National	social values
	state regulation of entrepreneurship and regional policy
	market conditions and taxation
	infrastructure development
Educational	higher education in entrepreneurship, entrepreneurship courses, business education, accelerators, hackathons and business incubators
Organizational	Motivation
	business climate and development strategy
	corporate sustainability
	new ways of working
	organizational capabilities (information, finance, working hours)
Personal	motivation and intentions
	Awareness
	Openness
	Extraversion
	upbringing and origin
	Values
	gender, age, education, experience

However, the framework of the factors is yet to be applied and assessed empirically in the Kenyan context. Moreover, the framework is not contextualized to the perspective of the Kenyan smallholder farmers. On this basis, this study explored the factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya.

2.6 Theoretical framework

The conceptualization of this study was based on the dynamic capability theory. Dynamic capability theory outlines path-dependent procedures that let businesses construct, integrate, and reconfigure their resource and capability portfolios in order to adapt to quickly changing circumstances (Teece *et al*., 1997). The dynamic capabilities are derived from the Resource Based View theory which states that resources and capabilities are the determinants of competitive advantage (Barney, 2001). Dynamic capability theory made up for that resource-based view theory's failings when it came to unfolding long-term competitive advantage and superior performance in a dynamic environment (Bleady *et al*., 2018). According to the dynamic capability theory, a firm's capabilities consisted of its ability to integrate resources in a creative and effective way, as well as its human resources and other resources (Bleady *et al*., 2018). According to Eisenhardt and Martin (2000), a firm's capabilities are its methods for integrating, reconfiguring, acquiring, and releasing resources to keep up with or spur market developments. These qualities may result from an individual's entrepreneurial skills, which are essential for attracting more resources from both inside and outside the company (building firm capability) at the business level (Hwang *et al*., 2020). To this end, it can be hypothesized that a SME's effectiveness in problem-solving depends on the entrepreneurial competency of the owner or manager and the firm's capability to support the implementation of any initiatives (Kisubi *et al*., 2022).

2.7 Conceptual Framework

In relation to this study, to determine the effect of entrepreneurial competency and agrienterprise farm capability on performance of smallholder Irish potato farmers' in Nyandarua County, different variables were co-operated in the proposed model. The independent variables comprised: entrepreneurial competency and factors in development of entrepreneurial competencies, while, agrienterprise farm capability played a mediating role on performance of smallholder Irish potato farmers as indicated in Figure 2.1 below. The entrepreneurial competencies that were considered included; opportunity competency, relationship competency, strategic competency and personal strength competency. The agrienterprise farm capabilities that were considered include; networking capability, technology management capability, technology integration capability, market linking capability and marketing capability. The smallholder Irish potato farmers' entrepreneurial competency was assumed to have a direct or indirect effect on performance.

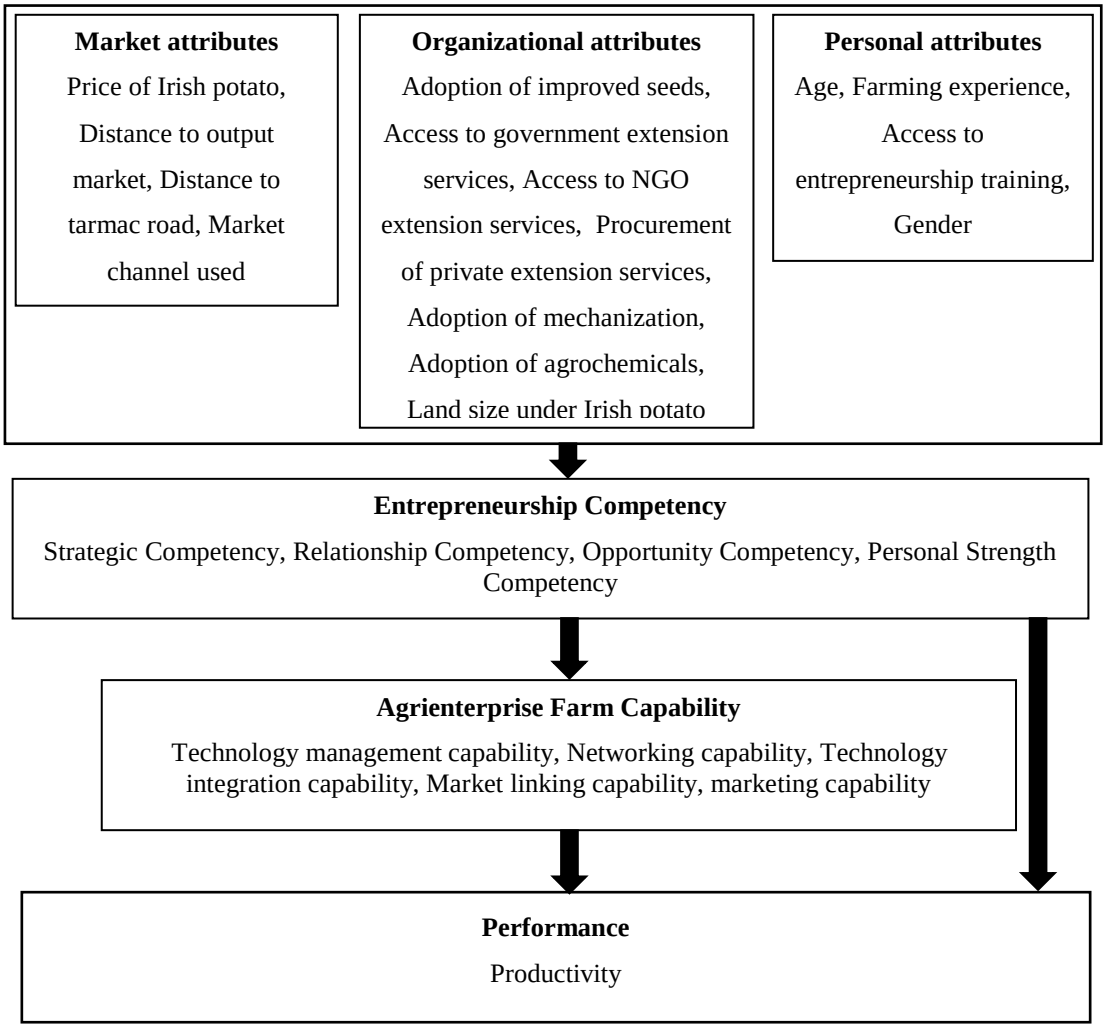

Figure 2.1 Conceptual framework

CHAPTER THREE
METHODOLOGY

Introduction

This chapter presents the structured approach used to collect, analyze, and interpret data to answer the specific research questions.

3.1 Study Area

The study was undertaken in Nyandarua County. Nyandarua is situated in central of Kenya, between longitudes 35° 13' East and 36°42' West and latitudes 0°8' North and 0°50' South. The County is elevated at 2667.11 meters above sea level with a Mediterranean, warm summer climate. Nyandarua County experiences an average annual temperature of 19.03ºC which is -3.47% lower than Kenya's averages. Nyandarua County characteristically receives about 120.38 millimetres of precipitation and has 224.82 rainy days (61.59% of the time) annually (Nyandarua County Government, 2017).

The County is separated into five Sub-Counties; Ndaragwa, Ol Kalou, Kinangop, Kipipiri, and Ol Joro Orok with a total of twenty-five wards. The area of the County is 3,245.2 Square Kilometres portion of which is covered by the Aberdare Ranges. Because the Aberdare Ranges surround it, it has rich, fertile soils and ideal ecological conditions, which makes crop cultivation advantageous all year round. As a result, Agriculture and allied businesses are Nyandarua's primary socioeconomic activities with Irish potatoes, cabbage, carrots, sugar beet, peas, floriculture, pyrethrum, grains, poultry, and dairy products being the principal agricultural products.

The County was purposively chosen because of the vibrant Irish potato sector contributing about 33% of the total Irish potatoes produced in Kenya (Nyandarua County Government, 2017). Irish potatoes is the main crop covering about 37,000 hectares annually. The County's Integrated Development Plan (CIDP) 2018–2022 recognizes Irish potatoes as a significant crop and outlines tactical measures to help the industry expand. There are over 70,000 small-holder Irish potato farmers in Nyandarua County produce more than KES 8 billion worth of Irish potatoes annually. The map of the study area is illustrated in Figure 3.1.

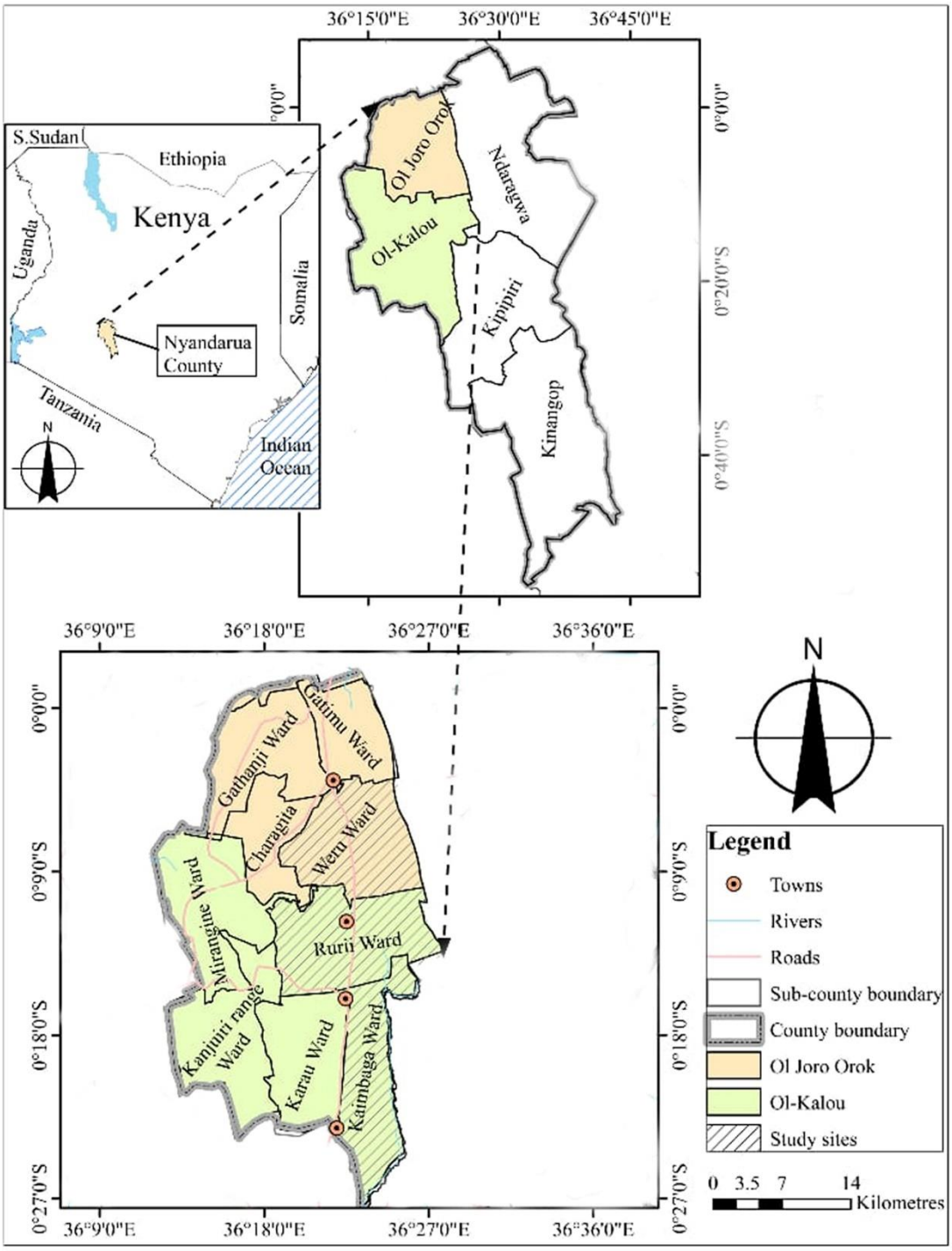

Figure 3.1 Study Area Map

Source: Nyandarua County CIDP 2018 - 2022

3.2 Research Design

This study was a cross-sectional survey and it adopted quantitative methodology.

3.3 Sampling and Study Data

Population of the Study

The population of the study was all the smallholder Irish potato farmers in Nyandarua County who were engaged in production and marketing Irish potatoes for at least one season in the previous production year.

Sampling Unit

The sampling unit for this study was the smallholder Irish potato farmer in Nyandarua County who was engaged in production and marketing Irish potatoes for at least one season in the previous production year.

Sampling Method

The research utilized a multistage sampling methodology. According to Lavrakas (2008), there are a number of situations in which multistage sampling is employed, such as when a sample frame is lacking or would be prohibitively expensive to construct. There was no access to a sampling frame for Irish potato farmers who had produced Irish potato for at one season in the previous production year. As a result, the multistage sampling method was justified. This was because it allowed the researcher to utilize the target population's hierarchical structure and design. The first stage was purposive selection of Nyandarua County because it is a key Irish potato producing county in Kenya. The second stage of the sampling involved the purposive selection of two Sub-Counties, Ol Kalou and Ol Joro Orok because they are key Irish potato producing Sub-Counties in Nyandarua County (Republic of Kenya, 2016). In the third stage, two wards were randomly selected from Ol kalou Sub-County while one ward was selected from Ol Joro Orok Sub-County to give a total of 3 wards; Kaimbaga, Rurii and Weru.

The fourth stage involved consulting three extension officers who worked in the three wards during the previous production year to identify 10 seeds from each ward from different villages who met the sampling unit criterion. In the fifth stage, each of the 10 seeds provided a list of 15 subjects from their villages who met the sampling unit criterion. This resulted into 30 geographical based strata being formed each with 15 subjects. The sixth stage involved applying systemic random sampling to select respondents from the strata to select 75 respondents from each ward giving a respondent list of 225. However the respondents from the list who participated in the study were 219 which resulted to a total of 249 respondents inclusive of the 30 initial seeds.

3.4 Tools for Data Collection

A semi structured questionnaire was administered to the smallholder Irish potato farmers by trained enumerators.

3.5 Pilot Study

To evaluate the reliability and validity of the data gathering tool, a pilot study was carried out. Validity is the extent to which an instrument measures what it claims to measure, whereas reliability is the degree to which a research instrument would produce the same results or data after multiple trials (Mugenda & Mugenda, 2013). The pilot study was carried out in Kinangop Sub-County since it has similar attributes to Ol kalou and Ol Joro Orok. The researcher administered 50 questionnaires. The final questionnaires that were distributed for the study were modified and adjusted based on the findings of the pilot study.

3.6 Data Types and Sources

This study utilized primary data which was collected from household survey. The primary data was collected included personal attributes, organizational attributes, education attributes, entrepreneurial competency attributes, agrienterprise firm capability attributes and performance indices.

3.7 Data Analysis

Data for the study was analysed using SPSS, Smart PLS version 4 and STATA version 18 software. A 10% significance level was used for hypothesis testing.

3.8 Analytical Framework

Objective one: To explore the entrepreneurial competencies and agrienterprise farm capabilities of smallholder Irish potato farmers in Nyandarua County, Kenya.

The instrument that was used to measure the entrepreneurial competencies was adapted from the instrument developed by Man (2001) as shown in Appendix 1 section D. The instrument comprised 49 statements that are related to the competencies of a business owner or manager that are used to measure 10 competencies as determined by Man (2001) as shown in Appendix 1 section E. The 10 entrepreneurial competencies as identified by Man (2001), comprise of: opportunity competencies, relationship competencies, conceptual competencies (analytical competencies and innovative competencies), organising competencies (operational competencies and human competencies), strategic competencies, commitment competencies, learning competencies, and personal strength competencies. A

seven-point anchored Likert scale was used to rate each statement, with 1 denoting "strongly disagree" and 7 denoting "strongly agree."

DeSarbo *et al*. (2005) developed the adapted instrument that was used by this study to assess the capabilities of agrienterprise farms. The instrument consisted of 23 statements that are relevant to a business owner's or manager's capabilities and are used to gauge the five capabilities elaborated by DeSarbo *et al.* (2005). The five firm capabilities as identified by DeSarbo *et al*. (2005), comprise of: management capability, information technology capability, technology capability, market linking capability and marketing capability. A seven-point anchored Likert scale was used to rate each statement, with 1 denoting "strongly disagree" and 7 denoting "strongly agree."

Following Man (2001), factor analysis (FA) was used to explore entrepreneurial competencies and agrienterprise firm capabilities. According to Byrant *et al*. (1999), FA is a multivariate statistical procedure used in dimensional reduction. Through this process, underlying dimensions are established between measured variables and latent constructs. Moreover, the approach provides evidence of reporting scales construct validity (Byrant *et al*., 1999). The analysis was performed with a varimax rotation, Kaiser normalisation and principal component analysis PCA as explained by Hair (2010). The analysis followed the ensuing criteria as explained by Hair (2010). Choice of PCA over common factor analysis (CFA) was based on one consideration. The consideration was purpose of the study. According to Kim (2008), the main purpose of PCA is data reduction that is summarizing numerous variables into a smaller number of components while CFA is used to identify a factor model that would best reproduce the observed correlation as such, it used for explaining the correlation between variables. Since the purpose of the objective was reducing the numerous entrepreneurial competency statements into fewer more comprehensible components, PCA was selected.

According to Hair (2010), there should be at least five variables for each suggested component in a study that is intended to disclose the factor structure. The minimal absolute sample size is 50 observations, and the sample must contain more observations than variables. The recommendation is to aim for at least 5 observations per variable.

The value of the Kaiser-Meyer-Olkin (KMO) test, which measures the sample adequacy's degree of variation, must be greater than 0.49. A Bartlett's test of sphericity that is statistically significant (sig. <.05) suggests that there are enough correlations between the variables to move forward.

Two criteria should be taken into account when determining how many components should be retained. First, components with an eigenvalue greater than 1 are included in accordance with the Kaiser-Guttmann criterion (Fekedulegn *et al*., 2002). Additionally, variables that demonstrate a significant degree of common variance according to the scree test and sufficient factors to meet a predetermined percentage of variance explained—typically 60% or higher—are included (i.e., components before inflection point).

When selecting rotational methods for factor rotation, orthogonal methods are the most popular and are recommended when the goal of the research is to reduce the amount of data to a set of uncorrelated measures or a smaller number of variables that can then be used in other multivariate techniques.

When it comes to evaluating factor loadings, values larger than ±.50 are typically thought to be required for practical importance, and factor loadings of ±.30 to ±.40 are at the very least acceptable. An optional structure exits when all variables have strong loadings on only one component. Cross-loading variables, those that have a significant load on two or more components, are typically eliminated unless there is a theoretical justification for not doing so or if the only goal is data minimization. In order for variables to be included in the analysis, their communalities need typically be greater than 0.5.

Objective two: To identify factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya

In this objective, the dependent variables were the entrepreneurial competencies which were measured using the principal components derived from the Principal Component Analysis in objective one. The independent variables hypothesized to influence entrepreneurial competencies comprised; organizational, national, educational and personal factors as shown in Appendix 1 section A, B and C. The factors were adopted from the systematic review of research in order to analyse the factors affecting the development of student and employee entrepreneurial competencies by Pesha (2022). The indicators underlying the factors were modified by the researcher and are elaborated in Table 3.1.

Table 3.1: Description of variables used to determine factors influencing entrepreneurial competency

Variables	**Description of Variables**	**Hypothesized sign**
Dependent variables		
Entrepreneurial Competency	Opportunity competencies	+
	Relationship competencies	
	Strategic competencies	
	Personal strength competencies	
Independent variables		
Market factors	Price of Irish potato	+
	Price per 50KG bag	
	Distance to output market	+
	Distance to the output market in KM	
	Type of road	+
	Murram road Distance to the nearest tarmac road	
	Market channel used	+
	Amount of Irish potato in kilogrammes sold to broker, direct-sold to local market and direct-sold at non-local market annually in kilograms	
Organizational factors	Adoption of improved seeds	+/-
	Dummy = 1 if farmer has adopted mechanization, 0 otherwise	
	Adoption of agrochemicals	+/-
	Dummy = 1 if farmer has adopted mechanization, 0 otherwise	
	Adoption of mechanization	+/-
	Dummy = 1 if farmer has adopted mechanization, 0 otherwise	
Variables	**Description of Variables**	**Hypothesized**

		sign
	Accessed government extension services Dummy = 1 if farmer has adopted mechanization, 0 otherwise	+/-
	Accessed NGO extension services Dummy = 1 if farmer has adopted mechanization, 0 otherwise	+/-
	Procurement of private extension services Dummy = 1 if farmer has adopted mechanization, 0 otherwise	+/-
	Land size under Irish potato production Land in acres	+
Personal factors	Age Age of farmer in years	+
	Gender Dummy = 1 if is male, 0 if female	+/-
	Farming experience Experience in Irish potato farming in years	+
	Entrepreneurship education Dummy = 1 if farmer has attended entrepreneurship trainings, 0 otherwise	+/-

A suitable model to investigate the relationship between entrepreneurship competency and the explanatory variables must comprised of four equations, one for each response, since the dependent variable "entrepreneurship competency" is multidimensional and, in our study, is represented by four variables. Stated otherwise, it was necessary to do a multivariate regression analysis. Multivariate analysis methods that were considered included; Multiple Regression Analysis, Logistic Regression Analysis, Multivariate Analysis of Variance (MANOVA), Canonical Correlation, Structural Equation Modelling and Multivariate Multiple Regression (Richarme, 2016). Multiple regression was not used because it examines the association between a single metric dependent variable and two or more metric independent variables but this study had more than one dependent variable.

