

# Role of digital platforms in maintaining the value chains of vegetable, root and tuber crops functional in the face of Covid-19

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**Research Report**

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## List of abbreviation and acronyms

ADC	Agricultural Development Corporation
AKF	Aga Khan Foundation
ATT	Attitude
AVE	Average Variance Extracted
CA	Cronbach's Alpha
CEO	Chief Executive Officer
CIP	International Potato Centre
COVID-19	Coronavirus Diseases 2019
CR	Composite Reliability
DSGs	Digital Saving Groups
FMK	Farmers Market Kenya
GAPs	Good Agronomic Practices
GDP	Growth Domestic Product
ICT	Information Communication Technology
INN	Innovativeness
IVR	Interactive Voice Response
KBM	Kernel Based Matching
KES	Kenyan Shillings
LMIC	Low-and Middle-Income Countries
MOU	Memorandum of Understanding
NNM	Nearest Neighborhood Matching
NPCK	National Potato Council of Kenya
PBC	Perceived Behavioral Control
PLS	Partial Least Square
PPP	Public Private Partnership
PROA	Proactiveness
PSM	Propensity Score Matching
PU	Perceived Usefulness
RM	Radius Matching
RT	Risk Taking
RTS	Remote Survey Tools
SE	Standard Error
SEM	Structural Equation Modeling
SMS	Short Message Services
SN	Subjective Norms
SRMR	Standardized Root Mean Square Residual
SSA	Sub-Saharan Africa
TPB	Theory of Planned Behavior
TTS	Trade Transparency Service
USSD	Unstructured Supplementary Service Data
VIF	Variance Inflation Factor



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## Executive summary

COVID-19 pandemic has had a far-reaching impact along the agricultural value chains in Kenya. The Kenyan government placed drastic impact measures to flatten the curve of COVID-19 infections, which affected the value chain actors differently. To counter the economic mayhem caused by the pandemic, the usefulness of digital platforms has been amplified in agricultural value chains, especially in vegetables, root and tubers. It is not clear if, how and to what extent the existing digital platforms developed by several private companies or supported by donors have contributed and are still contributing to maintaining agri-food chains functional and securing the livelihoods of associated value chain actors in Low- and Middle-Income Countries (LMIC) countries during COVID 19 pandemic. It is on the foregoing that International Potato Center (CIP) implemented a study to understand the role of digital platforms in maintaining the value chains of vegetable, root and tuber crops functional in the face of COVID-19 pandemic in Kenya.

Web-based portal, Android mobile App and Unstructured Supplementary Service Data (USSD) Short code services were the main digital platforms of focus. The study was built on case studies from Viazi Soko (NCPK) digital platform for farmers, Twiga food for traders and Soko Kijiji groceries digital platform for consumers. A participatory research methodology was used to integrate the desktop research, key informant/expert interviews, focus group discussion (FGD) and the surveys involving various value chain actors along the food value chain i.e., traders, transporters, consumers, and farmers. The study adopted mixed method approach with concurrent nested option. Both Quantitative and qualitative data were collected. Quantitative aspects of the study were collected using a structured questionnaire administered through face-to-face interviews to solicit primary information from 355 consumers, 100 traders and 370 farmers in the targeted sub-counties selected using multistage sampling technique. Quantitative data obtained was analyzed using Stata version 17 and SPSS version 28.0 to generate descriptive statistics. Propensity Score Matching was used to estimate the impact of the digital platforms on (i) the quantity of certified potato seeds used and (ii) the average weekly household expenditure on vegetables and fruits during the lockdown period. Structural equation model (SEM) was used to investigate (i) how producers' personality traits influence the usage of ViaziSoko for accessing quality farm Inputs and services and (ii) the role of entrepreneurial behavior in influencing use of digital platform in food purchase among consumers. For farmers, findings indicated that awareness and use of the digital platforms is still low. Approximately 32% of the interviewed farmers were aware of the digital platforms. Majority (86.55%) of those aware were medium and large-scale farmers.

