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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

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1. Introduction

The 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. This is because despite Irish potatoes being the second most important staple food crop in Kenya and employing more than 3.3 million Kenyans (Ministry of Agriculture, Livestock and Fisheries, 2016), potato production is characterized by persistent production and marketing challenges (Taiy *et al*., 2017). Agbolosoo (2021) asserts that the failure of potato farmers to adopt improved working methods can be directly attributed to their limited willingness to take the risk of experimenting with better combinations and production methods otherwise referred to as agrienterprise firm capabilities.

A capability 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). With regard to the definition of a firm capability, Eisenhardt and Martin (2000) stated that a firm's capabilities describe its methods for integrating, reconfiguring, acquiring, and releasing resources to keep up with or spur market developments. Another definition of firm capabilities was provided by Santos-Vijande *et al*. (2012) who postulated that firm capabilities reflect a complicated set of skills needed to carry out a firm's activities effectively and methodically while using a variety of firm resources in concert.

Numerous research have demonstrated a favorable and significant relationship between firm 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 behavior, 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, according to Barney *et al*. (2011) and Mithas *et al*. (2011).

In essence, enhancing agri-supply chain stakeholders' firm capabilities can provide an array of benefits to the Sub Saharan Africa agri-supply chains ranging from improved exports, better performing cooperatives, enhanced innovation, improved labor output and improved profitability. 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.

2. Methods

2.1 Study area

The research was conducted in Kenya's Nyandarua County. The County enjoys a mild, Mediterranean summer climate due to its elevation of 2667.11 meters above sea level. According to the Nyandarua County Government (2017), the county typically has 224.82 wet days (61.59% of the total) and 120.38 millimeters of precipitation annually. With a total of twenty-five wards, the County is divided into five Sub-Counties: Ndaragwa, Ol Kalou, Kinangop, Kipipiri, and Ol Joro Orok. The Aberdare Ranges enclose a portion of the County, spanning 3,245.2 square kilometers. Its rich, fertile soils and perfect ecological conditions, derived from the Aberdare Ranges surrounding it, make year-round crop farming advantageous. Therefore, the main socioeconomic activity in Nyandarua are agriculture and related companies. The main agricultural products include Irish potatoes, cabbage, carrots, sugar beet, peas, floriculture, pyrethrum, cereals, poultry, and dairy goods.

The County was specifically selected due to its thriving potato industry, which accounts for roughly 33% of Kenya's total potato production (Nyandarua County Government, 2017). The primary crop, which is grown on almost 37,000 hectares each year, is potatoes. Potatoes are identified as a major crop in the County's Integrated Development Plan (CIDP) 2018–2022, which also provides a list of strategic initiatives to support the growth of the sector. In Nyandarua County, small-scale potato growers yield an annual crop valued at around KES 8 billion.

2.2 Sampling approach and study data

This study was a cross-sectional survey and it adopted both quantitative and qualitative research methodologies. The population of the study was all the smallholder potato farmers in Nyandarua County who are engaged in production and marketing potatoes. The sampling unit for this study was the smallholder potato farmer in

Nyandarua County with a focus on Ol Kalou and Ol Joro Orok Sub-Counties. Sample size determination was as specified by Anderson *et al*. (2007) and 249 survey participants made up the sample that was gathered and utilized for analysis.

2.3 Ethical Considerations

A research authorization and an ethical clearance certificate were issued by the National Commission for Science, Technology, and Innovation (NACOSTI) and the Egerton University Ethics Review Committee (EUREC) before data collecting began. NACOSTI is the legal organization responsible for managing research operations in Kenya. The respondents were informed of the purpose of the study and given guarantees about the confidentiality of the information they submitted. Respondents were not required to supply any kind of identity on the surveys. The respondents were given the assurance by the researcher that the information they submitted would be kept private and utilized exclusively for this study's research needs.

2.3 Data analysis

Desarbo *et al*. (2007) developed an instrument that was modified to measure the capabilities of agrienterprise firms. The 23 statements in the instrument correspond to the skills of a manager or owner of a firm. Each item was rated on a seven-point anchored Likert scale, where 1 represents "strongly disagree" and 7 represents "strongly agree."

Using STATA software, factor analysis (FA) was employed to investigate the capacity of agricultural enterprises, in line with Man (2001). FA is a multivariate statistical technique used in dimensional reduction. This procedure establishes underlying dimensions between latent constructs and measurable variables. Additionally, the methodology demonstrates the construct validity of reporting scales. Principal component analysis (PCA), as described by Hair (2010), varimax rotation, and Kaiser normalization were used in the analysis. The analysis followed the PCA criteria as outlined by Hair (2010).