Because the goal of logistic regression analysis is to arrive at a probabilistic evaluation of a binary decision, it usually uses binary dependent variables, but the dependent

variables in this study were not binary. For this reason, it was not taken into consideration. Because MANOVA looks at the link between multiple categorical independent factors and two or more metric dependent variables, and since some of the independent variables in this study were metric, it was decided not to utilize it. Since the method uses metric independent variables and some of the independent variables in this investigation were binary, canonical correlation was not chosen.

Structural Equation Modelling (SEM) was not selected because it involves latent variables analysis yet the objective considered observed variables. Therefore, Multivariate Multiple Regression because it can be used to regress both categorical and metric independent variables on metric dependent variables. Multivariate Multiple Regression is multiple because there is more than one independent variable and it is multivariate because there is more than one dependent variable as was the case in this study.

Objective three: To determine the effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya

In relation to this objective, the dependent variable was the performance of smallholder Irish potato farmers while entrepreneurial competencies and agrienterprise farm capabilities were the independent and mediating variable respectively. The entrepreneurial competencies that were considered included; opportunity competency, relationship competency, strategic competency and personal strength competency. The agrienterprise farm capabilities that were considered include; networking capability, technology management capability, technology integration capability, market linking capability and marketing capability. The entrepreneurial competencies and agrienterprise farm capabilities were modelled as latent variables with indicators being the retained statements of each of the latent variables from the PCA conducted in objective one. The smallholder Irish potato farmers' entrepreneurial competency was assumed to have a direct or indirect effect on performance. Performance was measured as the Irish potato annual productivity of the farmers computed in kilogrammes of Irish potato harvested per acre.

The study adopted the Structural Equation Modelling to estimate the entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers because of the nature of the variables whereby we have observed and unobserved or latent variable. Because traditional regression analysis methods are impractical for analyzing multiple linear regression between the independent variables, multiple path analysis, direct and indirect effect, and overall model fitness, structural equation modelling SEM was the most appropriate

method for this investigation. According to Hair *et al*. (2017), SEM can also offer measures of fit for evaluating the complete model. Furthermore, confirmatory factor analysis is used in the method to address measurement problems within exogenous variables with various indicators (Okello, 2021).

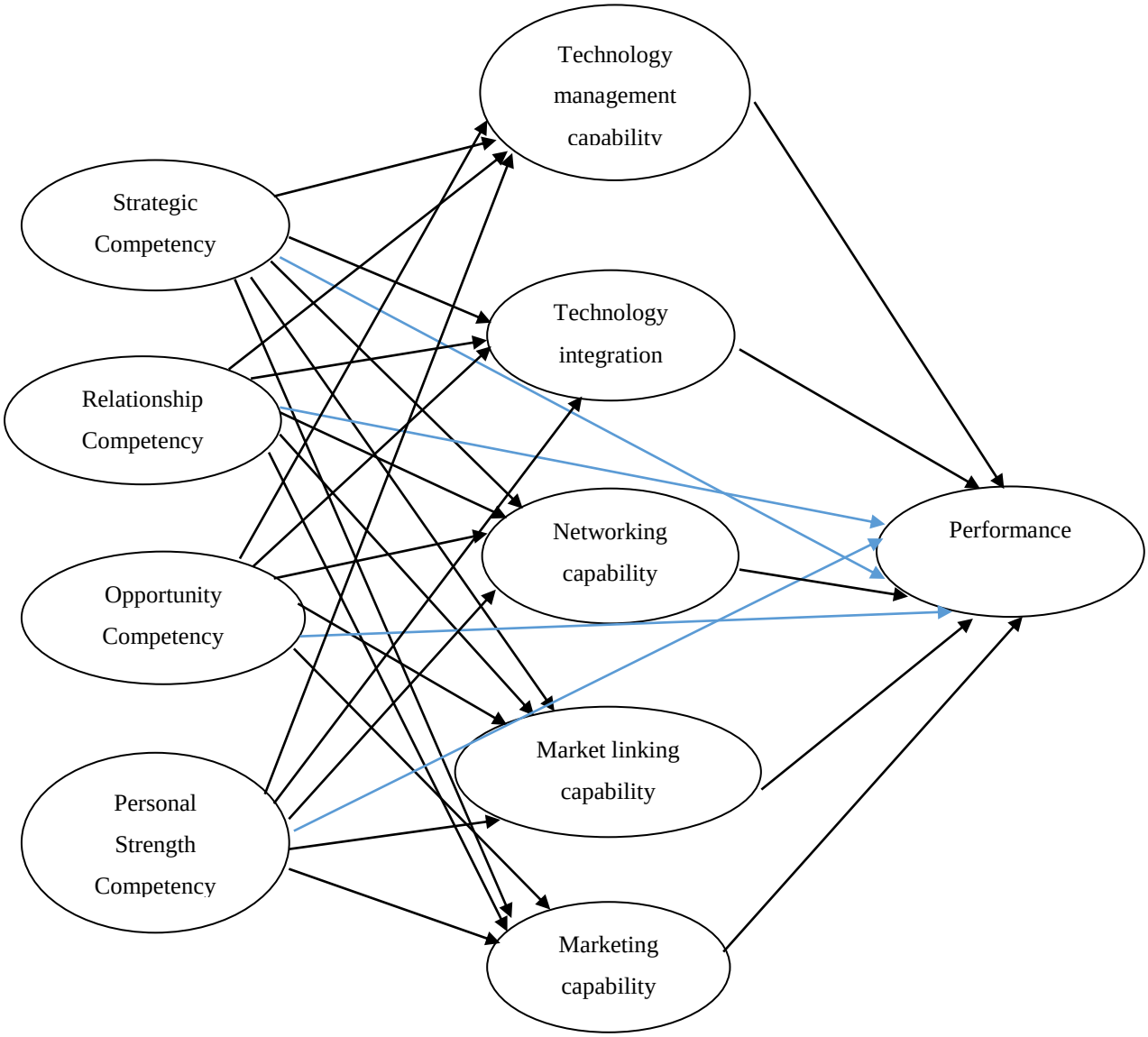

Figure 3.2 Structure equation model

3.9 Ethical Considerations

The National Commission for Science, Technology, and Innovation (NACOSTI) and the Egerton University Ethics Review Committee (EUREC) granted an ethical clearance certificate and a research permission prior to the commencement of data collection. The legal organization tasked with overseeing research operations in Kenya is called NACOSTI. The goal of the study was explained to the respondents, and they received assurances regarding the privacy of the data they provided. On the questionnaires, respondents were not compelled to provide any kind of identification. The researcher assured the respondents that the information they provide would be treated with confidentiality and that it would be used purely for this study's research purposes only.

CHAPTER FOUR
RESULTS AND DISCUSSION

Introduction

This chapter presents the findings of the study. It specifically provides the analysis results, interpretation and discussion from the analysis of the specific objectives.

4.1 Descriptive statistics

The socioeconomic variables that were included in the study were gender, age, farming experience, land under Irish potato production, produce price, distance to output market, distance to tarmac road, market channel, access to extension services, use of agrochemicals, mechanization and access to entrepreneurship training. The purpose of the descriptive analysis was to fully comprehend the sample's characteristics. The descriptive statistics that are provided give an overview of the key characteristics of the sample, which helps to characterize and summarize the data. As indicated in table 4.1, the study had 249 respondents out of which males constituted 53% while females constituted 47%. This implies that more males are involved in Irish potato farming in Nyandarua County. Women are more likely to grow subsistence crops, but men are more likely to produce high-value crops. According to, Kwambai *et al.* (2023) the main focus of majority of potato producers is selling it for cash. This gap is exacerbated by social norms that place women in charge of producing the majority of the food in the household as well as by the reality that women's contributions usually yield poorer returns due to gender biases in product markets. Land ownership constraints may also prevent women from scaling up to the level needed for high-value crops.

Table 4.1 Gender distribution of smallholder Irish potato farmers

		Frequency	Valid Percent
Gender	Female	116	46.6
	Male	133	53.4
	Total	249	100.0

In table 4.2, the minimum, maximum, mean and standard deviation statistics results of the listed dependent variables are reported. The average age of the respondents was 52 years. This finding indicates that the average Irish potato farmer is middle aged and thereby, alluding that youth in Kenya are not involved in Irish potato farming. This was in coherence with Maina *et al*. (2023) who reported the average age of Kenyan Irish potato farmers as 52

years. The average farming experience of farmers was 18 years. This was approximately the average farming experience of Kenyan Irish potato farmers of 19 years reported by Okello *et al*. (2016). The average size of land under of Irish potato production was 1.08 acres (0.44 Hectares) implying that the farmers are classified as small-scale farmers. According to UNCTAD, (2015) smallholder farmers are defined as those operating 2 ha of cropland or less. The average farm gate price received by the farmers was KES 1626 per 50 Kg bag. This price was approximate the reported national average 2022 farm gate price of KES 1790 (Agriculture and Food Authority, 2022).

The mean distance from farm to output market was 14 Km whilst the average distance from farm gate to the nearest tarmac road was 4 Km. With regards to market choice, brokers were the main market channel. On average, farmers sold to brokers 42 bags of produce annually. This was followed by produce directly sold at non-local market (2bags) then lastly produce directly sold at local market (1 bag). This is in line with Mutunga (2014) who stated that with regards to preference of Irish potato marketing, Irish potato farmers that prefer a channel without middlemen are significantly less than those that favour the existence of an intermediary with the next preferred market channel being direct farmer sales.

Table 4.2 Descriptive statistics of socioeconomic characteristics

	Minimum	**Maximum**	**MEAN**	**Std. Deviation**
Age (years)	27.00	85.00	51.63	13.01
Farming Experience (years)	2.00	50.00	18.45	12.10
Land under Irish potato production (acres)	0.13	6.00	1.08	0.97
Price (KES)	400.00	4250.00	1626.44	700.90
Total distance to output market (km)	1.00	210.00	14.17	29.49
Distance to tarmac road (km)	0.00	20.00	3.85	4.16
Produce sold to broker (bags)	3.00	255.00	41.65	40.00
Produce directly sold at local market (bags)	0.00	28.00	0.71	3.63
Produce directly sold at non-local market (bags)	0.00	220.00	2.35	17.51

As indicated in table 4.3, less than average of the farmers accessed extension services. According to the results. Only 41% accessed government extension, 32% received NGO extension and 9.2% received private extension. This result is supported by Mburu *et al*. (2023) who reported that in Kenya, the official agricultural extension services are supplied by the government with private extension providers very rarely being responsible for disseminating new technologies and innovations from research to farmers. Because of this, the delivery of extension services has been hampered by a widening gap between the ratio of extension staff to farmers, and a lack of adequate funding for public extension services (Nkurumwa, 2023).

Table 4.3 Access to extension services by smallholder Irish potato farmers

		Frequency	**Valid Percent**
Accessed Government extension	no	147	59.0
	yes	102	41.0
	Total	249	100.0
Accessed NGO extension	no	169	68.1
	yes	80	31.9
	Total	249	100.0
Accessed private extension	no	226	90.8
	yes	23	9.2
	Total	249	100.0

According to the results as shown in table 4.4, only 17% of the farmers used improved seeds. This is in coherence Mburu *et al*. (2023) who reports a low uptake of certified Irish potato seed due to several factors, such as exorbitant costs, limited number of seed sellers, and lack of awareness of their potential. The results also showed that majority of the farmers 93% and 61% used production agrochemicals and mechanized production respectively. This stands to show that the behaviour of the farmers is oriented towards technology adoption in Irish potato farming and intensification of production.

Table 4.4 Farming practices adopted by smallholder Irish potato farmers

		Frequency	Valid Percent
Used Improved seed	no	206	82.7
	yes	43	17.3
	Total	249	100.0
Used production agrochemicals	no	17	6.8
	yes	232	93.2
	Total	249	100.0
Production Mechanized	no	98	39.4
	yes	151	60.6
	Total	249	100.0

As indicated in table 4.5, majority of the farmers (60%), attended entrepreneurship trainings. This finding is an indication that the farmers are increasingly becoming entrepreneurial oriented as these trainings capacity farmers' entrepreneurial competencies.

Table 4.5 Access to entrepreneurship training by smallholder Irish potato farmers

		Frequency	Valid Percent
Attended entrepreneurship trainings	No	99	39.8
	Yes	150	60.2
	Total	249	100.0

4.2 Entrepreneurial competencies and agrienterprise farm capabilities of smallholder Irish potato farmers in Nyandarua County, Kenya.

To explore the entrepreneurial competencies and agrienterprise farm capabilities exhibited by the farmers from the measured 49 entrepreneurial competency statements and the 23 farm capabilities statements, Principal Component Analysis (PCA) was conducted. A seven-point anchored Likert scale was used to rate each statement, with 1 denoting "strongly disagree" and 7 denoting "strongly agree." According to, Byrant *et al*. (1999), PCA is a multivariate statistical procedure used in dimensional reduction. Through this process, underlying dimensions were established between measured variables and latent constructs. Moreover, the approach provides evidence of reporting scales construct validity (Byrant *et al*., 1999). The analysis was performed with a varimax rotation and Kaiser normalisation. The

analysis followed the ensuing criteria as explained by Hair (2010). The results of the analysis are presented and discussed in the subsequent sections.

4.2.1 Entrepreneurial competencies of smallholder Irish potato farmers in Nyandarua County, Kenya.

a. Measure of Sampling Adequacy (MSA) Test

The analysis included a total of 249 observations and 49 variables. This translated to an observation to variable ration of 5. This satisfied Hair's (2010) recommendation of at least 5 observations per variable. As shown in table 4.6, the degree of variance of sampling adequacy for analysis was achieved as the resultant KMO test value was 0.888 which was above 0.49 as required (Hair, 2010). The analysis had statistically significant Bartlett's test of sphericity of 0.000 which was less than 0.05 as required to indicate that sufficient correlations exist among the variables to proceed with the analysis.

Table 4.6 KMO and Bartlett's Test for entrepreneurial competencies

Test		**Statistic**
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.888
EC Bartlett's Test of Sphericity	Approx. Chi-Square	7402.125
	df	1176
	Sig.	0.000

b. Reliability Analysis and scree plot

The decisions of number of components to be retained was based on two considerations (Fekedulegn *et al*., 2002; Williams *et al*., 2012). First, in accordance with the Kaiser- Guttmann rule, components with an eigenvalue greater than 1 were included. In this regard, as shown in table 4.7, Component 1, 2, 3 and 4 were retained.

Table 4.7 Entrepreneurial competencies principal components, Eigenvalues and proportion of variance explained

Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
Comp1	6.35	4.51	0.40	0.40
Comp2	1.83	0.40	0.11	0.51
Comp3	1.43	0.18	0.09	0.60
Comp4	1.26	0.50	0.08	0.68
Comp5	0.76	0.07	0.05	0.73

Comp6	0.69	0.07	0.04	0.77
Comp7	0.62	0.10	0.04	0.81
Comp8	0.51	0.05	0.03	0.84
Comp9	0.46	0.03	0.03	0.87
Comp10	0.43	0.08	0.03	0.90
Comp11	0.36	0.04	0.02	0.92
Comp12	0.32	0.02	0.02	0.94
Comp13	0.30	0.05	0.02	0.96
Comp14	0.25	0.01	0.02	0.97
Comp15	0.24	0.05	0.01	0.99
Comp16	0.19	.	0.01	1.00

In addition to the Kaiser- Guttmann rule, the Scree test was used as the second criterion for component retention. Components shown by the Scree test to have substantial amounts of common variance i.e., factors before inflection point. Thus, Component 1, 2, 3 and 4 were retained as shown in figure 4.1.

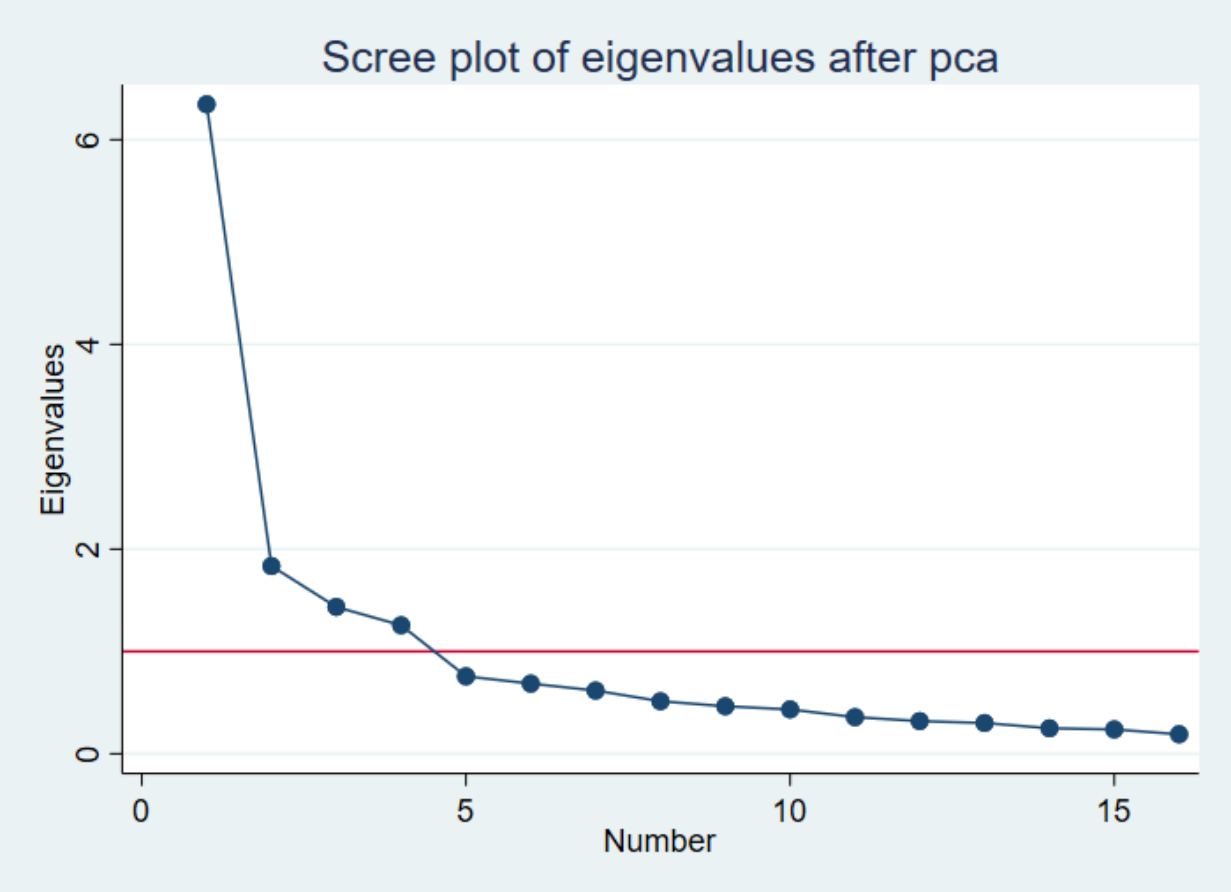

Figure 4.1 Scree plot of Eigenvalues after entrepreneurial competencies PCA

c. Rotated Component Matrix and component labelling

The components selected based on the Kaiser- Guttmann rule and Sree test were then Orthogonally rotated with Varimax rotation. The Orthogonal rotation is recommended by Hair (2010) when the analysis goal is data reduction to a smaller number of variables for subsequent use in other multivariate techniques as is the case in this study. Following the rotation, assessment of factor loadings and assessment of assignment of variables on components was conducted as recommended by Hair (2010). First, only factor loadings with values greater than ±0.50 were considered for practical significance and variables that cross-load (load highly on two or more component) were deleted. Variables with a uniqueness score of less than 0.5 were retained in the analysis. The inclusion and assignment of variables to components is presented in table 4.8 with retained component loadings highlighted.