The use of apps through a mobile phone was the most preferred digital platform by roughly 91% of the farmers. The ease of accessing input information/services and awareness of digital application inspired the use of digital platforms. Farmers' attitude and proactiveness influenced perceived usefulness of the digital platforms. Despite being in existence even before the pandemic, most of the farmers started using digital platforms in response to the pandemic. Relatively, majority of farmers (32.05%) started using digital platforms to access quality seeds, while 12.82% started using them to access extension and advisory services on Good Advisory Practices (GAPs) as well as access to market/output information in response to the pandemic. The digital intervention contributed significantly to the increase in the frequency of use of digital platforms. The greatest increase in the frequency was observed in the services related to access to market/output information 3.85% (from 19.23% to 23.08%), extension and advisory services on GAPs 6.41% (from 16.67% to 23.08%) as well as pest and disease advisory services 6.41% (from 12.82% to 19.23%) respectively. The digital platform showed a gradual role in bridging the gap in terms of input access by farmers during the pandemic and approximately 95% of the interviewed farmers confirmed their intention to continue using the digital platforms (ViaziSoko) beyond the pandemic.

For traders, the results revealed that most of them had procured their supplies over the mobile phone (91%) and through online platform (81%). On average, a single trader dealt in 16 different products. Vegetables was the most traded commodity across the three time periods of analysis compared to roots and tubers. Fear of getting infected with COVID-19 and liquidity constrain were the major threats affecting the business. Most of the traders procured their supplies from Nakuru before and during COVID-19 (77.97% and 88.52%). The increase in supplies during COVID-19 for Nakuru county resulted from Twiga foods supplies. Other traders procured their supplies from Nyandurua, Meru and Narok county. The quantity of vegetables and fruits sold to direct consumers, brokers/agents and sold to other outlets increased during COVID-19. Most traders (90.12%) started using online platform and 82.35% social media in response to the pandemic. Despite being the most adopted strategy in response to the pandemic, about 15% of traders are likely to cease or reduce the use of mobile phones to procure their supplies. This could be attributed to the high transaction costs involved in making payments for the supplies. Further, based on the perishability nature of agricultural products, traders would wish to physically see and choose products before making payments. Major sales and distribution strategies used in response to the pandemic are sales and distribution through social media (54.55%) and online platform (66.67%). Majority of traders (86%) reported to have made payments and financing electronically followed by advancing products as in-kind/trade creditors (73%) and lending cash to business partners (72%). Change in business working hours to avoid curfew and travel restrictions (90%) as well as the use of own savings to support business operation (86%) were the major business adaptation strategies used by traders.

For consumers, about 41% used digital platforms to purchase fruits and vegetables out of which 97% of them used mobile application. Convenience (95.86%) and fear of health-related complication (84.83%) were the major motivational factors to use digital platforms. COVID-19 pandemic increased the demand for digital platforms among 85% of the consumers (where 63% started using and 22% increased the use digital platforms). About 81% of consumers were mainly using digital platforms to access market information. Consumer willingness to adopt the digital platform was influenced positively by group membership and negatively by age and education level of the household head and the dependency ratio. Group membership were basically social and informal groups in the urban areas where among other issues consumers discuss food and digital related issues as well as procurement strategies) Most consumers (76.56%) purchased fruits and vegetables from designated points followed by local retailers in the neighborhood (49.26%). Digital platforms gained popularity (from 13.35% to 38.53%) during the pandemic compared to other channels Streetcar booths (2.83%) was a new channel during the pandemic. Despite reducing popularity during the pandemic, designated markets channel supported about 48% of the proportion of purchase. Users of digital platform experienced fluctuating but above average in the weekly expenditure compared to their counterparts. Change in price of the vegetables and fruits was the major contributor to the fluctuation (90.54%). Findings revealed that at one point in time during the pandemic. all sampled consumers who purchased through the digital platform used mobile money transfer to make pay for fruits and vegetables, with 99.31% likely to continue using the platform beyond the pandemic. In terms of entrepreneurial behavior, proactiveness and Innovativeness positively and significantly influenced perceived behavioral control. This implies that the more a consumer acts in anticipation of future problems, needs, or changes and use of new ideas or methods, the more they will think of themselves as having the efficacy to use the digital platforms in purchasing vegetables. Attitude positively and significantly influence perceived usefulness implying that the more favorable a consumer's opinion of the vegetables purchasing digital tool is, the more the consumer will view the tool as useful. Perceived behavioral control influenced perceived usefulness positively implying that the more consumers considered themselves to have the ability to use the vegetables purchasing digital tool, the higher they will consider the tool as useful. Subjective norm was also found to positively and significantly influence perceived usefulness meaning that the more positive the consumer's peers' opinion about the vegetables purchasing digital tool is, the more the consumer will view the tool as useful.