In a study aiming at revealing the factor structure, each proposed component should have a minimum of five variables, according to Hair (2010). There must be more observations in the sample than variables, with 50 observations being the absolute minimum. It is advised to try for a minimum of five observations for each variable. The sample adequacy's degree of variation is measured by the Kaiser-Meyer-Olkin (KMO) test, and its value must be more than 0.49. A statistically significant (sig. <.05) Bartlett's test of sphericity indicates that there are sufficient correlations between the variables to proceed.

When deciding how many components should be kept, two factors should be considered. First, components are included based on the Kaiser-Guttmann criterion (Fekedulegn *et al*., 2002) if their eigenvalue is greater than 1. Furthermore, variables that fulfill a certain percentage of variance explained, usually 60% or higher, and that show a considerable degree of shared variance according to the scree test are included (i.e., components before inflection point).

If the objective of the study is to decrease the quantity of data to a set of uncorrelated measures or a smaller number of variables that can subsequently be used in other multivariate procedures, orthogonal methods are the most widely used rotational methods for factor rotation and are advised. In factor loading evaluation, values greater than ±.50 are generally considered necessary for practical significance, while factor loadings of ±.30 to ±.40 are considered to be acceptable at the very least. When all variables have high loadings on a single component, the optional structure exits. Generally speaking, cross-loading variables—those with a substantial load on two or more components—are removed unless there is a theoretical basis for doing otherwise or if data minimization is the main objective. Generally, variables must have communalities larger than 0.5 in order to be included in the analysis.

3. Results and Discussions

3.1 Measure of Sampling Adequacy (MSA) Test

There were 23 variables and 249 observations in all in the analysis. An observation to variable ratio of 10 resulted from this. Hair (2010) recommended at least five observations per variable, and this was satisfied. Table

1 shows that the degree of variance of sample sufficiency for analysis was reached because the KMO test value that was obtained was 0.8129, which is higher than the required 0.49 (Hair, 2010). The analysis's Bartlett's test of sphericity yielded a statistical significance of 0.000, which is less than the necessary 0.05 to show that there are sufficient correlations between the variables in order to proceed with the analysis.

Table .1 Results of KMO and Bartlett's Test for agrienterprise farm capabilities

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

3.2 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 1. Scree plot of Eigenvalues after Agrienterprise farm capabilities PCA

The first requirement for component retention was variables before the inflection point, or components that the scree plot showed had considerable amounts of common variation. Second, components having an eigenvalue larger than one were incorporated in compliance with the Kaiser-Guttmann criterion; components 1, 2, 3, 4, and 5 were thus retained in the configuration shown in figure 1. According to table 2, components 1, 2, 3, 4, and 5 were kept in this way.

Table 2. 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

3.3 Rotated Component Matrix and component labelling

The components were rotated orthogonally using Varimax. Following the rotation, analyses of factor loadings and variable assignment on components were conducted in accordance with Hair's (2010) recommendations. At first, only factor loadings larger than ±0.50 were considered to have any practical value. Variables bearing a considerable load on two or more components, known as cross-loading variables, were removed. Secondly, the variables in the analysis were limited to those with a uniqueness score of less than 0.5. Table 3 shows how variables are included and assigned to components.

Table 3. 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 potatoes prior to marketing	0.74	0.39
	tc3: I develop new working methods (NWM) such as 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 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 potato production	0.83	0.24
	tc6: I have Quality control skills for optimal potato production and marketing	0.86	0.22
Component 4: Marketing Capability	mc3: I consider marketing in the production of 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

Itc2, Itc3, TC1, TC2, and TC3 were the first components with large retained component loadings. Adoption of mobile phones and other information communication technology (ITC2) is necessary to make it easier to integrate new technologies, like better seeds, into manufacturing. Itc3 describes how to obtain market information by using information communication technology, such as mobile phones. Using better seed is one example of how Tc1 involves implementing new technology in production. Before being marketed, potatoes must undergo post-harvest processing (TC2), while TC3 refers to the creation of new technologies such seed potato production. Based on these claims, this element is known as the technology integration capability since it involves integrating new technologies into the production process.

For the second component, the statements mlc3, itc4, and itc5 were kept. MLC3 requires the farmer to build and preserve enduring connections with participants in the value chain. Using information and communication technology to communicate with production employees and other value chain actors is required by Itc4 and Itc5. This component, which is known as networking capabilities, entails the farmer sharing information with people who share similar interests.