Table 4.8 Rotated Entrepreneurial Competencies

Component	Retained variable and variable statement	Component loading	Uniqueness
Component 1: Strategic Competency	**sc3**: I Prioritize production activities in alignment with marketing goals	0.73	0.36
	sc4: I Redesign production activities to better meet long-term objectives and changes	0.75	0.29
	sc5: I Align current production activities and marketing activities with long term goals	0.84	0.19
	sc6: I Monitor and evaluate progress toward long term goals	0.84	0.20
	sc7: I Determine production activities to achieve long term goals by weighing costs and benefits	0.85	0.23
Component 2: Relationship competency	**rc1**: I Develop long-term trusting relationships with other Irish potato value chain stakeholders	0.70	0.33
	rc3: I interact with other Irish potato stakeholders such as farmers and brokers	0.64	0.41
	rc4: I Maintain a personal network of Irish	0.78	0.33

	potato value chain actors contacts		
	rc6: I Communicate with other Irish potato value chain actors effectively	0.81	0.25
	lc3: I Learn as much as I can about Irish potato production and marketing	0.64	0.50
	lc4: I Keep up to date with recent knowledge, technology and processes about Irish potato production and marketing	0.65	0.40
Component 3: Opportunity Competency	**oc1**: I can identify products the Irish potato market needs	0.74	0.27
	oc2: I can Perceive unmet consumer needs	0.88	0.20
Component 4: Personal Strength Competency	**opc3**: Keep the Irish potato production and marketing running smoothly	0.56	0.46
	psc4: I Prioritize production and marketing tasks in my daily activities so as to manage my time	0.77	0.35
	psc6: I Manage my own growth in Irish potato production	0.77	0.36

The first components which had the highest factor loadings were for statements sc3, sc4, sc5, sc6 and sc7. sc3 covered farmer planning for production activities to best achieve marketing goals of the produce. Sc4 entailed activities relating to reforming the production activities in a way that enables the accomplishment of long-term farm goals as well as are compatible with changes that may occur in the long run. In order to best align the farm with long term changes, the marketing approach also needs to be restructured and this was covered by Sc5. Additionally, aligning the farm with long term goals require continuous monitoring and evaluation and this is explained by sc6. These decisions and plans which require long term commitment at the farm should be based on expected returns and possible uncertainties and risks which is covered by sc7. According to these statements, this component, which is named strategic competency, relates to the planning, monitoring, analysis, and assessment of all requirements in order to fulfil long-term goals and objectives.

The retained statements for the second component were rc1, rc3, rc4, rc6, lc3 and lc4. Lc3 and lc4 which involved the farmer learning about how the value chain works and taking it further by continuously staying updated on new knowledge about the value chain. For this to be successful, the farmer needs to be in contact with other actors in the value chain who will provide the required knowledge. This is explained in rc1, rc3, rc4 and rc6. Rc3 and rc6 which entail the farmer establishing contact with other value chain actors and effectively communicating to them. Statement rc1 and rc4 require the farmer to not only establish contact with other value chain actors but also to ensure that the contact and communication is continuous and sustainable. This component involves the farmers maintaining an ongoing level of engagement with stakeholders in their sphere of operation and is thus named relationship competency.

The retained statements for the third component were oc1 and oc2. Statement oc2 entails the ability of the farmer to identify needs of consumers that are yet to be met by the market while, oc1 involves the ability of the farmer in identifying the holistic needs of the market in their value chain. These statements centre on looking for and recognizing needs and gaps in the market. For farmers, these gaps and needs could mean business opportunities. Consequently, the component is called opportunity competency.

The fourth component was loaded with statements opc3, psc4 and psc6. Statement psc4 entails the farmer effectively planning their time to allow for effective implementation of production and marketing activities. Statement opc3 entails the farmer ensuring themselves that the production and marketing activities are conducted effectively while psc6 entails the farmer being at the centre of improvement in production. These statements describe the importance of self-management and improvement in farming and require self-efficacy. Thus, the component is named personal strength competency.

d. Entrepreneurial competencies scoring

The PCA score which is anchored on the 7-point Likert scale was used to determine a score for the farmers' competencies by adding the score out of 7 for each statement together and obtaining an average score per competency as explained by Nieuwoudt *et al*. (2017). As a result, each farmer received a score for every competency. The computation only took into account the competencies found in the PCA. The distribution of farmers' entrepreneurial competences between the minimum, mean, and maximum values is displayed in table 4.9 below. The average scores were transformed into percentages in order to compare the various competences with one another and to make the numbers easier to understand.

Table 4.9 Entrepreneurial competencies scoring

	Min	Max	MEAN	Std. Deviation	Skewness	Kurtosis
Strategic competency	14	100	69.45	18.953	-1.209	1.256
Relationship competency	14	100	73.15	16.526	-1.177	1.409
Opportunity competency	14	100	47.48	23.141	0.143	-1.138
Personal strength competency	33	100	83.00	10.635	-0.966	2.290

With the exception of opportunity competency, all of the other competencies realized for the farmers are near higher end of the distribution. Opportunity competency has the lowest average score (47%), which suggests there is the most space for development. Among other competencies, the strongest competency found was that of personal strength competency (83%) followed by relationship competency (73%) and finally, strategic competency (69%). With average scores of 83% and lower for each of these competences, there is still opportunity for development.

The farmers' average score for personal strength competency was 83%. This indicates that farmers are disposed towards effective time management, growth management and overall agrienterprise management. Effective time management helps to increase farm output, increase sales level, accomplish tasks more efficiently, deliver more quality products, gain more customer loyalty, gain more employee loyalty, increase response to unexpected matters, increase profitability, stand-out in the industry, increase overall survival of the farm, and improve more on ideas and innovation (Akinkoye *et al*., 2022). Any business must have effective management to be successful, and farms are no exception (Li & Li, 2018). Additionally, Li and Li (2018) discovered evidence that the more skilled farm managers are more productive in terms of both maximizing farm income and minimizing farm expenses.

The farmers' average relationship competency score was 73%, which indicates that their behavior is oriented toward interpersonal networks, interactions, and negotiation. By incorporating these relationship-building behaviors into their daily operations, farmers may be able to expand their negotiating skills. Although Irish potato farmers are seen as price takers since they are perceived not to have price setting power in a system dominated by middlemen (Taiy *et al*., 2016), they can still bargain for better delivery or transportation

conditions to make sure they get the most for their produce. This relates to building a personal network and engaging with others. Etriya *et al*. (2019) explains that networks give farmers access to more resources, improve their understanding of the markets, and allow them to seize opportunities by creating innovations.

With an average score of 69% for strategic competences, farmers are clearly actively developing, assessing, and putting into practice plans related to organizational and operational competencies on their farms. Farmers should be expected to score higher because strategic abilities are related to strategy implementation, which impacts their capacity to meet objectives, boost sales, and ultimately increase profitability. This is supported by Baratelli (2020), who postulated that a more productive and efficient farming system emerges from agribusiness's adoption of suitable strategic management practices which will result in reduced production and marketing expenses as well as more effective distribution of resources.

Given that the farmers' opportunity scores are below average; it is clear from their actions that they are not actively looking for new chances inside the Irish potato value chain. According to Nieuwoudt *et al*. (2017) farmers' market and production efficiency, and/or production costs can all be increased or decreased by taking advantage of new prospects in the value chain. However, this competency area has the lowest average score when compared to the other entrepreneurial competencies, suggesting that there is room for improvement by looking for new markets or by recognizing opportunities like vertical or horizontal integration in the value chain.

4.2.2 Exploring the agrienterprise farm capabilities of smallholder Irish potato farmers in Nyandarua County, Kenya.

a. Measure of Sampling Adequacy (MSA) Test

The analysis included a total of 249 observations and 23 variables. This translated to an observation to variable ration of 10. This satisfied Hair's (2010) recommendation of at least 5 observations per variable. The degree of variance of sample adequacy for analysis was attained, as indicated in table 4.10, because the resulting KMO test value was 0.8129, above the necessary 0.49 (Hair, 2010). The statistical significance of the Bartlett's test of sphericity for the analysis was 0.000, which is less than the required 0.05 to demonstrate that there are adequate correlations between the variables to continue with the analysis.

Table 4.10 Results of KMO and Bartlett's Test for agrienterprise farm capabilities

Test		Statistic
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.8129
EC Bartlett's Test of Sphericity	Approx. Chi-Square	3525.688
	df	406
	Sig.	0.000

b. Reliability Analysis and scree plot

Two considerations were taken into account when deciding how many components to retain (Fekedulegn *et al*., 2002; Williams *et al*., 2012).

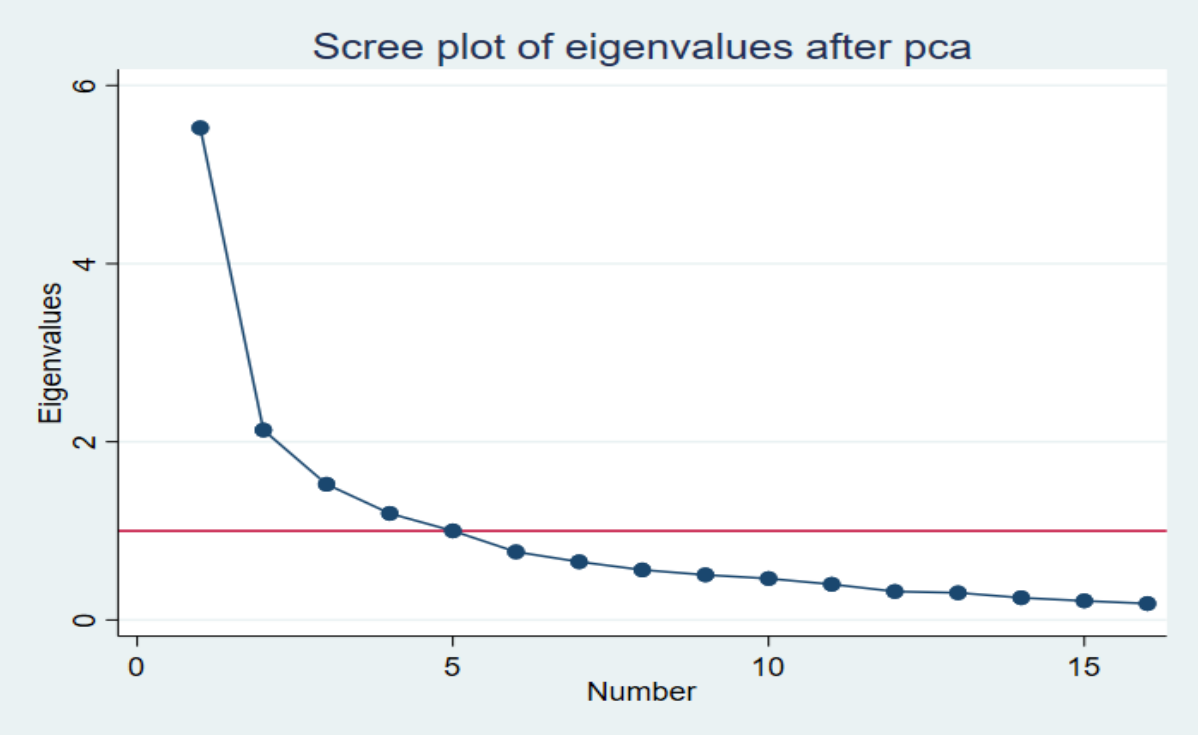

Figure 4.2 Scree plot of Eigenvalues after Agrienterprise farm capabilities PCA

The components that the scree plot indicated had significant amounts of common variance, or variables prior to the inflection point, was the first criterion for component retention. Components 1, 2, 3, 4, and 5 were therefore kept as they are depicted in figure 4.2. Second, components with an eigenvalue greater than 1 were included in accordance with the Kaiser-Guttmann rule. In this sense, Components 1, 2, 3, 4, and 5 were retained, as indicated in table 4.11.

Table 4.11 Agrienterprise farm capabilities principal components, Eigenvalues and proportion of variance explained

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.52	3.39	0.35	0.35
Comp2	2.13	0.61	0.13	0.48
Comp3	1.52	0.33	0.10	0.57
Comp4	1.20	0.20	0.07	0.65
Comp5	1.00	0.24	0.06	0.71
Comp6	0.76	0.11	0.05	0.76
Comp7	0.65	0.09	0.04	0.80
Comp8	0.56	0.06	0.04	0.83
Comp9	0.51	0.04	0.03	0.87
Comp10	0.46	0.06	0.03	0.90
Comp11	0.40	0.08	0.03	0.92
Comp12	0.32	0.02	0.02	0.94
Comp13	0.31	0.06	0.02	0.96
Comp14	0.25	0.03	0.02	0.98
Comp15	0.21	0.03	0.01	0.99
Comp16	0.18	.	0.01	1.00

c. Rotated Component Matrix and component labelling

The components underwent Varimax orthogonal rotation. Hair (2010) suggests using the orthogonal rotation when the aim of the analysis is to reduce the amount of data to a smaller number of variables for subsequent multivariate analysis, which is the situation in this study. As advised by Hair (2010), assessments of factor loadings and variable assignment on components were carried out after the rotation. Initially, factor loadings greater than ±0.50 were the only ones taken into account for practical significance. Cross-loading variables (those with a significant load on two or more components) were eliminated. Second, the analysis only included variables whose uniqueness score was less than 0.5. Table 4.12 illustrates the inclusion and assignment of variables to components, with the retained component loadings bolded.

Table 4.12 Rotated Agrienterprise farm capabilities components

Component	Retained variable and variable statement	Component loading	Uniqueness
Component 1: Technology Integration Capability	**itc2**: I use Information technology systems such as phones for facilitating adoption and implementation of new working methods (NWM) such as adopting improved seed	0.65	0.40
	itc3: I use Information technology systems such as phones for acquiring market information	0.66	0.29
	tc1: I adopt and adapt new working methods (NWM) such as adopting improved seed	0.73	0.35
	tc2: I add value to my Irish potatoes prior to marketing	0.74	0.39
	tc3: I develop new working methods (NWM) such as Irish potato seed production	0.77	0.34
Component 2: Networking Capability	**mlc3**: I manage durable relationship with market channels members such as whole sellers, retailers	0.51	0.48
	itc4: I use Information technology systems such as phones for internal communication of Irish potato production activities with my staff	0.86	0.18
	itc5: I use Information technology systems such as phones for external communication (e.g., suppliers, customers, channel members, etc.)	0.87	0.16
Component 3: Technology Management Capability	**tc4**: I have adequate knowledge of development of new working methods (NWM) such as mechanization and new varieties	0.68	0.30
	tc5: I have adequate Production facilities for optimal Irish potato production	0.83	0.24

	tc6: I have Quality control skills for optimal Irish potato production and marketing	0.86	0.22
Component 4: Marketing Capability	**mc3**: I consider marketing in the production of Irish potatoes	0.76	0.32
	mc4: I have the skills to segment and target different markets channels	0.77	0.30
	mc6: The advertising strategy I implement is successful in achieving my marketing goals	0.65	0.40
Component 5: Market Linking Capability	**mlc5**: I establish relationships with customers	0.86	0.16
	mlc6: I have the ability to retain customers	0.91	0.12

The first component with high retained component loadings were for statement itc2, itc3, tc1, tc2 and tc3. itc2 entails adoption of information communication technology such as mobile phones to facilitate incorporation of new technology such as improved seeds in production. Itc3 explains use of information communication technology such as mobile phones to acquire market information. Tc1 entails the adoption of new technologies in production such as use of improved seed. Tc2 involves the post-harvest processing of Irish potatoes prior to marketing and tc3 entails the development of new technologies such as seed Irish potato production. From these statements, this component entails the incorporation of improved technologies in the production and is therefore called the technology integration capability.

The retained statements for the second component were mlc3, itc4 and itc5. Mlc3 entails the farmer establishing and maintain durable relationships with value chain actors. Itc4 and itc5 entails the adoption of information communication technology in communicating with production staff as well as other actors in the value chain. This component involves the farmer sharing information between individuals with similar interests and is thus named networking capability

The retained statements for the third components were tc4, tc5 and tc6. statement tc4 requires the farmer to have sufficient knowledge about new technologies such as improved seed and mechanization. Tc5 entails the farmer having sufficient production facilities to facilitate optimal production. Tc6 entails the farmer having adequate quality control skills to ensure optimal Irish potato production marketing. These statements describe skills that

empower an organization to apply technology properly to achieve its goals efficiently and is thus named technology management capability.

The retained statement for the fourth component were mc3, mc4 and mc6. mc3 entails the farmer considering market conditions as they continue with the production of Irish potatoes. Mc4 requires the farmer to have the skills to segment and target different markets channels. Mc6 entails the advertising strategy implemented by the farmer being successful in attaining the farmers' marketing goals. These statements describe activities, processes for creating, communicating and delivering products to market. The component is therefore named marketing capability.

The fifth statement was loaded with statements mlc5 and mlc6. mlc5 entails the farmer establishing relationships with customers while mlc6 require the farmer to retain those customers. These statements are about connecting farmers more directly with markets and is thus named market linking capability.

d. Agrienteprise farm capabilities scoring

Following the PCA a score which is anchored on the 7-point Likert scale was used to determine a score for the farmers' agrienterprise farm capabilities by adding the score out of 7 for each statement together and obtaining an average score per capability as explained by Nieuwoudt *et al*. (2017). As a result, each farmer receives a score for every agrienterprise farm capability. The computation only took into account the agrienterprise farm capabilities found in the PCA. The distribution of farmers' agrienterprise farm capabilities between the minimum, mean, and maximum values is displayed in table 4.13 below. The average scores were transformed into percentages in order to compare the various agrienterprise farm capabilities with one another and to make the numbers easier to comprehend. The strongest agrienterprise farm capability found was networking capability (71%) followed by technology management capability (60%), followed by market linking capability (53%) and finally, technology integration capability and marketing capability scoring the lowest (47%).

Table 4.13 Agrienterprise farm capabilities scoring

	Min	Max	MEAN	Std. Deviation	Skewness	Kurtosis
Technology integration capability	14	100	47.45	22.896	0.025	-1.103
Networking capability	14	100	70.57	21.216	-0.988	0.217
Technology management capability	14	100	60.26	22.802	-0.433	-0.854
Marketing capability	14	100	46.82	20.055	0.191	-0.710
Market linking capability	14	100	52.90	26.549	-0.164	-1.267

The average score for networking capability (71%) indicates that farmers are disposed towards interactions, creating interpersonal networks as well as utilizing information communication technologies in these networks. Establishing connections between farmers and pertinent stakeholders through networking within the agriculture sector promotes a collaborative culture. In this way, farmers can become knowledgeable about new technologies, environmentally friendly agricultural practices, and developments in crop management, which will ultimately increase farm productivity and efficiency. This supported by Pratiwi and Suzuki (2017) who postulated that networking by farmers corresponds to better learning outcomes.

According to the technology management score of 60%, farmers are presumably using policies and procedures that make use of technology in order to build, maintain, and improve their competitive advantage by utilizing their technological know-how. Wu (2022) provides evidence for this, stating that a greater uptake of new agricultural technologies will enhance the farms' financial gains.

The slightly above average score of market linking capability (53%), indicates that the farmers are inclines towards establishing and maintaining interpersonal relationship with consumers, thus shortening value chains. Through establishing linkages with consumers, farmers can gain insight into consumer preferences, market trends, and emerging demands, enabling them to modify their agricultural practices accordingly. The importance of market linking capability is supported by Corsi *et al*. (2022) who established abundant evidence of a considerable benefit of interpersonal relationships between farmers and consumers in a sales environment.

The below average score for technology integration capability (47%) indicates that there is low incorporation of improved technologies in production among farmers. Adoption of several complimentary agricultural technologies, such as chemical fertilizers, pesticides, improved seed, and techniques for conserving water and soil, has been demonstrated to increase farmer income (Biru *et al*., 2020). Thus, there exist a need to improve farmers' technology integration capability as is a lot of room for improvement and a pertinence of the improvement. Given the farmers' marketing capability was below average (47%), it is clear that they are not actively implementing activities to promote the buying of their products. Farmers' market involvement is essential to ending poverty and increasing income. Participation in the commodity market by farmers boosts their consumer spending, guarantees food security, and enhances smallholders' standard of living (Dey & Singh, 2023). Therefore, efforts should be made to improve marketing capabilities of farmers.

4.3 Factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya

The dependent variables used in the analysis to identify factors influencing entrepreneurial competency was the average score for the farmers' competencies which was calculated by adding the score for each statement together and obtaining an average score per competency as explained by Nieuwoudt *et al*. (2017). As a result, each farmer receives a score for every competency. The computation only took into account the competencies found in the Objective one PCA. A multivariate multiple regression was then conducted with the following regressors; Age, Farming Experience, Attendance of Entrepreneurship trainings, Land size under Irish potato production, Produce Price, Use of Improved seed, Access to government extension, Access to NGO extension, Access to private extension, Production mechanization, Distance to output market, Distance to tarmac road, Gender, Produce selling to broker, Produce self-selling at local market, Produce self-selling at non-local market and Use of production agrochemicals.

To conduct the Multivariate Multiple Regression results of factors influencing entrepreneurial competencies, we first conducted MANOVA which indicated if all of the equations, taken together, are statistically significant. The MANOVA results are shown in Table 4.14. The null hypothesis, according to which the regression coefficients for all independent and dependent variables are equal to zero, is tested by the overall F. The multivariate F takes into account correlations between the criterion variables by calculating the sum of cross products and the sum of squares between and within groups. All four tests in the "Model" section—Wilk's lambda, Lawley-Hotelling trace, Pillai's trace, and Roy's

biggest root—have statistically significant F and p values (p <.001). The conclusion is that there are differences between the dependent variables as a function of one or more independent factors since the multivariate tests taken as a whole are significant (Dattalo, 2013).

Table 4.14 MANOVA results

Source	Test	Statistic	df	F(df1,	df2) =	F	Prob>F	
Model	Wilks' lambda	0.3460	17	68	893.1	4.08	0.000***	a
	Pillai's trace	0.8909		68	920	3.88	0.000***	a
	Lawley-Hotelling trace	1.2895		68	902	4.28	0.000***	a
	Roy's largest root	0.6714		17	230	9.08	0.000***	u
Residual			230					

e = exact, a = approximate, u = upper bound on F

After the MANOVA, the Multivariate Multiple Regression was conducted and it produced to results. Table 4.15 provides the number of parameters, RMSE, R-squared, F-ratio, and p-value for each of the four models. It is evident from the P-labelled column that all four of the univariate models have statistical significance. The 17 predictor factors, as indicated in the R-sq. column, account for 29%, 36%, 28%, and 22% of the variance in the outcome variables, which are relationship competency, opportunity competency, strategic competency, and personal strength competency, respectively.

Table 4.15 Univariate models number of parameters, RMSE, R-squared, F-ratio, and p-value.

Equation	Parms	RMSE	R-sq	F	P
Strategic Competency	18	1.157267	0.2894	5.510613	0.000***
Relationship Competency	18	0.962583	0.3578	7.537635	0.000***
Opportunity Competency	18	1.424015	0.2801	5.265127	0.000***
Personal Strength Competency	18	0.681318	0.2231	3.885467	0.000***

*** = significant at 10%, 5% and 1% level, respectively

Table 4.16 shows the results of the Multivariate Multiple Regression results of factors influencing entrepreneurial competencies. Personal strength competency was found to be negatively influenced by age (β-0.0102378 p-value=0.087). This implies that older farmers

are less likely to keep Irish potato production and marketing running smoothly. In general, farmers' capacity to work on their farms decreases as they get older (Kemisola *et al*., 2013).

Opportunity competency was found to be negatively influenced by farming experience (β=-0.0335189 p-value=0.015). In essence, this implies that the more years a farmer practices Irish potato production, the less inclined they are towards looking for and recognizing needs and gaps in the market. This result is consistent with the findings of Kemisola *et al*. (2013), who found that as a customer's agricultural years grow, their responsiveness to market intelligence about present and future requirements declines. Farming experience was found to positively influence personal strength competency (β=0.0108782 p-value=0.099). This means that the more years a farmer practices Irish potato production the more competent they are at running their farms. Studies have revealed that farmers with more years of experience tend to enhance farmers' aptitude to effectively manage their farms and make knowledgeable decisions (Akitantayo *et al*., (2022).

Table 4.16 Multivariate Multiple Regression results of factors influencing entrepreneurial competencies

	Strategic Competency		**Relationship Competency**		**Opportunity Competency**		**Personal Strength Competency**	
	Coeff	P value	Coeff	P value	Coeff	P value	Coeff	P value
Age (years)	-0.011889	0.241	-0.0130869	0.121	0.0133275	0.285	-0.0102378	0.087*
Farming Experience (years)	-0.0083265	0.456	-0.0073317	0.430	-0.0335189	0.015**	0.0108782	0.099*
Attended Entrepreneurship trainings	0.2536292	0.136	0.5073855	0.000***	0.4165428	0.047**	0.1427604	0.154
Land size under Irish potato production (acres)	0.1960929	0.056*	0.058303	0.493	0.2078833	0.099*	0.1207719	0.046**
Price (KES)	0.0000873	0.441	0.0003773	0.000***	0.0002496	0.074*	-0.0001347	0.044**
Used Improved seed	-0.0950528	0.664	-0.1538902	0.398	0.0926596	0.731	-0.1193878	0.354
Accessed government extension	0.4847734	0.004***	0.3203431	0.022**	0.5185047	0.012**	0.0986948	0.317
Accessed NGO extension	0.2618608	0.140	-0.2138672	0.147	-0.6434702	0.003***	-0.0201607	0.846
Accessed private extension	0.1839257	0.508	0.0497883	0.829	-0.1971834	0.564	0.3936245	0.017**
Production mechanized	0.5932001	0.001***	0.478511	0.002***	0.1527836	0.497	0.3192219	0.003***
Distance to output market (km)	0.0041279	0.140	-0.0001576	0.946	-0.007626	0.027**	0.0038175	0.021**
Distance to tarmac road (km)	-0.0147029	0.496	-0.0084601	0.638	-0.0141559	0.594	0.0372603	0.004***
Gender	-0.0476441	0.764	-0.2545011	0.055*	-0.2569913	0.189	0.0719213	0.442
Produce sold to broker (bags)	0.0008552	0.731	0.0033194	0.110	0.0000283	0.993	-0.0022063	0.134
Produce directly sold at local	-0.0002158	0.992	0.0289437	0.106	0.0676391	0.011**	-0.0152558	0.228

market (bags)								
Produce directly sold at non-local market (bags)	0.0055622	0.237	0.0045217	0.247	0.0141112	0.015**	0.0034878	0.208
Used production agrochemicals	-0.3713394	0.238	-0.0343993	0.895	0.007771	0.984	-0.0041891	0.982

*, **, *** = significant at 10%, 5% and 1% level, respectively

Attending entrepreneurship trainings was found to positively influence relationship competency (β=0.5073855 p-value=0.000). This means that farmers who attend entrepreneurial trainings are more disposed to establishing and maintaining associations with Irish potato value chain actors such as other farmers and buyers. This result is consistent with the findings of Opolot *et al*. (2018), who found that entrepreneurship programs aid in strengthening ties between farmers and other public and private sector organizations by emphasizing to farmers the value of expanding their knowledge and thinking beyond their own boundaries. Attending entrepreneurship training positively influenced opportunity competency (β=0.4165428 p-value=0.047). This means that farmers who attended entrepreneurship trainings are more likely to analyse needs of buyers and market trends. Farmers can gain expertise in value addition and marketing through entrepreneurship training, which is crucial for increasing the profitability of farming (Opolot *et al*., 2018).

According to the results, land size under Irish potato production positively influenced strategic competency (β=0.1960929 p-value=0.056). This implies that a farmer who allocates more land for Irish potato production is more inclined towards adopting long term strategies that enable them to overcome risks and uncertainties. This result is in line Gebre *et al*. (2023) with the reported positive association between farm size and planning for adaptation strategies in face of uncertainties such as climate change. The size of land under Irish potato production also positively influenced opportunity competency (β=0.2078833 p-value=0.099). This suggests that the larger the land for Irish potato production allocated the more likely the production is to be commercial with regards to producing according to market needs. Large farm households have the ability of employ some of their land for cash crop production, which puts them in a better situation to partake in the output market (Osmani & Hossain 2016).

According to the results, land size under Irish potato production had a positive effect on personal strength competency (β=0.1207719 p-value=0.046). This shows that a farmer's ability to plan and execute the steps required to get a particular result in Irish potato production is positively correlated with the size of the land (Masta & Janjhua, 2023). Larger farm land often requires more man hours, more resources and have higher risks. Thus, farmers who run these farms are often more likely to carry out adequate planning and ensure smooth running of activities in order to avoid huge losses.

Price received by the farmer was also found to positively influence relationship competency (β=0.0003773 p-value=0.000). This implies that farmers who receive higher prices are more likely to develop long-term trusting relationships with other Irish potato value

chain actors such as their buyers. The results of this study are consistent with those of Mutonyi *et al*. (2016), who found that farmers are more inclined to form long-term relationships with their buyers when prices are higher. The price of Irish potato produce was found to positively influence opportunity competency (β=0.0002496 p-value=0.074). This means that better market prices incentivise farmers to produce what the market needs. This is because the goal of market-oriented farming is to generate a profit by selling farm products in the market. The results further showed that price of produce negatively influences personal strength competency (β=-0.0001347 p-value=0.044). This implies that in presence of high market prices, farmers are less likely to assert more effort in ensuring that Irish potato production and marketing runs smoothly. The results are not in line with the economic rationale theory, which holds that financial incentives can promote the adoption of best management practices (Liu *et al*., 2018).

The results also showed that access to government extension positively influenced strategic competency (β=0.4847734 p-value=0.004). This means that farmers who receive government extension are more likely to plan their Irish potato production in line with current recognized risks and uncertainties. The Kenyan Ministry of Agriculture extension services are guided by the National Agriculture Extension Policy which aligns extension to emerging research and policy in target areas (Nkurumwa, 2023). Consequently, farmers who receive this extension are more likely to plan for current and upcoming changes. Access to government extension was found to positively influence relationship competency (β=0.3203431 p-value=0.022). This means that farmers who receive government extension are more likely to engage with value chain actors such as extension agents. This is because government extension in Kenya is demand driven and requires the farmer to seek out extension officers and maintain communication in order to benefit from the services.

While access to government extension was found to positively opportunity competency (β=0.5185047 p-value=0.012), access to NGO extension was found to have a negative effect on the development of opportunity competency (β=-0.6434702 p-value=0.003). This implies that accessing government extension is associated with farmers whom are proactive in understanding what the market requires while those whom receive NGO extension are not likely to actively search for market information. Literature contains ample proof that NGO-led interventions might result in dependency syndrome (Tuchitechi & Lee, 2018). Dependency syndrome is a condition in which people who get benefits from non-governmental organizations either lose the will to try to improve their own lives after obtaining the benefits or purposefully put in less effort at work to be eligible for the transfer.

Thus, farmers who receive supply driven NGO extension are more likely to develop dependency syndrome than their counterparts accessing government extension which is demand driven.

Access to private extension positively influenced personal strength competency (β=0.3936245 p-value=0.017). This implied that farmers who received private extension are more prone to improve their farm management ability. Research has indicated that agricultural interventions that involve farmers contributing resources, even at very low levels, are more likely to be sustainable (Sylla *et al*., 2019). Thus, farmers who pay for extension are more likely to follow through on advice received in order to get a return on investment.

The results indicated that mechanization of production positively influenced strategic competency (β=0.5932001 p-value=0.001). This implies that farmers who mechanize are more likely to understand and implement farm activities which pay off in the long run. Although initial investment in agricultural machinery is costly, research has shown that farmers who adopt mechanization receive higher income in subsequent years of mechanization use (Ahmed & Miller, 2023). Thus, farmers who adopt mechanization are oriented towards long-term production goals. The results further indicated that relationship competency is positively influenced by mechanization of production (β=0.478511 p-value=0.002). This means that farmers who mechanize are more likely to be members of farmer associations. A plausible explanation to this finding is Irish potato farmers in Nyandarua County subscribing to machinery rings. A machinery ring is a community-based self-help group made up of farmers who offer mechanization services and mutual assistance to one another. Therefore, farmers who adopt machinery have to interact with other farmers.

Mechanization of production had a positive effect on personal strength competency (β=0.3192219 p-value=0.003). This implies that farmers who adopted mechanization are more likely to effectively run their production and marketing activities. Sims and Kienzle (2016) corroborate this finding, relating mechanization to increased labor efficiency, increased production input efficiency, increased timeliness of operations, and the ability to adopt more sustainable production systems.

The distance to output market was found to negatively influence opportunity competency (β=-0.007626 p-value=0.027). This implies that farmers whose farms are further away from the market are less likely to understand what Irish potato buyers need. This result is consistent with that of Mussema and Dawit (2012), who discovered that among smallholder farmers, the conversion from farming to meeting the family's basic needs to increasing market-set production was inversely correlated with market distance. Distance to

tarmac road (β=0.0372603 p-value=0.004) and distance to output market (β=0.0038175 p-value=0.021) were found to positively influence personal strength competence. This implies that a farmer who is further away from the market is more likely to self-develop the skills required to run Irish potato production and marketing smoothly. Farmers further away from markets receive fewer supply driven extension services (Asfaw, 2021). This would thus incentivise the farmers to self-evaluate and improve on their weaknesses so as to be able to independently be in charge of their own growth with regards to production and marketing due to the missing supply driven evaluation and improvement.

The results showed that female farmers were more likely to develop relationship competency (β=-0.2545011 p-value=0.055). This implies that female farmers are more predisposed to creating and maintain networks with other Irish potato value chain stakeholders. This is because as research indicates, women are more likely than men to be members of farmer's organizations (Nakazi *et al*., 2017).

Farmer directly selling produce at local market (β=0.0676391p-value=0.011) and non-local market (β=0.0141112 p-value=0.015) were found to positively influence opportunity competency. This means that farmers who transport and sell their produce themselves at markets are more likely to produce based on market trends. Market channels are mainly differentiated by farmers in terms of transaction costs, produce prices and quality requirements. Farmers opting out of the convenient brokers' market channel and deciding to self-sell their produce in nearby and distance markets is an indication of their opportunity capacity expressed by way of awareness of market needs. This is corroborated by Kyaw *et al*. (2018), who stated that farmers can make better judgments about which markets to sell to and when to sell the commodity when they have access to market information.

4.4 The effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya

This analysis sought to determine the effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers. Entrepreneurial competencies, the dependent variable, was measured using the 4 resultant competencies of the PCA conducted in objective one. The four competencies; Strategic Competency (5 statements), Relationship Competency (6 statements), Opportunity Competency (2 statements) and Personal Strength Competency (3 statements), were anchored on a 7-point Likert scale ranging from strongly agree=7 to strongly disagree=1.

Agrienterprise farm capabilities, the mediating variable, was measured using the 5 resultant capabilities of the PCA conducted in objective one. The five capabilities; Technology Integration Capability (5 statements), Networking Capability (3 statements), Technology Management Capability (3 statements), Marketing Capability (3 statements) and Market Linking Capability (2 statements), were anchored on a 7-point Likert scale ranging from strongly agree=7 to strongly disagree=1. Performance was measured using Irish potato productivity which was computed from the kilograms of Irish potato harvested per acre of land.

Partial Least Square Structural Squation Modeling, PLS-SEM, was utilized to test the hypotheses in this objective since it takes into account the primary characteristics of the dependent, independent, and mediating variable in this objective. The characteristics of the variables are that there are several outcome variables that are both observable and unobserved. This model was appropriate since it allowed the researchers to incorporate both observed and unobserved variables (construct/latent components) into the same model and allowed them to assess both the measurement and structural models. The bootstrapping method was used to complete the mediation study (Hair *et al*., 2017). The data was then analyzed through partial least square structural equation modelling (PLS-SEM) using SmartPLS version 4.0.9.9 software.

4.4.1 Outer model assessment

a. Reliability and validity tests of constructs

Convergent validity, according to Hair *et al*. (2017), occurs when construct indicators converge to represent a single underlying construct. Cronbach's alpha (CA), rho_A, composite reliability (rho_c), and average variance extracted (AVE) were used to test this

validity. Cronbach's alpha (CA), as shown in table 4.17, ranged from 0.548 to 0.910, which is within Taber's (2018) acceptable range. The values for average variance extracted (AVE) likewise surpassed the barrier of 0.4, and the range of rho_c was 0.759 to 0.934, exceeding the minimal acceptable level of 0.70 (Hair *et al*., 2017).

Table 4.17 Reliability and validity tests of constructs

	MCB	**MLCB**	**NCB**	**OC**	**PSC**	**RC**	**SC**	**TICB**	**TMCB**
AVE	0.628	0.876	0.708	0.789	0.52	0.595	0.736	0.585	0.706
rho_c	0.835	0.934	0.879	0.882	0.759	0.898	0.933	0.875	0.878
CA	0.702	0.858	0.792	0.734	0.548	0.863	0.91	0.82	0.798

Relationship Competency (RC), Opportunity Competency (OC), Personal Strength Competency (PSC), Technology Integration Capability (TICB), Networking Capability (NCB), Technology Management Capability (TMCB), Marketing Capability (MCB) and Market Linking Capability (MLCB)

b. Discriminant validity test of constructs

A discriminant validity test was carried out utilizing the Heterotrait-Monotrait (HTMT) Ratio Matrix to make sure the constructs employed in the study were unrelated. All of the values in Table 4.18 HTMT ratio test of discriminant validity were less than 0.85, proving that the constructs had discriminant validity (Hair *et al*., 2017). In conclusion, the findings of the convergent and discriminant validity tests show that the study's data are valid and reliable for testing the hypotheses developed using SmartPLS-SEM.

Table 4.18 Heterotrait-Monotrait (HTMT) Ratio Test

	MCB <-> AP	**MLCB** <-> AP	**MLCB** <-> **MCB**	**NCB** <-> AP	**NC** <-> **MCB**
HTMT	0.039	0.144	0.313	0.074	0.612
	NCB <-> **MLCB**	**OC** <-> **AP**	**OC** <-> **MCB**	**OC** <-> **MLCB**	**OC** <-> **NCB**
HTMT	0.408	0.114	0.596	0.476	0.386
	PSC <-> **AP**	**PSC** <-> **MCB**	**PSC** <-> **MLCB**	**PSC** <-> **NCB**	**PSC** <-> **OC**
HTMT	0.327	0.246	0.137	0.363	0.193
	RC <-> **AP**	**RC** <-> **MCB**	**RC** <-> **MLCB**	**RC** <-> **NCB**	**RC** <-> **OC**
HTMT	0.079	0.559	0.492	0.678	0.568
	RC <-> **PSC**	**SC** <-> **AP**	**SC** <-> **MCB**	**SC** <-> **MLCB**	**SC** <-> **NCB**

HTMT	0.370	0.090	0.487	0.264	0.595
	SC <-> OC	**SC <-> PSC**	**SC <-> RC**	**TICB <-> AP**	**TICB <-> MCB**
HTMT	0.518	0.433	0.631	0.216	0.659
	TICB <-> MLCB	**TICB <-> NC**	**TICB <-> OC**	**TICB <-> PSC**	**TICB <-> RC**
HTMT	0.418	0.523	0.768	0.344	0.691
	TICB <-> SC	**TMCB <-> AP**	**TMCB <-> MCB**	**TMCB <-> MLCB**	**TMCB <-> NCB**
HTMT	0.442	0.101	0.517	0.355	0.584
	TMCB <-> OC	**TMCB <-> PSC**	**TMCB <-> RC**	**TMC <-> SC**	**TMC <-> TIC**
HTMT	0.319	0.287	0.427	0.489	0.258

Relationship Competency (RC), Opportunity Competency (OC), Personal Strength Competency (PSC), Technology Integration Capability (TICB), Networking Capability (NCB), Technology Management Capability (TMCB), Marketing Capability (MCB) and Market Linking Capability (MLCB), Annual productivity (AP).

The model fit was assessed using standardized root mean square residual (SRMR). The SRMR indicated model fit as it satisfied Hu and Bentler's (1999) requirement of the recommendation of a SRMR of 0.09 or lower as shown in table 4.19.

Table 4.19 Model fit

	SRMR
Saturated model	0.079
Estimated model	0.086

The Structural model of mediating role of agrienterprises farm capabilities on the relationship between entrepreneurial competencies and agrienterprises performance is illustrated in figure 4.3.

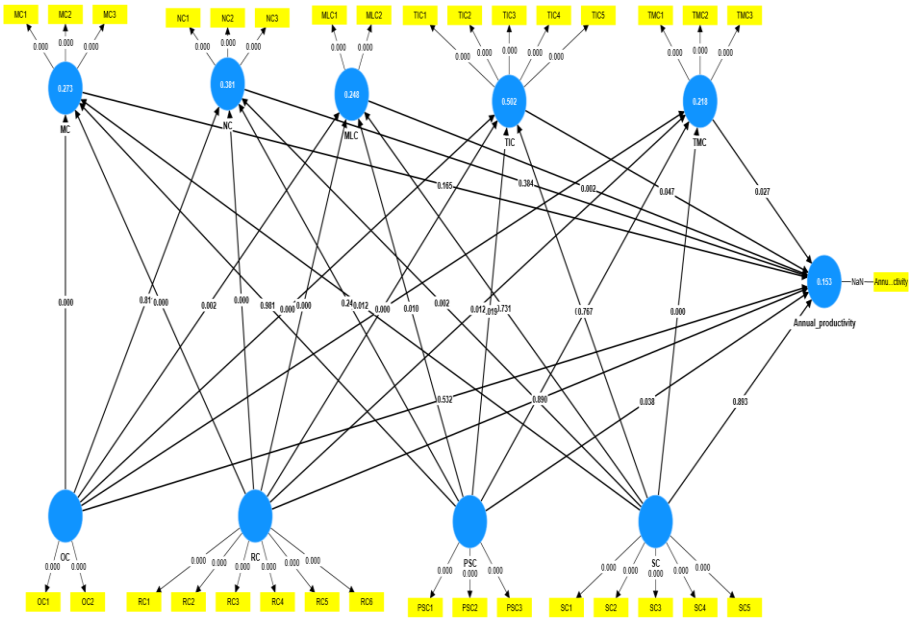

Figure 4.3. Structural model of mediating role of agrienterprises farm capabilities on the relationship between entrepreneurial competencies and agrienterprises performance

4.4.2 Inner model Assessment-Structural model results

Table 4.20 indicates the direct effects of entrepreneurial competencies on agrienterprises farm capabilities, agrienterprises farm capabilities on agrienterprises performance and entrepreneurial competencies on agrienterprises performance.