TC4, TC5, and TC6 were the statements that were kept for the third component. Statement TC4 states that the farmer must be sufficiently informed about new technologies, including mechanization and better seed. Tc5 requires the farmer to have enough facilities for production in order to enable maximum output. For potato production and marketing to be at their best, Tc6 requires the farmer to possess the necessary quality control abilities. These claims define the set of abilities known as technology management capability, which enables a company to effectively use technology to accomplish its objectives.

For the fourth component, the statements mc3, mc4, and mc6 were kept. In mc3, the farmer keeps in mind the state of the market while continuing to grow potatoes. The farmer must possess the ability to target and segment several market channels in order to comply with Mc4. Mc6 denotes the farmer's advertising plan being successful in achieving the farmer's marketing objectives. These claims outline the procedures and actions involved in developing, promoting, and bringing items to market. For this reason, the element is called marketing capability.

Statements mlc5 and mlc6 were loaded into the fifth statement. While mlc6 requires the farmer to keep those clients, mlc5 requires the farmer to build relationships with those consumers. These claims pertain to establishing a more direct connection between farmers and markets, a concept known as "market linking capability."

3.4 Agrienteprise firm capabilities scoring

As indicated by Nieuwoudt (2016), a score based on the 7-point Likert scale was used to calculate the farmers' agrienterprise firm capabilities after the PCA. This was done by combining the scores out of 7 for each statement collectively and calculating the average score per capacity. Consequently, each agrienterprise firm capability is assigned a score to each farmer. The computation solely considered the capabilities found in the PCA for agrienterprise. Table 4 below shows the distribution of farmers' agrienterprise firm capabilties between the minimum, mean, and maximum values. The average scores were transformed into percentages in order to compare the various agrienterprise firm capabilities with one another and to make the numbers easier to comprehend. The strongest agrienterprise firm 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. 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

Farmers are inclined toward interactions, building interpersonal networks, and leveraging information communication technology within these networks, as indicated by their average networking capability score of 71%. Building relationships between farmers and relevant stakeholders via agriculture sector networking fosters a cooperative culture. By doing this, farmers can learn about cutting-edge crop management techniques, ecologically friendly farming methods, and new technologies that will ultimately boost farm output and efficiency. This is corroborated by Pratiwi and Suzuki's (2017) theory that improved learning outcomes are associated with farmers' networking.

Farmers are probably employing technology-driven policies and procedures to leverage their technological know-how to create, preserve, and enhance their competitive edge, as indicated by their 60% technology management score. Wu (2022) offers evidence in support of this, claiming that increased use of new agricultural technologies will increase the farms' profits.

The farmers' somewhat above average market connection capability score of 53% suggests that they are inclined to build and maintain personal relationships with customers, hence reducing value chains. By building relationships with consumers, farmers can learn about market trends, consumer preferences, and new demands, which allows them to adjust their farming methods. Corsi *et al*. (2022), who provided copious evidence of the significant advantages of interpersonal interactions between farmers and customers in a sales context, support the significance of market linking capability.

Farmers are not integrating improved technologies into their operations, as evidenced by their below-average technology integration capability score of 47%. It has been shown that adopting a number of complementary agricultural technologies can boost farmer income, including chemical fertilizers, pesticides, better seed, and methods for preserving water and soil (Biru *et al*., 2020). Therefore, there is a need to enhance farmers' ability to integrate technology, since there is much space for improvement and the progress would be relevant. It is evident that the farmers are not aggressively promoting the purchase of their products, as seen by their below average (47%), marketing competence. Increasing income and eradicating poverty require the participation of farmers markets. Farmers who participate in the commodities market enhance the standard of living of smallholders, provide food security, and increase consumer spending (Dey & Singh, 2023). Thus, efforts should be undertaken to strengthen farmers' marketing capacities.

4. Conclusions and Recommendations

From the results of the analysis, potato producers exhibit strength in establishing and maintaining working relationships with other supply chain actors, using ICT tools for internal and external communication, adapting possessed technology to meet production goals and establishing long term linkages with their clients. On the other hand, potato producers displayed weaknesses 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.

Author contribution statement

Fahad Luttah Juma: Conceived and designed the study, conducted the analysis and interpreted the findings, drafted the paper, revised it critically for intellectual content and final version to be published.

Dickson Okello: Conceived and designed the study, revised it critically for intellectual content and final version to be published

Patience Mshenga: Conceived and designed the study, revised it critically for intellectual content and final version to be published.

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