Table 4.20 Direct effects of entrepreneurial competencies on agrienterprises farm capabilities, agrienterprises farm capabilities on agrienterprises performance and entrepreneurial competencies on agrienterprises performance

	Beta Coefficient	SD	T statistics	P values
MCB -> AP	0.088	0.063	1.389	0.165
MLCB -> AP	0.177	0.058	3.067	0.002***
NCB -> AP	-0.060	0.069	0.871	0.384
OC -> AP	-0.081	0.061	1.324	0.185
OC -> MCB	0.255	0.070	3.650	0.000***
OC -> MLCB	0.233	0.076	3.067	0.002***
OC -> NCB	-0.016	0.065	0.240	0.811
OC -> TICB	0.411	0.054	7.552	0.000***
OC -> TMCB	0.022	0.067	0.323	0.747
PSC -> AP	-0.289	0.106	2.724	0.006***
PSC -> MCB	0.001	0.064	0.023	0.981

PSC -> MLCB	-0.152	0.059	2.585	0.010**
PSC -> NCB	0.066	0.057	1.164	0.244
PSC -> TICB	0.113	0.048	2.346	0.019**
PSC -> TMCB	0.022	0.073	0.296	0.767
RC -> AP	0.011	0.069	0.161	0.872
RC -> MCB	0.236	0.066	3.585	0.000***
RC -> MLCB	0.369	0.072	5.093	0.000***
RC -> NCB	0.413	0.075	5.478	0.000***
RC -> TICB	0.409	0.052	7.904	0.000***
RC -> TMCB	0.189	0.075	2.517	0.012**
SC -> AP	0.034	0.069	0.489	0.625
SC -> MCB	0.150	0.060	2.516	0.012**
SC -> MLCB	-0.024	0.071	0.344	0.731
SC -> NCB	0.265	0.087	3.038	0.002***
SC -> TICB	-0.047	0.053	0.878	0.380
SC -> TMCB	0.315	0.076	4.128	0.000***
TICB -> AP	-0.215	0.109	1.983	0.047**
TMCB -> AP	0.128	0.058	2.211	0.027**

*, **, *** = significant at 10%, 5% and 1% level, respectively Strategic Competency (SC), Relationship Competency (RC), Opportunity Competency (OC), Personal Strength Competency (PSC), Technology Integration Capability (TICB), Networking Capability (NCB), Technology Management Capability (TMCB), Marketing Capability (MCB) and Market Linking Capability (MLCB), Annual productivity (AP).

a. Direct effect of entrepreneurial competencies on technology integration capability, networking capability, technology management capability, marketing capability and market linking capability.

The analysis results indicated that opportunity competency positively influenced technology integration capability (β=0.411 p-value=0.000). This implies that a farmer who is more oriented towards identifying market needs is more likely to uptake new technology. This finding is supported by Kaliba *et al*. (2018) who established that market participation leads to adoption of new crop technologies. Consumers' preferences are ever changing and innovations in agriculture are always aligned to consumer needs. Therefore, farmers who intends to align production and marketing to consumer needs often adopt new technology in order to meet the consumer needs. Personal strength competency was found to positively

influence technology integration capability (β=0.113 p-value=0.019). This means that for a farmer who wants production and marketing activities to run smoothly is more likely to adopt technology. This conclusion is supported by Sims and Kienzle (2016), who link mechanization to improved labour efficiency, enhanced production input efficiency, improved operational timeliness, and the capacity to implement more sustainable production systems.

The analysis showed that relationship competency positively influenced technology integration capability (β=0.409 p-value=0.000). This implies that farmers who interact with other value chain actors are most likely to adopt technology in production. The fact that Irish potato growers in Nyandarua County subscribe to machinery rings provides a logical explanation for this observation. A machinery ring is an association of farmers who provide mutual aid and mechanization services to each other in a community-based self-help group. As a result, farmers that use machinery must communicate with other farmers.

According to the results, relationship competency positively influences networking capability (β=0.413 p-value=0.000). This means that farmers who establish communication with other value chain actor are more likely to incorporate information communication technology in production and marketing. Farmers gain better knowledge about farming techniques when they visit their peer groups and take part in various social programs and this encourages them to use their phones, which are the quickest and easiest way to obtain information, to search for it (Asif *et al*., 2017).

The results further indicated that strategic competency positively influence networking capability (β=0.265 p-value=0.002). This result suggests that a farmer who wants to align production and marketing goals to long term goals is more likely to use Information technology systems such as phones for internal and external communication. This finding is supported by Nyandoro (2016) who stated that Positioning ICT as a tool for an enterprise is related to the strategic influence of the entrepreneur. The agricultural value chain in recent years requires high levels of interconnectedness among actors. This is because consumers have become bolder in demanding for satisfaction of their needs and wants. Therefore, to stay ahead of the curve by aligning production and marketing to current and future market needs, farmers intensify use of information communication technology which provides them access with market information.

Relationship competency was found to positively influence technology management capability (β=0.189 p-value=0.012). This implies that farmers who interact with other value chain actors are most likely to effectively use technology in production and marketing. This

observation makes sense given that Irish potato growers in Nyandarua County are members of machinery rings. Through the machinery rings, farmers that work together as a community-based self-help organization, offering each other mutual assistance and mechanization services. Farmers who intend to utilize machinery effectively therefore need to interact with other farmers.

Strategic competency was also found to positively influence technology management capability (β=0.315 p-value=0.000). Return on investment of agricultural technology is fully attained years after initial investment. To ensure this return is attained, farmers therefore need to align their production and marketing to the long-term goal of gaining from the adoption of the technology. This is supported by Ahmed and Miller (2023) who stated that although initial investment in agricultural machinery is costly, research has shown that farmers who adopt mechanization receive higher income in subsequent years of mechanization use. Thus, farmers who effectively utilize agricultural mechanization are oriented towards long-term production and marketing goals.

Opportunity competency had a positive impact on marketing capability (β=0.255 p-value =0.000). This implies that farmers who engaged with consumers to understand market needs are more likely to consider market information in production, successfully segment the market and implement successful advertising campaigns. The Simple Trade Era (pre-industrial revolution), Production Era (1860s–1920s), Sales Era (1920s–1940s), Marketing Department Era (1940s–1960s), and Marketing Company Era (1960s–1990s) are the eras of marketing that we are presently living in. This era is characterized by relationship marketing, which centers on establishing and preserving connections with customers in order to foster customer loyalty. Thus, interpersonal consumer communication is a vector of quality and market performance (Florea & Duica, 2017).

The results indicated that relationship competency positively influenced marketing capability (β=0.236 p-value=0.000). This implies that farmers who established relationships with other value chain members were more likely to attain marketing success. Farmers engage with other farmers and establish farmer groups such as cooperatives that enable them to implement collective marketing. Through the collective marketing, farmers gain greater bargaining power that benefits them with higher prices and aggregate their produce which reduces transportation cost thus enabling them to access more lucrative market segments such as consumers in distant towns. In summary, collective marketing leads to better sales (Kwezirimana & Mugwe, 2023). Strategic competency was also found to positively influence marketing capability (β=0.150 p-value=0.012). This implies that aligning production towards

long-term goals increases the likelihood of marketing success. Agwu (2018) asserts that in order for businesses to succeed in their industry, they must not only have a well-defined vision and mission, but also carefully implement strategic management techniques to grow their customer base, which will raise transaction volume and, ultimately, market share.

The results indicated that market linking capability was positively influenced by opportunity competency (β=0.233 p-value=0.002). This implies that increased effective engagement with consumers leads to an increased consumer loyalty. Ellitan (2023) asserts that the promotion marketing mix, which includes public relations, advertising, and an overall media strategy, encourages customers to make repeat purchases and select your business over a rival that provides a comparable product or service. Relationship competency was found to positively influence market linking capability (β=0.369 p-value=0.000). This suggests that building and maintaining relationships with customers through relationship marketing encourages customer loyalty. According to Florea and Duica (2017), interpersonal consumer communication is a vector of quality and market performance.

Personal strength competency was found to have a negative impact on market linking capability (β=-0.152 p-value=0.010). Personal strength competency reflects a farmer's self-efficacy. This finding implies that a farmer's confidence in the adequacy of their marketing ability is associated with poor customer loyalty. Numerous studies on self-efficacy show that performance and self-efficacy are favourably correlated. A more nuanced picture is painted by current research, which shows no or even a negative association between performance and self-efficacy. Due to high levels of confidence, self-efficacy has a detrimental impact on performance since it reduces resource allocation (Beck & Schmidt, 2018). Thus, farmers with higher marketing self-efficacy will allocate less resources to customer engagement and this will lead to reduced customer loyalty.

b. Direct effects of entrepreneurial competencies and agrienterprise farm capabilities on performance

With regards to factors influencing performance, market linking capability was found to positively influence annual productivity (β=0.177 p-value=0.002). This implies that enhanced performance is a result of relationship marketing's ability to establish and sustain relationships with customers. Interpersonal customer interactions are a performance vector according to Florea and Duica (2017). Whilst technology management capability was found to positively influence annual productivity (β=0.128 p-value=0.027), technology integration capability was found to negatively impact annual productivity (β=-0.215 p-value=0.047). This is because when other factors of production are held constant, initial investment in

technology is expensive and reduces net profit. However, with years of effective technology management the return on investment will be achieved. This is supported by Ahmed and Miller (2023) who postulated that despite the significant upfront costs associated with purchasing agricultural machinery, studies have indicated that farmers who implement mechanization see increased revenue in the years that follow.

Personal strength competency was also found to negatively affect annual productivity (β=-0.289 p-value=0.006). Personal strength competency is a proxy of a farmer's self-efficacy. This finding implies that a farmer's confidence in the adequacy of their ability is associated with poor performance. According to Beck and Schmidt (2018), high levels of self-efficacy efficacy decrease resource allocation, which has a negative effect on performance. Therefore, less resources will be contributed to the business by farmers who have greater levels of self-, which will result in lower performance.

4.4.3 Mediation analysis results for agrienterprise farm capabilities on the relationship between entrepreneurial competencies and agrienterprise performance

In mediation analysis, we take into account an intermediate variable, referred to as the mediator, which aids in the explanation of how or why an independent variable (entrepreneurial competency) affects a dependent variable (performance). It was critical to conduct a mediation analysis in this objective because according to Kisubi (2022), although capabilities determine performance, they are influenced by entrepreneurial competencies. Further it is suggested by Hwang *et al*. (2020) that capabilities analysis be used to look at how competencies affect performance. The results for the mediation analysis for agrienterprise farm capabilities on the relationship between entrepreneurial competencies and agrienterprise performance are shown in table 4.21.

Table 4.21 Mediation analysis results

	Specific indirect effects		**Direct effects**		
Path	Beta Coefficient	P values	Path	Beta Coefficient	P values
PSC -> TMCB -> AP	0.003	0.810			
PSC -> MLCB -> AP	-0.027	0.035**	PSC -> AP	-0.289	0.006***
RC -> TICB -> AP	-0.088	0.058*	RC -> AP	0.011	0.872
OC -> MCB -> AP	0.022	0.235			
OC -> TICB -> AP	-0.088	0.060*	OC -> AP	-0.081	0.185

RC -> TMCB -> AP	0.024	0.113			
RC -> MCB -> AP	0.021	0.215			
PSC -> NCB -> AP	-0.004	0.551			
RC -> MLCB -> AP	0.065	0.011**	RC -> AP	0.011	0.872
SC -> NCB -> AP	-0.016	0.411			
PSC -> TICB -> AP	-0.024	0.187			
SC -> TICB -> AP	0.010	0.477			
OC -> NCB -> AP	0.001	0.886			
RC -> NCB -> AP	-0.025	0.422			
SC -> TMCB -> AP	0.040	0.054*	SC -> AP	0.034	0.625
PSC -> MCB -> AP	0.000	0.985			
OC -> TMCB -> AP	0.003	0.784			
OC -> MLCB -> AP	0.041	0.049**	OC -> AP	-0.081	0.185
SC -> MCB -> AP	0.013	0.235			
SC -> MLCB -> AP	-0.004	0.758			

*, **, *** = significant at 10%, 5% and 1% level, respectively Strategic Competency (SC), Relationship Competency (RC), Opportunity Competency (OC), Personal Strength Competency (PSC), Technology Integration Capability (TICB), Networking Capability (NCB), Technology Management Capability (TMCB), Marketing Capability (MCB) and Market Linking Capability (MLCB), Annual productivity (AP).

The results further indicate that both the direct relationship from personal strength competency to annual productivity (β=-0.289 p-value=0.006) and the indirect relationship through market linking capability (β=-0.027 p-value=0.035) are significant. We therefore conclude that market linking capability partially mediates the relationship since both the direct and the indirect effects are significant and meaningful. This implies that even with a loyal customer base, a farmer with high self-efficacy will not necessarily increase production. High levels of self-efficacy, according to Beck and Schmidt (2018), reduce resource allocation, which has a detrimental impact on performance. Thus, a farmer with a customer base may reduce production capacity because of the confidence that they will still be able to profitable sell whatever they will produce to their clientele. To further corroborate the type of partial mediation, we contemplate the direction of the effect. Since the direct and indirect effects are both negative, market linking capability represents complementary mediation of the relationship from personal strength competency to annual productivity (Hair *et al*., 2021).

The results also show that whilst the direct relationship from relationship competency to annual productivity is not significant, the relationship is negatively significant through technology integration capability (β=-0.088 p-value=0.058). Thus, technology integration capability fully mediates the relationship from relationship competency to annual productivity. This implies that a farmer's interacting with stakeholders and keeping up to date with recent knowledge, technology and processes about Irish potato production and marketing will not translate into improved productivity without actual integration of the knowledge, technology and processes in Irish potato production and marketing. This relationship path is supported by Kashada *et al*. (2016) who explained that with the adoption of any new technology, the chance of the investment's success increases however, awareness of the technology has a direct influence on the adoption of the particular technology. But with other production factors held constant, the initial investment in technology lowers net profit because it is an expensive endeavor (Ahmed & Miller, 2023).

The relationship from opportunity competency to annual productivity was also found to be negatively significant through technology integration capability (β=-0.088 p-value=0.060). In this way, technology integration capability also fully mediates the relationship from opportunity competency to annual productivity. This implies that other than just gathering market information, farmers need to invest in appropriate technologies required to deliver market needs in order to incentivize increased performance. However, considering that investment in technology is expensive, with other factors of production are held constant, initial investment in technology reduces net profit (Ahmed & Miller, 2023).

The direct relationship from relationship competency to annual productivity is not significant (β=0.011 p-value=0.872) but the indirect relationship through market linking capability is positively significant (β=0.065 p-value=0.011). We conclude that market linking capability fully mediates the relationship from relationship competency to annual productivity. This finding implies that continued engagement with customers is the basis of incentivizing increased production other than just one-off market communication. This finding is corroborated by Vishnoi *et al*. (2019) who stated that market intelligence which is obtained through analysis of generated information about customer requirements from customer communication is related commercial performance though a mediating connection of customer loyalty.

The results indicate that while the direct relationship from strategic competency to annual productivity is not significant (β=0.034 p-value=0.625), the indirect relationship through technology management capability is positively significant (β=0.040p-value=0.054).

We conclude that technology management capability fully mediates the relationship between strategic competency and annual productivity. The implication of this finding is that a farmer redesigning production activity to better meet long-term objectives and uncertainties will not necessarily lead to increased farm performance without the farmer first gaining adequate knowledge of adopted technologies, acquiring sufficient facilities aligned to the changes and implementing quality assurance on the changes. This study is supported by Köseoglu *et al*. (2020) who among other factors, identified appropriate training, resource allocation, and quality control as key success factors of strategy implementation.

The direct relationship from opportunity competency to annual productivity is found to be insignificant (β=-0.081 p-value=0.185). However, the indirect relationship through market linking capability is positively significant (β=0.041 p-value=0.049) hence, market linking capability fully mediates the relationship from opportunity competency to annual productivity. This study suggests that encouraging greater production requires more than just obtaining market data; it also requires building meaningful, long-term relationships with customers. Vishnoi *et al*. (2019), who claimed that market intelligence is connected to corporate success through a mediating link of customer loyalty, support this conclusion.

This indirect effect of entrepreneurial competencies on performance through firm capabilities concur with Kisubi *et al*. (2022) who postulated that the relationship between entrepreneurial competencies and SME performance is mediated by a firm's capabilities. While enhanced entrepreneurial competencies are theorized to lead to improved agribusiness performance, agripreneurs operations operate with resource constraints that limit the profitable employment of the competencies. These resources include conventional resources such as finances as well as organization level capabilities such as adopted routines and procedures for technology integration and marketing. Nevertheless, as postulated by the dynamic capability theory and now empirically established by this study, entrepreneurial competencies fuel the accumulation of firm capabilities thus overcoming the capability resources and improving performance.

CHAPTER FIVE

SUMARRY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

In Kenya, the Irish potato value chain is an important subsector for industrialization, employment, and food security. Nonetheless, agronomic and marketing difficulties remain a recurring problem for small-holder Irish potato farmers, which has led to subpar output. With little success, a great deal of agronomic and marketing-related research has been conducted to solve the issues Irish potato producers face. Research has indicated that possessing entrepreneurial competencies offers a feasible approach to tackle agronomic and marketing issues while improving overall performance. Numerous studies also suggest that enterprise farm capabilities might help improve performance in a dynamic environment by supporting the effective adaptation of human and financial resources, including entrepreneurial competences. There is, however, little empirical data regarding the integrative impact of entrepreneurial competencies and agrienterprise farm capabilities on the performance of smallholder Irish potato farmers in Kenya because research on this topic has primarily been carried out in developed nations.

Therefore, this study sought to appraise the nexus of entrepreneurial competency, agrienterprise farm capability and, performance of smallholder Irish potato farmers in Nyandarua County in Kenya. The specific objectives of the study were: to explore the entrepreneurial competencies and agrienterprise farm capabilities of smallholder Irish potato farmers, to identify factors influencing entrepreneurial competency among smallholder Irish potato farmers and, to determine the effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya. A multistage sampling method was used to select a sample of 249 smallholder Irish potato farmers in Nyandarua County. Through a Cross-sectional survey, data were collected using a standardized questionnaire and analyzed through Principal Component Analysis, Multivariate Multiple Regression and Structural Equation Modeling using STATA and Smart PLS.

Findings of the study

Objective 1: Entrepreneurial competency and agrienterprise farm capabilities levels among smallholder Irish potato farmers in Nyandarua County, Kenya.

The results indicated that the farmers exhibited the following entrepreneurial competencies; Strategic competency, Relationship competency, Opportunity competency and Personal strength competency. With regards to scoring the entrepreneurial competencies, the

results indicated that with the exception of opportunity competency, all of the competencies found for the farmers are near the upper bound. Opportunity competency had the lowest average score (47%), which suggests there is the most space for development. The strongest competency found was personal strength competency (83%) followed by relationship competency (73%) and finally, strategic competency (69%). With average scores of 83% and lower for each of these competences, there is still opportunity for development.

The results showed that the farmers possessed the following agrienterprise farm capabilities; Technology integration capability, Networking capability, Technology management capability, Marketing capability and Market linking capability. With regards to scoring the capabilities, the strongest agrienterprise farm capability found was networking capability (71%) followed by technology management capability (60%), followed by market linking capability (53%) and finally, technology integration capability and marketing capability scoring the lowest (47%).

Objective 2: Factors influencing entrepreneurial competency among smallholder Irish potato farmers in Nyandarua County, Kenya

The results showed that the amount of land used for Irish potato cultivation had a beneficial impact on strategic competency. The findings also demonstrated a positive relationship between strategic competency and government extension access. The findings showed that production mechanization enhanced strategic competency. Relationship competency was found to be positively impacted by attending entrepreneurial trainings. It was also discovered that price had a positive impact on relationship competency. Relationship competency was found to be positively impacted by access to government extensions

The results also showed that production mechanization has a positive impact on relationship competency. The findings indicated that relationship competency was more likely to be developed by female farmers. Age was found to have a detrimental influence on opportunity competency. Participating in entrepreneurial trainings was found to improve opportunity competency. Opportunity competency was also positively influenced by the area of land used for Irish potato cultivation. Opportunity competency was found to be positively impacted by the price of Irish potato produce.

Access to NGO extension was found to have a detrimental impact on the development of opportunity competency, whereas access to government extension was found to positively impact opportunity competency. Opportunity competency was found to be negatively

impacted by the distance to the output market. It was discovered that farmers selling their own produce at both local and non-local markets have a positive impact on opportunity competency. There was a negative relationship established between age and personal strength competency. On the other hand, it was discovered that having farming experience improved one's personal strength competency. The amount of the area used for Irish potato production was found to positively impact personal strength competency.

The outcomes also demonstrated a negative relationship between produce price and personal strength competency. Personal strength competency was positively impacted by having access to private extension. Personal strength competency was positively impacted by production mechanization. It was discovered that the distances to the tarmac road and the output market had a beneficial impact on personal strength competency.

Objective 3: The effect of entrepreneurial competency mediated by agrienterprise farm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya

The results indicate that while the direct relationship from strategic competency to annual productivity is not significant, the indirect relationship through technology management capability is positively significant. Therefore, technology management capability fully mediates the relationship between strategic competency and annual productivity.

The direct relationship from relationship competency to annual productivity is not significant but the indirect relationship through market linking capability is positively. Thus, market linking capability fully mediates the relationship from relationship competency to annual productivity. The results also show that whilst the direct relationship from relationship competency to annual productivity is not significant, the relationship is negatively significant through technology integration capability. Thus, technology integration capability fully mediates the relationship from relationship competency to annual productivity.

The direct relationship from opportunity competency to annual productivity is found to be insignificant. However, the indirect relationship through market linking capability is positively significant hence, market linking capability fully mediates the relationship from opportunity competency to annual productivity. The relationship from opportunity competency to annual productivity was also found to be negatively significant through technology integration capability. In this way, technology integration capability also fully mediates the relationship from opportunity competency to annual productivity.

The results further indicate that both the direct relationship from personal strength competency to annual productivity and the indirect relationship through market linking are significant. We therefore conclude that market linking capability partially mediates the relationship since both the direct and the indirect effects are significant and meaningful.

5.3 Conclusions

The following are the key conclusions of the study according to the objectives.

i. Smallholder Irish potato farmers are limited in; recognizing and capitalizing the variety of market opportunities in the potato value chain such as producing for fast food eateries, adopting new technologies developed for potato producers such as certified seed and identifying and fulfilling the different market needs of consumers in the potato value chain for example through producing different varieties for conventional markets and fast food eateries.

ii. Smallholder Irish potato farmers can enhance their entrepreneurial competency through attending entrepreneurship trainings, accessing government extension services, accessing private extension service, mechanizing Irish potato production and choosing market channels with better market prices for example through direct selling of produce to market instead of using brokers.

iii. Smallholder Irish potato farmers can increase their performance by enhancing entrepreneurial competencies subject to using production technologies in production and establishing loyal customer base.

5.4 Recommendations

From the findings of the study, the following are some recommendations that can be derived;

i. *Entrepreneurship capacity building trainings for smallholder Irish potato farmers* – The capacity building trainings should place greater emphasis on improving the capacity of farmers in recognizing and capitalizing the variety of market opportunities in the potato value chain through training farmers in opportunity identification and capitalization models such as human centred design thinking where farmers production processes and products should be based on actual consumer needs. The trainings should also up skill the farmers on adopting new technologies developed for potato producers through models for technology adoption such as innovation value chain which facilitates farmers to systematically learn, test, improve and fully adopt technologies. Finally the trainings should also focus on capacity building the farmers in identifying and fulfilling the different market needs of

consumers in the potato value chain through training them on market segmentation and developing going to market strategies.

ii. *Bundled agribusiness support services for smallholder Irish potato farmers* – Because entrepreneurial competencies were enhanced by varied factors, it is recommended that agribusiness support services for smallholder Irish potato farmers should be offered as a bundle instead of only offering individual services. The bundle should cover entrepreneurship, mechanization and marketing and it should be offered by government or private extension organizations.

iii. *Collective technology integration, technology management and marketing programs for smallholder Irish potato farmers* – because farmers can only utilize their entrepreneurial competencies for improved performance through technology and marketing capabilities, it is recommended that programs which eases technology adoption, technology management and marketing be implemented by the farmers. Technology adoption and management programs such as machinery rings helps farmers adopt and properly utilize technologies through reducing costs and providing expert services. Through Blockchain technology and cooperatives, farmers can directly sell to preferred customers at reduced costs without need for intermediaries.

5.5 Suggestions for further research

As this study has established that entrepreneurial competencies do not directly influence farm performance, more research should be conducted on other mediators of this relationship. This is because entrepreneurial competencies are currently being championed as the pathway to improved performance however, this study has established that this relationship does not occur directly.

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APPENDICES

APPENDIX A: QUESTIONNAIRE

The purpose of this study is to assess the effect of entrepreneurial competency and agrienterprise firm capability on performance of smallholder Irish potato farmers in Nyandarua County, Kenya. You have been identified as a useful informant to assist us (Egerton University) to achieve this mission. Your participation is voluntary and you are assured that the information you provide will be treated with confidentiality and used for the sole purpose of research. Kindly respond to the queries below. If you need more writing space you can attach more paper.

Questionnaire identification

Questionnaire Number _____

Sub-County _____ Ward _____

Name of Enumerator_____

Date_____ Starting time_____ Finishing time_____

SECTION A: PERSONAL ATTRIBUTES

A1: Provide the following details

Age (*years*)	**Gender** *1 = Male* *0 = Female*	**Farming Experience** *Experience in Irish potato farming in years*	**Entrepreneurship education** *Have you attended any entrepreneurship trainings* *1 = Yes* *0 = No*

SECTION B: ORGANIZATIONAL ATTRIBUTES

B1: Provide the following details

Land size *Size of land under Irish potato farming in acres*	**Irish potato yield** *Average yield of bags per acre of Irish potato*

B2: Provide the following details

Question	**Response**

Did you use improved seeds in the previous season? *1 = yes 0 = no*	
Did you use any agrochemicals in the previous season? *1 = yes 0 = no*	
Accessed government extension in the previous season? *1 = yes 0 = no*	
Accessed NGO extension in the previous season? *1 = yes 0 = no*	
Accessed private extension in the previous season? *1 = yes 0 = no*	
Adoption of mechanization *1 = yes 0 = no*	

SECTION C: MARKET ATTRIBUTES

C1: Provide the following details

Question	**Response**
What price average price of Irish potato in KES per 50KG bag did you receive in the previous year	
What is the distance to the nearest output market in KM	
Quantity of Irish potatoes sold to broker in the previous year	
Quantity of Irish potatoes self-sold at local market in the previous season	
Quantity of Irish potatoes self-sold at no-local market in the previous season	
Distance of murram road to the tarmac road in KM	

SECTION D: AGRIENTERPRISE FARM CAPABILITIES

D1: In your opinion, state your level of agreement or disagreement to the following statements regarding agrienterprise farm capabilities. (1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neither agree nor disagree, 5=slightly agree, 6=Agree, 7=strongly agree)

		Score						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Mc1	I have comprehensive knowledge of Irish potato marketing channels							
Mc2	I have comprehensive knowledge about the marketing activities of other Irish potato farmers in my locality							
Mc3	I consider marketing in the production of Irish potatoes							
Mc4	I have the skills to segment and target different markets channels							
Mc5	The pricing strategy I implement is effective							

Mc6	The advertising strategy I implement is effective							
Mlc1	I have the skills to collect and understand information about the needs of existing and potential customers							
Mlc2	I establish relationships with channel members such as whole sellers, retailers							
Mlc3	I manage durable relationship with market channels members such as whole sellers, retailers							
Mlc4	I create and manage durable relationships with input suppliers							
Mlc5	I establish relationships with customers							
Mlc5	I have the ability to retain customers							
Itc1	I use Information technologies systems such as phones for learning of new working methods (NWM) such as adopting improved seed							
Itc2	I use Information technology systems such as phones for facilitating adoption and implementation of new working methods (NWM) such as adopting improved seed							
Itc3	I use Information technology systems such as phones for acquiring market information							
Itc4	I use Information technology systems such as phones for internal communication of Irish potato production activities with my staff							
Itc4	I use Information technology systems such as phones for external communication (e.g., suppliers, customers, channel members, etc.)							
Tc1	I adopt and adapt new working methods (NWM) such as adopting improved seed							
Tc2	I add value to my Irish potatoes prior to marketing							
Tc3	I develop new working methods (NWM) such as Irish potato seed production							
Tc4	I have adequate knowledge of development of new working methods (NWM) such as mechanization and new varieties							

Tc5	I have adequate Production facilities for optimal Irish potato production							
Tc6	I have Quality control skills for optimal Irish potato production and marketing							
Mngc1	I effectively coordinate all the activities and resources required from production up to delivery of goods to customer							
Mngc2	I effectively control the production costs							
Mngc3	I have financial management skills							
Mngc4	I effectively manage Human resources							
Mngc5	I achieve accuracy in profitability and revenue forecasting							
Mngc5	I conduct an effective Marketing planning process							

SECTION E: ENTREPRENEURIAL COMPETENCIES

E1: In your opinion, state your level of agreement or disagreement to the following statements regarding entrepreneurial competencies. (1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neither agree nor disagree, 5=slightly agree, 6=Agree, 7=strongly agree)

		Scores						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Oc1	Identify products the Irish potato market needs							
Oc2	Perceive unmet consumer needs							
Oc3	Actively look for Irish potato products that provide real benefit to customers							
Oc4	Seize high-quality business opportunities							
rc1	Develop long-term trusting relationships with others							
rc2	Negotiate with others							
rc3	Interact with others							

rc4	Maintain a personal network of work contacts							
rc5	Understand what others mean by their words and actions							
rc6	Communicate with others effectively							
ac1	Apply ideas, issues, and observations from other crops to Irish potato production							
ac2	Integrate ideas, issues, and observations from Irish potato production to other crop production							
ac3	Take reasonable job-related risks							
ac4	Monitor progress toward objectives in risky actions							
ic1	Look at old problems in new ways							
ic2	Explore new ideas							
ic3	Treat new problems as opportunities							
opc1	Plan the operations of the business							
opc2	Plan the organisation of different resources							
opc3	Keep the farming organisation running smoothly							
opc4	Organise resources							
Opc5	Coordinate tasks							
hc1	Supervise lower ranking employees							
hc2	Lead employees							
hc3	Organise people							

hc4	Motivate people							
hc5	Delegate effectively							
sc1	Determine long-term issues, problems, or opportunities in Irish potato production							
sc2	Aware of the projected directions of the industry and how changes might impact my Irish potato production							
sc3	Prioritize production activities in alignment with marketing goals							
sc4	Redesign production activities to better meet long-term objectives and changes							
sc5	Align current production activities and marketing activities with long term goals							
sc6	Monitor and evaluate progress toward long term goals							
sc7	Determine production activities to achieve long term goals by weighing costs and benefits							
cc1	Dedicated to make the venture work whenever possible							
cc2	Refuse to let the venture fail whenever appropriate							
cc3	Possess an extremely strong internal drive							
cc4	Commit to long-term business goals							
lc1	Learn from a variety of means							
lc2	Learn proactively							
lc3	Learn as much as I can in my field							

lc4	Keep up to date in my field							
lc5	Apply learned skills and knowledge into actual practices							
psc1	Maintain a high energy level							
psc2	Motivate self to function at optimum level of performance							
psc3	Respond to constructive criticism							
psc4	Maintain a positive attitude							
psc5	Prioritise tasks to manage my time							
psc6	Identify my own strengths and weaknesses and match them with opportunities and threats							
psc7	Manage my own career development							

APPENDIX B: National Commission for Science Technology and Innovation (NACOSTI) clearance certificate

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **402368**

Date of Issue: **20/December/2023**

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APPENDIX C: Raw results of responses to Entrepreneurial Competency and Agrienterprise Firm Capability statements

	Minimum	Maximum	Mean	Std. Deviation
mc1	1	7	3.86	1.874
mc2	1	7	4.47	1.909
mc3	1	7	3.96	1.909
mc4	1	7	2.99	1.774
mc5	1	7	3.10	1.721
mc6	1	7	2.86	1.637
mlc1	1	7	3.55	1.687
mlc2	1	7	4.50	1.695
mlc3	1	7	4.58	1.752
mlc4	1	7	5.08	1.677
mlc5	1	7	3.56	2.005
mlc6	1	7	3.84	1.970
itc1	1	7	3.51	2.176
itc2	1	7	3.31	2.019
itc3	1	7	3.89	2.191
itc4	1	7	5.09	1.737
itc5	1	7	5.14	1.813
tc1	1	7	3.39	2.147
tc2	1	7	2.71	2.011
tc3	1	7	3.31	2.119
tc4	1	7	4.09	1.950
tc5	1	7	4.47	2.010
tc6	1	7	4.10	1.718
mngc1	1	7	5.67	1.246
mngc2	1	7	5.31	1.395
mngc3	1	7	4.75	1.861
mngc4	1	7	5.96	1.189
mngc5	1	7	3.10	1.829
mngc6	1	7	3.61	1.971
oc1	1	7	3.77	1.890
oc2	1	7	2.88	1.754
oc3	1	7	3.65	1.888
oc4	1	7	4.62	1.688
rc1	1	7	4.76	1.611
rc2	1	7	5.20	1.577
rc3	1	7	5.63	1.247

rc4	1	7	4.85	1.545
rc5	1	7	4.30	1.741
rc6	1	7	5.16	1.541
ac1	1	7	5.69	1.312
ac2	1	7	5.65	1.242
ac3	1	7	4.92	1.743
ac4	1	7	5.25	1.598
ic1	1	7	5.08	1.611
ic2	1	7	5.17	1.450
ic3	1	7	4.87	1.744
opc1	1	7	5.49	1.232
opc2	1	7	5.45	1.364
opc3	1	7	5.50	1.280
opc4	1	7	5.80	1.136
hc1	1	7	6.33	.964
hc2	1	7	6.24	1.049
hc3	1	7	6.19	1.045
hc4	1	7	6.01	1.286
hc5	1	7	5.44	1.736
sc1	1	7	4.34	1.614
sc2	1	7	3.90	1.692
sc3	1	7	4.65	1.678
sc4	1	7	4.71	1.506
sc5	1	7	4.84	1.494
sc6	1	7	5.07	1.520
sc7	1	7	5.03	1.549
cc1	2	7	6.00	.864
cc2	2	7	5.90	1.009
cc3	2	7	6.09	.971
cc4	1	7	5.37	1.542
lc1	1	7	5.65	1.344
lc2	1	7	5.05	1.598
lc3	1	7	5.53	1.344
lc4	1	7	4.79	1.681
lc5	1	7	5.78	1.402
psc1	2	7	5.99	.967
psc2	2	7	6.04	.888
psc3	1	7	5.39	1.523
psc4	1	7	5.92	.912
psc5	2	7	5.69	1.006

psc6	2	7	6.01	.896
psc7	2	7	5.80	1.001
Valid N (listwise)				

APPENDIX D: PCA results

PCA for entrepreneurial competencies

```
. factor $xlist,pcf
(obs=249)
Factor analysis/correlation                       Number of obs    =        249
    Method: principal-component factors           Retained factors =          4
    Rotation: (unrotated)                         Number of params =         58
    --------------------------------------------------------------------------
         Factor  |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      6.34625      4.51171            0.3966       0.3966
        Factor2  |      1.83454      0.39999            0.1147       0.5113
        Factor3  |      1.43454      0.17845            0.0897       0.6010
        Factor4  |      1.25610      0.49903            0.0785       0.6795
        Factor5  |      0.75706      0.07124            0.0473       0.7268
        Factor6  |      0.68582      0.06818            0.0429       0.7696
        Factor7  |      0.61764      0.10416            0.0386       0.8082
        Factor8  |      0.51348      0.04906            0.0321       0.8403
        Factor9  |      0.46442      0.03095            0.0290       0.8694
       Factor10  |      0.43347      0.07551            0.0271       0.8965
       Factor11  |      0.35796      0.03851            0.0224       0.9188
       Factor12  |      0.31945      0.01868            0.0200       0.9388
       Factor13  |      0.30077      0.05143            0.0188       0.9576
       Factor14  |      0.24934      0.01084            0.0156       0.9732
       Factor15  |      0.23850      0.04784            0.0149       0.9881
       Factor16  |      0.19066            .            0.0119       1.0000
    --------------------------------------------------------------------------
    LR test: independent vs. saturated: chi2(120) = 1994.32 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
    -----------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4 |   Uniqueness
    -------------+--------------------------------------+--------------
             oc1 |   0.6303   -0.1593   -0.1641    0.5303 |      0.2691
             oc2 |   0.4336   -0.1476   -0.2040    0.7417 |      0.1985
             rc1 |   0.7124   -0.3817    0.0695    0.0999 |      0.3319
             rc3 |   0.6247   -0.1732    0.0165   -0.4141 |      0.4080
             rc4 |   0.6732   -0.4240    0.0988   -0.1568 |      0.3327
             rc6 |   0.7391   -0.4117   -0.0002   -0.1952 |      0.2462
            opc3 |   0.1179    0.6104    0.2859    0.2605 |      0.4639
             sc3 |   0.7047    0.3014   -0.2259    0.0375 |      0.3601
             sc4 |   0.7726    0.3361   -0.0591   -0.0159 |      0.2864
             sc5 |   0.7765    0.4353   -0.1129   -0.0808 |      0.1884
             sc6 |   0.7907    0.2868   -0.2556   -0.1700 |      0.1984
             sc7 |   0.7093    0.3826   -0.2837   -0.1882 |      0.2345
             lc3 |   0.6150   -0.2686    0.2135   -0.0880 |      0.4963
             lc4 |   0.6522   -0.3295    0.2193    0.1174 |      0.4042
            psc4 |   0.3805    0.1840    0.6696    0.1347 |      0.3549
            psc6 |   0.2771    0.2311    0.7172   -0.0228 |      0.3550
    -----------------------------------------------------------------------
```

```
. estat kmo
Kaiser-Meyer-Olkin measure of sampling adequacy
    ----------------------
        Variable |     kmo
    -------------+--------
             oc1 |  0.8448
             oc2 |  0.7449
             rc1 |  0.9053
             rc3 |  0.9292
             rc4 |  0.8912
             rc6 |  0.8864
            opc3 |  0.6455
             sc3 |  0.9359
             sc4 |  0.9360
             sc5 |  0.9004
             sc6 |  0.9039
             sc7 |  0.9128
             lc3 |  0.9354
             lc4 |  0.9010
            psc4 |  0.7446
            psc6 |  0.7261
    -------------+--------
         Overall |  0.8886
    ----------------------

. pca $xlist
Principal components/correlation                  Number of obs    =        249
                                                  Number of comp.  =         16
                                                  Trace            =         16
    Rotation: (unrotated = principal)             Rho              =     1.0000
    --------------------------------------------------------------------------
       Component |   Eigenvalue   Difference         Proportion   Cumulative
    -------------+------------------------------------------------------------
           Comp1 |      6.34625      4.51171             0.3966       0.3966
           Comp2 |      1.83454      .399991             0.1147       0.5113
           Comp3 |      1.43454      .178448             0.0897       0.6010
           Comp4 |       1.2561      .499033             0.0785       0.6795
           Comp5 |      .757062     .0712389             0.0473       0.7268
           Comp6 |      .685824     .0681803             0.0429       0.7696
           Comp7 |      .617643       .10416             0.0386       0.8082
           Comp8 |      .513483     .0490635             0.0321       0.8403
           Comp9 |      .464419     .0309532             0.0290       0.8694
          Comp10 |      .433466     .0755098             0.0271       0.8965
          Comp11 |      .357956     .0385069             0.0224       0.9188
          Comp12 |      .319449     .0186777             0.0200       0.9388
          Comp13 |      .300772     .0514322             0.0188       0.9576
          Comp14 |      .249339     .0108387             0.0156       0.9732
          Comp15 |      .238501     .0478403             0.0149       0.9881
          Comp16 |       .19066            .             0.0119       1.0000
    --------------------------------------------------------------------------

Principal components (eigenvectors)
    ------------------------------------------------------------------------------------
        Variable |    Comp1     Comp2     Comp3     Comp4     Comp5     Comp6     Comp7
    -------------+----------------------------------------------------------------------
             oc1 |   0.2502   -0.1176   -0.1371    0.4732   -0.2352   -0.1920   -0.0618
             oc2 |   0.1721   -0.1090   -0.1703    0.6618    0.1601   -0.0813    0.2179
             rc1 |   0.2828   -0.2818    0.0580    0.0891    0.2175   -0.1842   -0.2239
             rc3 |   0.2480   -0.1279    0.0138   -0.3695    0.3224   -0.0968    0.1498
```

```
         rc4 |   0.2672   -0.3130    0.0825   -0.1399    0.3108   -0.1969   -0.0546
         rc6 |   0.2934   -0.3039   -0.0002   -0.1742    0.1068   -0.0277   -0.2616
        opc3 |   0.0468    0.4507    0.2387    0.2324    0.6789    0.3143   -0.1084
         sc3 |   0.2797    0.2226   -0.1886    0.0335   -0.0010    0.1547    0.0958
         sc4 |   0.3067    0.2481   -0.0494   -0.0142   -0.0377   -0.1743    0.1329
         sc5 |   0.3082    0.3214   -0.0942   -0.0721   -0.0620    0.0026   -0.0066
         sc6 |   0.3139    0.2117   -0.2134   -0.1517   -0.1421   -0.0167   -0.0390
         sc7 |   0.2816    0.2825   -0.2369   -0.1680   -0.1488   -0.0208   -0.1123
         lc3 |   0.2441   -0.1983    0.1783   -0.0785   -0.1392    0.6002    0.3209
         lc4 |   0.2589   -0.2433    0.1831    0.1047   -0.1926    0.4020    0.1297
        psc4 |   0.1511    0.1358    0.5590    0.1202   -0.2910    0.0196   -0.5991
        psc6 |   0.1100    0.1707    0.5988   -0.0203   -0.1009   -0.4446    0.5227
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
    Variable |    Comp8     Comp9    Comp10    Comp11    Comp12    Comp13    Comp14
-------------+-----------------------------------------------------------------
         oc1 |   0.0030   -0.0658    0.2296    0.6103   -0.2878    0.0953   -0.0522
         oc2 |   0.1662    0.2036    0.0962   -0.3820    0.3628    0.1331    0.0938
         rc1 |  -0.2631   -0.3670    0.1519   -0.2430   -0.0607   -0.4777   -0.2532
         rc3 |   0.6504   -0.0899    0.4305    0.0146   -0.0579    0.0336   -0.0448
         rc4 |  -0.1511    0.3110   -0.3891    0.1093   -0.1356    0.4480   -0.3442
         rc6 |  -0.2157   -0.0241   -0.0895    0.0917    0.3356    0.0003    0.6552
        opc3 |  -0.0665    0.0611    0.0188    0.2931   -0.0390   -0.0993    0.0760
         sc3 |   0.0078   -0.7391   -0.2786   -0.1008   -0.0795    0.3328    0.0268
         sc4 |  -0.1194    0.2732   -0.0946   -0.3202   -0.5513   -0.3056    0.1652
         sc5 |   0.0117    0.1313   -0.1206   -0.1986    0.1804    0.1546   -0.2328
         sc6 |   0.0758    0.1770    0.0946    0.0972   -0.1097    0.0637    0.3693
         sc7 |  -0.1134    0.1086    0.1093    0.2287    0.4883   -0.2505   -0.3657
         lc3 |  -0.3858    0.0883    0.4211   -0.0812   -0.0654    0.1717   -0.0744
         lc4 |   0.4080    0.0581   -0.5021    0.1500    0.0311   -0.4021   -0.0435
        psc4 |   0.2077    0.0198    0.1320   -0.2266   -0.0174    0.2167   -0.0273
        psc6 |  -0.1215   -0.1328   -0.0312    0.1479    0.2171   -0.0198    0.0910
-------------------------------------------------------------------------------

------------------------------------------------
    Variable |   Comp15    Comp16 | Unexplained
-------------+--------------------+-------------
         oc1 |  -0.0000   -0.2466 |           0
         oc2 |   0.0879    0.1473 |           0
         rc1 |  -0.3159    0.1270 |           0
         rc3 |   0.1153   -0.1149 |           0
         rc4 |   0.0617    0.2042 |           0
         rc6 |   0.1474   -0.2889 |           0
        opc3 |  -0.0259   -0.0023 |           0
         sc3 |   0.1974    0.1076 |           0
         sc4 |   0.3867   -0.1332 |           0
         sc5 |  -0.4816   -0.6081 |           0
         sc6 |  -0.4945    0.5600 |           0
         sc7 |   0.3996    0.1945 |           0
         lc3 |   0.0284   -0.0013 |           0
         lc4 |  -0.0635    0.0267 |           0
        psc4 |   0.1391    0.0900 |           0
        psc6 |  -0.0639    0.0604 |           0
------------------------------------------------

. factor $xlist, pcf factors(4)
(obs=249)
Factor analysis/correlation                       Number of obs    =        249
```

```
    Method: principal-component factors          Retained factors =          4
    Rotation: (unrotated)                        Number of params =         58

    --------------------------------------------------------------------------
         Factor  |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      6.34625      4.51171            0.3966       0.3966
        Factor2  |      1.83454      0.39999            0.1147       0.5113
        Factor3  |      1.43454      0.17845            0.0897       0.6010
        Factor4  |      1.25610      0.49903            0.0785       0.6795
        Factor5  |      0.75706      0.07124            0.0473       0.7268
        Factor6  |      0.68582      0.06818            0.0429       0.7696
        Factor7  |      0.61764      0.10416            0.0386       0.8082
        Factor8  |      0.51348      0.04906            0.0321       0.8403
        Factor9  |      0.46442      0.03095            0.0290       0.8694
       Factor10  |      0.43347      0.07551            0.0271       0.8965
       Factor11  |      0.35796      0.03851            0.0224       0.9188
       Factor12  |      0.31945      0.01868            0.0200       0.9388
       Factor13  |      0.30077      0.05143            0.0188       0.9576
       Factor14  |      0.24934      0.01084            0.0156       0.9732
       Factor15  |      0.23850      0.04784            0.0149       0.9881
       Factor16  |      0.19066            .            0.0119       1.0000
    --------------------------------------------------------------------------
    LR test: independent vs. saturated: chi2(120) = 1994.32 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
    ------------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4 |   Uniqueness
    -------------+----------------------------------------+--------------
             oc1 |   0.6303   -0.1593   -0.1641    0.5303 |      0.2691
             oc2 |   0.4336   -0.1476   -0.2040    0.7417 |      0.1985
             rc1 |   0.7124   -0.3817    0.0695    0.0999 |      0.3319
             rc3 |   0.6247   -0.1732    0.0165   -0.4141 |      0.4080
             rc4 |   0.6732   -0.4240    0.0988   -0.1568 |      0.3327
             rc6 |   0.7391   -0.4117   -0.0002   -0.1952 |      0.2462
            opc3 |   0.1179    0.6104    0.2859    0.2605 |      0.4639
             sc3 |   0.7047    0.3014   -0.2259    0.0375 |      0.3601
             sc4 |   0.7726    0.3361   -0.0591   -0.0159 |      0.2864
             sc5 |   0.7765    0.4353   -0.1129   -0.0808 |      0.1884
             sc6 |   0.7907    0.2868   -0.2556   -0.1700 |      0.1984
             sc7 |   0.7093    0.3826   -0.2837   -0.1882 |      0.2345
             lc3 |   0.6150   -0.2686    0.2135   -0.0880 |      0.4963
             lc4 |   0.6522   -0.3295    0.2193    0.1174 |      0.4042
            psc4 |   0.3805    0.1840    0.6696    0.1347 |      0.3549
            psc6 |   0.2771    0.2311    0.7172   -0.0228 |      0.3550
    ------------------------------------------------------------------------

. rotate, normalize
Factor analysis/correlation                  Number of obs    =        249
    Method: principal-component factors      Retained factors =          4
    Rotation: orthogonal varimax (Kaiser on) Number of params =         58
    --------------------------------------------------------------------------
         Factor  |     Variance   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      3.78281      0.19505            0.2364       0.2364
        Factor2  |      3.58776      1.79731            0.2242       0.4607
        Factor3  |      1.79045      0.08004            0.1119       0.5726
        Factor4  |      1.71041            .            0.1069       0.6795
    --------------------------------------------------------------------------
```

```
    LR test: independent vs. saturated: chi2(120) = 1994.32 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances
    ------------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4 |   Uniqueness
    -------------+----------------------------------------+--------------
              oc1 |   0.2806    0.3165    0.7425    0.0256 |      0.2691
              oc2 |   0.1274    0.1119    0.8790   -0.0083 |      0.1985
              rc1 |   0.2014    0.6971    0.3665    0.0848 |      0.3319
              rc3 |   0.3939    0.6425   -0.1549    0.0056 |      0.4080
              rc4 |   0.1913    0.7839    0.1208    0.0392 |      0.3327
              rc6 |   0.2886    0.8086    0.1239   -0.0362 |      0.2462
             opc3 |   0.2834   -0.3604    0.1192    0.5583 |      0.4639
              sc3 |   0.7326    0.1849    0.2521    0.0739 |      0.3601
              sc4 |   0.7463    0.2546    0.1867    0.2385 |      0.2864
              sc5 |   0.8425    0.1979    0.1227    0.2183 |      0.1884
              sc6 |   0.8355    0.3056    0.0979    0.0225 |      0.1984
              sc7 |   0.8531    0.1883    0.0452    0.0138 |      0.2345
              lc3 |   0.1877    0.6440    0.1173    0.1999 |      0.4963
              lc4 |   0.1315    0.6488    0.3256    0.2271 |      0.4042
             psc4 |   0.0826    0.2135    0.0832    0.7654 |      0.3549
             psc6 |   0.0558    0.1726   -0.1105    0.7745 |      0.3550
    ------------------------------------------------------------------------

Factor rotation matrix
    -------------------------------------------------
                 | Factor1  Factor2  Factor3  Factor4
    -------------+-----------------------------------
         Factor1 |  0.6710   0.6355   0.3171   0.2131
         Factor2 |  0.6014  -0.6813  -0.1647   0.3834
         Factor3 | -0.3818   0.2052  -0.1945   0.8799
         Factor4 | -0.2058  -0.2997   0.9135   0.1825
    -------------------------------------------------
```

PCA for Agrienteprise farm capabilities

```
. factor $xlist, pcf
(obs=249)
Factor analysis/correlation                       Number of obs    =        249
    Method: principal-component factors           Retained factors =          5
    Rotation: (unrotated)                         Number of params =         70
    --------------------------------------------------------------------------
         Factor  |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      5.52429      3.39228            0.3453       0.3453
        Factor2  |      2.13202      0.60823            0.1333       0.4785
        Factor3  |      1.52378      0.32790            0.0952       0.5738
        Factor4  |      1.19589      0.19568            0.0747       0.6485
        Factor5  |      1.00020      0.23578            0.0625       0.7110
        Factor6  |      0.76442      0.11151            0.0478       0.7588
        Factor7  |      0.65291      0.09076            0.0408       0.7996
        Factor8  |      0.56214      0.05609            0.0351       0.8347
        Factor9  |      0.50605      0.04119            0.0316       0.8664
       Factor10  |      0.46486      0.06443            0.0291       0.8954
       Factor11  |      0.40043      0.08018            0.0250       0.9204
       Factor12  |      0.32025      0.01515            0.0200       0.9405
       Factor13  |      0.30510      0.05596            0.0191       0.9595
       Factor14  |      0.24915      0.03490            0.0156       0.9751
       Factor15  |      0.21424      0.02998            0.0134       0.9885
       Factor16  |      0.18426            .            0.0115       1.0000
```

```
    ------------------------------------------------------------------------------
    LR test: independent vs. saturated: chi2(120) = 1824.73 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
    ------------------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4   Factor5 |   Uniqueness
    -------------+--------------------------------------------------+--------------
             mc3 |   0.5423    0.2044   -0.2131    0.0267   -0.5504 |      0.3151
             mc4 |   0.6113   -0.1594   -0.2771    0.1507   -0.4514 |      0.2976
             mc6 |   0.6044   -0.1161   -0.3524    0.1457   -0.2677 |      0.4041
            mlc3 |   0.6792    0.0922    0.0017   -0.2204   -0.0558 |      0.4785
            mlc5 |   0.5582   -0.1129    0.7081   -0.0303   -0.1294 |      0.1566
            mlc6 |   0.4985    0.1483    0.7535    0.0518   -0.2006 |      0.1188
            itc2 |   0.6434   -0.3597    0.1488   -0.0818    0.1660 |      0.4002
            itc3 |   0.7032   -0.4290   -0.1272   -0.1361   -0.0254 |      0.2861
            itc4 |   0.5924    0.3511   -0.1917   -0.5201    0.1991 |      0.1789
            itc5 |   0.6595    0.2839   -0.0610   -0.5381    0.1729 |      0.1613
             tc1 |   0.6939   -0.3502   -0.0191    0.0625    0.2138 |      0.3458
             tc2 |   0.3704   -0.5240    0.0672    0.3510    0.2664 |      0.3895
             tc3 |   0.5831   -0.4638   -0.2193    0.1159    0.2197 |      0.3351
             tc4 |   0.6048    0.4895    0.1850    0.2306    0.0760 |      0.3014
             tc5 |   0.4564    0.6105   -0.1937    0.3318    0.1871 |      0.2365
             tc6 |   0.4925    0.5159   -0.0686    0.4583    0.2415 |      0.2182
    ------------------------------------------------------------------------------

. estat kmo
Kaiser-Meyer-Olkin measure of sampling adequacy
    ----------------------
        Variable |     kmo
    -------------+---------
             mc3 |  0.8475
             mc4 |  0.8458
             mc6 |  0.8581
            mlc3 |  0.8947
            mlc5 |  0.7327
            mlc6 |  0.6829
            itc2 |  0.8561
            itc3 |  0.8774
            itc4 |  0.7539
            itc5 |  0.7828
             tc1 |  0.8675
             tc2 |  0.7921
             tc3 |  0.7925
             tc4 |  0.8631
             tc5 |  0.7348
             tc6 |  0.7943
    -------------+---------
         Overall |  0.8129
    ----------------------

. pca $xlist
Principal components/correlation                  Number of obs    =        249
                                                  Number of comp.  =         16
                                                  Trace            =         16
    Rotation: (unrotated = principal)             Rho              =     1.0000
    ------------------------------------------------------------------------------
       Component |   Eigenvalue   Difference         Proportion   Cumulative
    -------------+----------------------------------------------------------------
           Comp1 |      5.52429      3.39228             0.3453       0.3453
```

Comp2	2.13202	.608233	0.1333	0.4785
Comp3	1.52378	.327899	0.0952	0.5738
Comp4	1.19589	.195683	0.0747	0.6485
Comp5	1.0002	.235783	0.0625	0.7110
Comp6	.76442	.111511	0.0478	0.7588
Comp7	.652908	.0907646	0.0408	0.7996
Comp8	.562144	.0560943	0.0351	0.8347
Comp9	.506049	.0411891	0.0316	0.8664
Comp10	.46486	.0644287	0.0291	0.8954
Comp11	.400431	.0801774	0.0250	0.9204
Comp12	.320254	.0151501	0.0200	0.9405
Comp13	.305104	.055958	0.0191	0.9595
Comp14	.249146	.0349045	0.0156	0.9751
Comp15	.214241	.0299809	0.0134	0.9885
Comp16	.184261	.	0.0115	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7
mc3	0.2307	0.1400	-0.1726	0.0244	-0.5503	-0.1857	-0.1847
mc4	0.2601	-0.1092	-0.2245	0.1378	-0.4514	-0.0857	-0.1613
mc6	0.2572	-0.0795	-0.2855	0.1332	-0.2677	0.4609	0.2221
mlc3	0.2890	0.0631	0.0013	-0.2015	-0.0558	-0.1024	0.6191
mlc5	0.2375	-0.0774	0.5736	-0.0277	-0.1294	0.1118	0.1427
mlc6	0.2121	0.1016	0.6104	0.0473	-0.2005	0.0375	0.0338
itc2	0.2737	-0.2464	0.1206	-0.0748	0.1660	0.0552	-0.5752
itc3	0.2992	-0.2938	-0.1031	-0.1244	-0.0254	0.1673	-0.1301
itc4	0.2520	0.2405	-0.1553	-0.4756	0.1991	0.1238	-0.1558
itc5	0.2806	0.1944	-0.0494	-0.4921	0.1728	0.1109	0.0436
tc1	0.2952	-0.2398	-0.0155	0.0572	0.2138	-0.4400	-0.0201
tc2	0.1576	-0.3589	0.0545	0.3209	0.2664	0.4367	0.0520
tc3	0.2481	-0.3177	-0.1776	0.1060	0.2197	-0.3957	0.2834
tc4	0.2573	0.3352	0.1499	0.2108	0.0760	-0.2458	-0.1682
tc5	0.1942	0.4181	-0.1569	0.3034	0.1870	0.2426	0.0112
tc6	0.2095	0.3533	-0.0556	0.4191	0.2414	-0.0496	-0.0027

Variable	Comp8	Comp9	Comp10	Comp11	Comp12	Comp13	Comp14
mc3	0.6151	0.1072	-0.1876	0.1910	0.1710	0.0499	0.1061
mc4	-0.3259	-0.0766	0.6357	0.0177	-0.1060	0.0398	-0.2508
mc6	-0.2927	0.2346	-0.3571	-0.3046	-0.0656	0.2498	0.2557
mlc3	0.1939	-0.5968	0.0031	-0.0669	-0.0899	0.0871	-0.0114
mlc5	-0.1347	0.1065	-0.0132	0.1290	0.2910	-0.0749	0.0586
mlc6	-0.0839	0.1458	0.0718	0.1071	-0.0626	0.0377	0.0132
itc2	-0.0330	-0.4652	-0.0530	0.0031	-0.0765	0.2889	0.4154
itc3	-0.0914	-0.1417	-0.3738	0.1876	-0.1074	-0.6351	-0.3497
itc4	0.0073	0.3043	0.1159	0.1090	0.2350	-0.0424	0.0873
itc5	0.0409	0.1658	0.1725	-0.0298	-0.2925	0.1792	-0.1710
tc1	-0.0796	0.1167	-0.2013	-0.2883	0.4321	0.3135	-0.4145
tc2	0.5635	0.1444	0.2896	-0.0630	-0.0701	0.0577	-0.1701
tc3	-0.0635	0.2578	0.1677	0.2462	-0.0655	-0.2290	0.5202
tc4	0.0940	0.0973	-0.0402	-0.5901	-0.3615	-0.3355	0.0799
tc5	-0.0740	-0.2676	0.1870	-0.0406	0.5383	-0.2374	0.0971
tc6	-0.1169	0.0161	-0.2301	0.5406	-0.2899	0.2742	-0.1946

```
    ------------------------------------------------
        Variable |   Comp15    Comp16 | Unexplained
    -------------+----------------------+-------------
             mc3 |   0.0915   -0.1117 |           0
             mc4 |  -0.1478    0.0013 |           0
             mc6 |   0.0088    0.0408 |           0
            mlc3 |  -0.1775    0.1719 |           0
            mlc5 |  -0.3800   -0.5233 |           0
            mlc6 |   0.4372    0.5343 |           0
            itc2 |   0.0135   -0.0206 |           0
            itc3 |   0.0960    0.0521 |           0
            itc4 |  -0.4383    0.4175 |           0
            itc5 |   0.4335   -0.4474 |           0
             tc1 |   0.0908    0.0584 |           0
             tc2 |  -0.0890    0.0687 |           0
             tc3 |   0.1487   -0.0305 |           0
             tc4 |  -0.2006   -0.0439 |           0
             tc5 |   0.3159   -0.0885 |           0
             tc6 |  -0.1866   -0.0257 |           0
    ------------------------------------------------

. factor $xlist, pcf factors(5)
(obs=249)
Factor analysis/correlation                      Number of obs    =        249
    Method: principal-component factors          Retained factors =          5
    Rotation: (unrotated)                        Number of params =         70
    --------------------------------------------------------------------------
         Factor  |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      5.52429      3.39228            0.3453       0.3453
        Factor2  |      2.13202      0.60823            0.1333       0.4785
        Factor3  |      1.52378      0.32790            0.0952       0.5738
        Factor4  |      1.19589      0.19568            0.0747       0.6485
        Factor5  |      1.00020      0.23578            0.0625       0.7110
        Factor6  |      0.76442      0.11151            0.0478       0.7588
        Factor7  |      0.65291      0.09076            0.0408       0.7996
        Factor8  |      0.56214      0.05609            0.0351       0.8347
        Factor9  |      0.50605      0.04119            0.0316       0.8664
       Factor10  |      0.46486      0.06443            0.0291       0.8954
       Factor11  |      0.40043      0.08018            0.0250       0.9204
       Factor12  |      0.32025      0.01515            0.0200       0.9405
       Factor13  |      0.30510      0.05596            0.0191       0.9595
       Factor14  |      0.24915      0.03490            0.0156       0.9751
       Factor15  |      0.21424      0.02998            0.0134       0.9885
       Factor16  |      0.18426            .            0.0115       1.0000
    --------------------------------------------------------------------------
    LR test: independent vs. saturated: chi2(120) = 1824.73 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
    -----------------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4   Factor5 |   Uniqueness
    -------------+-----------------------------------------------------+--------------
             mc3 |   0.5423    0.2044   -0.2131    0.0267   -0.5504 |      0.3151
             mc4 |   0.6113   -0.1594   -0.2771    0.1507   -0.4514 |      0.2976
             mc6 |   0.6044   -0.1161   -0.3524    0.1457   -0.2677 |      0.4041
            mlc3 |   0.6792    0.0922    0.0017   -0.2204   -0.0558 |      0.4785
            mlc5 |   0.5582   -0.1129    0.7081   -0.0303   -0.1294 |      0.1566
            mlc6 |   0.4985    0.1483    0.7535    0.0518   -0.2006 |      0.1188
```

```
        itc2 |   0.6434   -0.3597    0.1488   -0.0818    0.1660 |      0.4002
        itc3 |   0.7032   -0.4290   -0.1272   -0.1361   -0.0254 |      0.2861
        itc4 |   0.5924    0.3511   -0.1917   -0.5201    0.1991 |      0.1789
        itc5 |   0.6595    0.2839   -0.0610   -0.5381    0.1729 |      0.1613
         tc1 |   0.6939   -0.3502   -0.0191    0.0625    0.2138 |      0.3458
         tc2 |   0.3704   -0.5240    0.0672    0.3510    0.2664 |      0.3895
         tc3 |   0.5831   -0.4638   -0.2193    0.1159    0.2197 |      0.3351
         tc4 |   0.6048    0.4895    0.1850    0.2306    0.0760 |      0.3014
         tc5 |   0.4564    0.6105   -0.1937    0.3318    0.1871 |      0.2365
         tc6 |   0.4925    0.5159   -0.0686    0.4583    0.2415 |      0.2182
    ------------------------------------------------------------------------------

. rotate, normalize
Factor analysis/correlation                    Number of obs    =        249
    Method: principal-component factors        Retained factors =          5
    Rotation: orthogonal varimax (Kaiser on)   Number of params =         70

    --------------------------------------------------------------------------
         Factor  |     Variance   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      2.93725      0.71170            0.1836       0.1836
        Factor2  |      2.22555      0.06331            0.1391       0.3227
        Factor3  |      2.16223      0.11561            0.1351       0.4578
        Factor4  |      2.04662      0.04209            0.1279       0.5857
        Factor5  |      2.00453            .            0.1253       0.7110
    --------------------------------------------------------------------------
    LR test: independent vs. saturated: chi2(120) = 1824.73 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances
    ------------------------------------------------------------------------------
        Variable |  Factor1   Factor2   Factor3   Factor4   Factor5 |   Uniqueness
    -------------+--------------------------------------------------+--------------
             mc3 |  -0.0487    0.2017    0.1912    0.7635    0.1496 |      0.3151
             mc4 |   0.3107    0.0588    0.0841    0.7677    0.0767 |      0.2976
             mc6 |   0.3580    0.1243    0.1714    0.6492   -0.0380 |      0.4041
            mlc3 |   0.2456    0.5066    0.1652    0.3279    0.2640 |      0.4785
            mlc5 |   0.2760    0.1213    0.0139    0.0736    0.8642 |      0.1566
            mlc6 |   0.0463    0.0843    0.1849    0.0857    0.9113 |      0.1188
            itc2 |   0.6464    0.2740   -0.0083    0.1071    0.3087 |      0.4002
            itc3 |   0.6568    0.3209   -0.1011    0.3911    0.1282 |      0.2861
            itc4 |   0.0796    0.8641    0.2292    0.1246    0.0071 |      0.1789
            itc5 |   0.1391    0.8651    0.1802    0.1234    0.1527 |      0.1613
             tc1 |   0.7287    0.2215    0.1277    0.1766    0.1632 |      0.3458
             tc2 |   0.7423   -0.2099    0.0693   -0.0105    0.1028 |      0.3895
             tc3 |   0.7731    0.1236    0.0609    0.2106   -0.0625 |      0.3351
             tc4 |   0.0622    0.2382    0.6841    0.1573    0.3812 |      0.3014
             tc5 |  -0.0096    0.2041    0.8331    0.1623   -0.0361 |      0.2365
             tc6 |   0.1144    0.0873    0.8634    0.1032    0.0708 |      0.2182
    ------------------------------------------------------------------------------
Factor rotation matrix
    -------------------------------------------------------------
                 | Factor1  Factor2  Factor3  Factor4  Factor5
    -------------+-----------------------------------------------
         Factor1 |  0.5542   0.4683   0.3653   0.4603   0.3582
         Factor2 | -0.6888   0.2988   0.6587  -0.0278   0.0392
         Factor3 | -0.0724  -0.1432  -0.0811  -0.4016   0.8980
         Factor4 |  0.1992  -0.7881   0.5710   0.1142  -0.0070
         Factor5 |  0.4165   0.2232   0.3162  -0.7830  -0.2524
    -------------------------------------------------------------
```

APPENDIX E: Multivariate regression results of factors influencing entrepreneurial competencies

```
. manova SC RC OC PSC = c.Age_of_respondent_in_years c.Fmng_exp entr_trng c.Size_land c.annl_prc imprvd_sds
govt_extnsn     NGO_extnsn     prvt_extnsn     mechnztn     c.mkt_dstnc     c.Distance_of_murram_to_tarmac_in
Gender_of_respondent c.Sold_to_broker c.self_Sold_lclmkt c.Self_sold_to_nnlclmkt Used_agrChmcls
                      Number of obs =        248

                      W = Wilks' lambda      L = Lawley-Hotelling trace
                      P = Pillai's trace     R = Roy's largest root

      Source | Statistic        df    F(df1,     df2) =   F   Prob>F
-------------+-----------------------------------------------------
       Model |W   0.3460        17     68.0    893.1     4.08 0.0000 a
             |P   0.8909               68.0    920.0     3.88 0.0000 a
             |L   1.2895               68.0    902.0     4.28 0.0000 a
             |R   0.6714               17.0    230.0     9.08 0.0000 u
             |-----------------------------------------------------
    Residual |                 230
-------------+-----------------------------------------------------
Age_of_re~s |W   0.9640         1      4.0    227.0     2.12 0.0796 e
             |P   0.0360               4.0    227.0     2.12 0.0796 e
             |L   0.0373               4.0    227.0     2.12 0.0796 e
             |R   0.0373               4.0    227.0     2.12 0.0796 e
             |-----------------------------------------------------
    Fmng_exp |W   0.9577         1      4.0    227.0     2.51 0.0430 e
             |P   0.0423               4.0    227.0     2.51 0.0430 e
             |L   0.0441               4.0    227.0     2.51 0.0430 e
             |R   0.0441               4.0    227.0     2.51 0.0430 e
             |-----------------------------------------------------
   entr_trng |W   0.9397         1      4.0    227.0     3.64 0.0067 e
             |P   0.0603               4.0    227.0     3.64 0.0067 e
             |L   0.0642               4.0    227.0     3.64 0.0067 e
             |R   0.0642               4.0    227.0     3.64 0.0067 e
             |-----------------------------------------------------
   Size_land |W   0.9697         1      4.0    227.0     1.77 0.1351 e
             |P   0.0303               4.0    227.0     1.77 0.1351 e
             |L   0.0312               4.0    227.0     1.77 0.1351 e
             |R   0.0312               4.0    227.0     1.77 0.1351 e
             |-----------------------------------------------------
    annl_prc |W   0.9062         1      4.0    227.0     5.87 0.0002 e
             |P   0.0938               4.0    227.0     5.87 0.0002 e
             |L   0.1035               4.0    227.0     5.87 0.0002 e
             |R   0.1035               4.0    227.0     5.87 0.0002 e
             |-----------------------------------------------------
  imprvd_sds |W   0.9916         1      4.0    227.0     0.48 0.7484 e
             |P   0.0084               4.0    227.0     0.48 0.7484 e
             |L   0.0085               4.0    227.0     0.48 0.7484 e
             |R   0.0085               4.0    227.0     0.48 0.7484 e
             |-----------------------------------------------------
govt_extnsn |W   0.9518         1      4.0    227.0     2.88 0.0237 e
             |P   0.0482               4.0    227.0     2.88 0.0237 e
             |L   0.0507               4.0    227.0     2.88 0.0237 e
             |R   0.0507               4.0    227.0     2.88 0.0237 e
             |-----------------------------------------------------
 NGO_extnsn |W   0.9235         1      4.0    227.0     4.70 0.0012 e
             |P   0.0765               4.0    227.0     4.70 0.0012 e
             |L   0.0828               4.0    227.0     4.70 0.0012 e
```

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                |R   0.0828               4.0    227.0     4.70 0.0012 e
                |----------------------------------------------------------
prvt_extnsn     |W   0.9713         1     4.0    227.0     1.68 0.1563 e
                |P   0.0287               4.0    227.0     1.68 0.1563 e
                |L   0.0295               4.0    227.0     1.68 0.1563 e
                |R   0.0295               4.0    227.0     1.68 0.1563 e
                |----------------------------------------------------------
   mechnztn     |W   0.9196         1     4.0    227.0     4.96 0.0007 e
                |P   0.0804               4.0    227.0     4.96 0.0007 e
                |L   0.0874               4.0    227.0     4.96 0.0007 e
                |R   0.0874               4.0    227.0     4.96 0.0007 e
                |----------------------------------------------------------
  mkt_dstnc     |W   0.9361         1     4.0    227.0     3.87 0.0046 e
                |P   0.0639               4.0    227.0     3.87 0.0046 e
                |L   0.0682               4.0    227.0     3.87 0.0046 e
                |R   0.0682               4.0    227.0     3.87 0.0046 e
                |----------------------------------------------------------
Distance_~n     |W   0.9539         1     4.0    227.0     2.74 0.0293 e
                |P   0.0461               4.0    227.0     2.74 0.0293 e
                |L   0.0483               4.0    227.0     2.74 0.0293 e
                |R   0.0483               4.0    227.0     2.74 0.0293 e
                |----------------------------------------------------------
Gender_of~t     |W   0.9753         1     4.0    227.0     1.44 0.2218 e
                |P   0.0247               4.0    227.0     1.44 0.2218 e
                |L   0.0254               4.0    227.0     1.44 0.2218 e
                |R   0.0254               4.0    227.0     1.44 0.2218 e
                |----------------------------------------------------------
Sold_to_b~r     |W   0.9758         1     4.0    227.0     1.41 0.2325 e
                |P   0.0242               4.0    227.0     1.41 0.2325 e
                |L   0.0248               4.0    227.0     1.41 0.2325 e
                |R   0.0248               4.0    227.0     1.41 0.2325 e
                |----------------------------------------------------------
self_Sold~t     |W   0.9536         1     4.0    227.0     2.76 0.0286 e
                |P   0.0464               4.0    227.0     2.76 0.0286 e
                |L   0.0486               4.0    227.0     2.76 0.0286 e
                |R   0.0486               4.0    227.0     2.76 0.0286 e
                |----------------------------------------------------------
Self_sold~t     |W   0.9707         1     4.0    227.0     1.71 0.1476 e
                |P   0.0293               4.0    227.0     1.71 0.1476 e
                |L   0.0302               4.0    227.0     1.71 0.1476 e
                |R   0.0302               4.0    227.0     1.71 0.1476 e
                |----------------------------------------------------------
Used_agrC~s     |W   0.9922         1     4.0    227.0     0.45 0.7737 e
                |P   0.0078               4.0    227.0     0.45 0.7737 e
                |L   0.0079               4.0    227.0     0.45 0.7737 e
                |R   0.0079               4.0    227.0     0.45 0.7737 e
                |----------------------------------------------------------
       Residual |                230
----------------+-----------------------------------------------------------
          Total |                247
------------------------------------------------------------------------------
                  e = exact, a = approximate, u = upper bound on F

. mvreg
Equation             Obs   Parms        RMSE    "R-sq"          F        P
------------------------------------------------------------------------------
SC                   248      18    1.157267    0.2894   5.510613   0.0000
RC                   248      18    .9625828    0.3578   7.537635   0.0000
OC                   248      18    1.424015    0.2801   5.265127   0.0000
PSC                  248      18     .681318    0.2231   3.885467   0.0000
```

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SC						
Age_of_respondent_in_years	-.011889	.0101163	-1.18	0.241	-.0318216	.0080435
Fmng_exp	-.0083265	.0111404	-0.75	0.456	-.0302768	.0136238
entr_trng						
Yes	.2536292	.1695032	1.50	0.136	-.0803483	.5876068
Size_land	.1960929	.1020472	1.92	0.056	-.0049739	.3971597
annl_prc	.0000873	.0001131	0.77	0.441	-.0001354	.0003101
imprvd_sds						
yes	-.0950528	.2183888	-0.44	0.664	-.5253513	.3352456
govt_extnsn						
yes	.4847734	.1673115	2.90	0.004	.1551142	.8144326
NGO_extnsn						
yes	.2618608	.17667	1.48	0.140	-.0862378	.6099593
prvt_extnsn						
yes	.1839257	.2774796	0.66	0.508	-.3628012	.7306525
mechnztn						
yes	.5932001	.1823062	3.25	0.001	.2339965	.9524038
mkt_dstnc	.0041279	.0027844	1.48	0.140	-.0013583	.0096142
Distance_of_murram_to_tarmac_in	-.0147029	.0215634	-0.68	0.496	-.0571899	.027784
Gender_of_respondent						
male	-.0476441	.1586175	-0.30	0.764	-.3601733	.264885
Sold_to_broker	.0008552	.0024889	0.34	0.731	-.0040487	.0057591
self_Sold_lclmkt	-.0002158	.0214443	-0.01	0.992	-.0424682	.0420365
Self_sold_to_nnlclmkt	.0055622	.004688	1.19	0.237	-.0036746	.0147991
Used_agrChmcls						
yes	-.3713394	.3138878	-1.18	0.238	-.9898024	.2471236
_cons	4.798151	.530484	9.04	0.000	3.752921	5.84338
RC						
Age_of_respondent_in_years	-.0130869	.0084145	-1.56	0.121	-.0296663	.0034924
Fmng_exp	-.0073317	.0092663	-0.79	0.430	-.0255894	.0109259
entr_trng						
Yes	.5073855	.1409881	3.60	0.000	.2295921	.785179
Size_land	.058303	.0848801	0.69	0.493	-.1089389	.2255449
annl_prc	.0003773	.000094	4.01	0.000	.000192	.0005626
imprvd_sds						
yes	-.1538902	.1816499	-0.85	0.398	-.5118007	.2040203
govt_extnsn						
yes	.3203431	.1391652	2.30	0.022	.0461416	.5945446
NGO_extnsn						
yes	-.2138672	.1469493	-1.46	0.147	-.5034061	.0756717
prvt_extnsn						
yes	.0497883	.2308	0.22	0.829	-.4049642	.5045408

mechnztn						
yes	.478511	.1516373	3.16	0.002	.1797352	.7772869
mkt_dstnc	-.0001576	.002316	-0.07	0.946	-.004721	.0044057
Distance_of_murram_to_tarmac_in	-.0084601	.0179358	-0.47	0.638	-.0437996	.0268794
Gender_of_respondent						
male	-.2545011	.1319337	-1.93	0.055	-.5144543	.0054521
Sold_to_broker	.0033194	.0020702	1.60	0.110	-.0007595	.0073984
self_Sold_lclmkt	.0289437	.0178368	1.62	0.106	-.0062006	.0640881
Self_sold_to_nnlclmkt	.0045217	.0038993	1.16	0.247	-.0031613	.0122047
Used_agrChmcls						
yes	-.0343993	.2610833	-0.13	0.895	-.54882	.4800214
_cons	4.65259	.4412422	10.54	0.000	3.783197	5.521984
OC						
Age_of_respondent_in_years	.0133275	.0124481	1.07	0.285	-.0111995	.0378544
Fmng_exp	-.0335189	.0137083	-2.45	0.015	-.0605287	-.0065091
entr_trng						
Yes	.4165428	.2085734	2.00	0.047	.005584	.8275016
Size_land	.2078833	.1255689	1.66	0.099	-.039529	.4552956
annl_prc	.0002496	.0001391	1.79	0.074	-.0000245	.0005237
imprvd_sds						
yes	.0926596	.2687271	0.34	0.731	-.4368219	.622141
govt_extnsn						
yes	.5185047	.2058765	2.52	0.012	.1128597	.9241498
NGO_extnsn						
yes	-.6434702	.2173921	-2.96	0.003	-1.071805	-.2151355
prvt_extnsn						
yes	-.1971834	.3414382	-0.58	0.564	-.8699299	.4755631
mechnztn						
yes	.1527836	.2243275	0.68	0.497	-.2892159	.5947831
mkt_dstnc	-.007626	.0034263	-2.23	0.027	-.0143768	-.0008751
Distance_of_murram_to_tarmac_in	-.0141559	.0265337	-0.53	0.594	-.0664361	.0381242
Gender_of_respondent						
male	-.2569913	.1951786	-1.32	0.189	-.6415579	.1275752
Sold_to_broker	.0000283	.0030626	0.01	0.993	-.0060059	.0060626
self_Sold_lclmkt	.0676391	.0263871	2.56	0.011	.0156476	.1196305
Self_sold_to_nnlclmkt	.0141112	.0057685	2.45	0.015	.0027452	.0254771
Used_agrChmcls						
yes	.007771	.3862384	0.02	0.984	-.7532467	.7687887
_cons	2.481019	.6527597	3.80	0.000	1.194866	3.767172
PSC						
Age_of_respondent_in_years	-.0102378	.0059558	-1.72	0.087	-.0219727	.0014971
Fmng_exp	.0108782	.0065587	1.66	0.099	-.0020446	.023801
entr_trng						
Yes	.1427604	.0997917	1.43	0.154	-.0538623	.3393832
Size_land	.1207719	.0600783	2.01	0.046	.0023978	.239146

annl_prc	-.0001347	.0000666	-2.02	0.044	-.0002659	-3.60e-06
imprvd_sds						
yes	-.1193878	.1285721	-0.93	0.354	-.3727175	.133942
govt_extnsn						
yes	.0986948	.0985014	1.00	0.317	-.0953856	.2927752
NGO_extnsn						
yes	-.0201607	.104011	-0.19	0.846	-.2250969	.1847755
prvt_extnsn						
yes	.3936245	.1633607	2.41	0.017	.0717498	.7154993
mechnztn						
yes	.3192219	.1073292	2.97	0.003	.1077478	.530696
mkt_dstnc	.0038175	.0016393	2.33	0.021	.0005875	.0070474
Distance_of_murram_to_tarmac_in	.0372603	.012695	2.94	0.004	.0122469	.0622736
Gender_of_respondent						
male	.0719213	.093383	0.77	0.442	-.1120741	.2559167
Sold_to_broker	-.0022063	.0014653	-1.51	0.134	-.0050934	.0006808
self_Sold_lclmkt	-.0152558	.0126249	-1.21	0.228	-.0401311	.0096194
Self_sold_to_nnlclmkt	.0034878	.00276	1.26	0.208	-.0019502	.0089258
Used_agrChmcls						
yes	-.0041891	.1847953	-0.02	0.982	-.3682971	.3599188
_cons	5.761085	.3123121	18.45	0.000	5.145727	6.376443

APPENDIX F: Abstract Page Snapshot of Manuscript Accepted for Publication

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Demystifying Firm Capabilities of Agri-Supply Chain Stakeholders; Elucidating Strengths and Limitations. An Empirical Study of Irish Potato Producers in Kenya.

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Abstract

Employment of firm capabilities by agripreneurs has the potential to alleviate persistent challenges and poor performance synonymous with agri-supply chains in Sub Saharan Africa. The augmentation of firm capabilities is more so needed by Kenyan potato producers who face persistent production and marketing challenges. However, there is little to no information on the firm capabilities of agri-supply chain actors in Sub Saharan Africa and specifically, smallholder farmers in Kenya. In this regard, this study sought to explore agrienterprise firm capabilities of smallholder potato farmers in Kenya and identify the types and levels of their agrienterprise firm capabilities. Data was collected through multistage sampling by cross sectional survey using a sample of 249 smallholder potato farmers and the data was analyzed using Principal Component Analysis. Based on the findings, agrienterprise firm capabilities that were found to be exhibited by the farmers ranked from the highest to lowest in terms of levels possessed are as follows; networking capability followed by technology management capability, followed by market linking capability and finally, technology integration capability and marketing capability scoring the lowest. It can be concluded that most farmers were limited in adoption of improved technologies in potato production, orienting their production to market trends and being able to decipher the needs of different market segments and communicate their value proposition to address these needs. It is therefore recommended that potato producers be provided with bundled agribusiness support services that will facilitate the potato producers to institutionalize improved technology adoption and enhanced market participation.

Keywords: Firm capabilities, Agripreneurship, Agri-supply chains

1. Introduction