The study recommends the following suggestions:

- It is clear agritech companies seeing pandemic is an opportunity for strengthening food value chain. However, they still lack sustainable business models for the agriculture contexts. Therefore, design for digital platforms need to integrate sustainable business models to avoid collapsing of the platforms due to heavy reliance on external support and inadequate revenue models. Adoption of a self-sustainable business approach as well as re-orienting the business approach towards public private partnerships and diversifying product/service portfolio by integrating different services and value chains, backward and forward integration to create new revenue streams provides some of the options for consideration by service providers.
- Develop a framework for embedding farmer oriented in existing local extension services to support practical implementation of agronomic recommendations.
- Enhancing entrepreneur behavior of farmers and traders is critical in adoption of agri-digital solutions.
- Building agile business with flexibility to adjust to various shocks beyond the pandemic. Focusing on the transition post COVID will be critical in maintaining the business space of the digital platforms by building strong market offering.
- Donor support is critical for digital startups at the beginning of the business as many startups are coming up during this pandemic time, however, it is critical for donor to analyze their business model for sustainability of digital platform especially the platforms with little or no commercial orientation but have a clear welfare gain with social enterprise business model.
- Strong bio-security measures in the context of COVID-19 are important in enhancing trust especially in product handling by the agricultural digital service providers.
- Combined county permits to allow one easily transaction in any county with fresh produce among digital platforms with strong cross county distribution of products to traders. This has implication in increasing cost of business.
- Product differentiation is key in making the digital platforms competitiveness. Strong focus of the digital platforms in providing unique products and solutions in ever-changing environment is key in keeping pace with consumers dynamic needs, key among them Enhance interactiveness between agricultural digital solutions and clients e.g. chatbot

Integrating youth entrepreneurs and higher education students to support development of ICT related agri-solutions e.g., accessible database by use of USSD code for vendors to easily authenticate the quality of the produce as well as data science. This will facilitate creation of robust learning curve to trigger development of marketable and viable agricultural digital services.

## 1. Introduction and objectives

### 1.1 Introduction

The COVID-19 pandemic has had a far-reaching impact in the agricultural value chains in Kenya. The Kenyan government had placed drastic impact measures to flatten the curve of COVID-19 infections which has affected the value chain actors differently. The COVID-19 containment measures Kenya has instituted included physical distancing, closures of markets, lockdowns, mobility restrictions, quarantines, and social isolation. In response to COVID-19 pandemic disruption, the usefulness of digital platforms has been amplified in agricultural value chains, especially in root and tubers, and vegetables.

It is not clear if, how and to what extent the existing digital platforms developed by several private companies or supported by donors have contributed and are still contributing to maintaining agri-food chains functional and securing the livelihoods of associated value chain actors in Low- and Middle-Income Countries (LMIC) countries during COVID 19 pandemic. It is on the foregoing that CIP had implemented a study to understand the role of digital platforms in maintaining the value chains of vegetable, root and tuber crops functional in the face of COVID-19 in Kenya. The research was guided by the following objectives:

### 1.2 Objectives

- 1) Identify and review existing digital platforms used in agri-food value chains (inputs and outputs) and certifications processes, and analyze their functions, strengths, weaknesses, opportunities, threats, and challenges.
- 2) Understand the strategies put in place by the digital companies to expand their contribution to business continuity in the food chain and how they have adjusted to the crisis.
- 3) Analyze how digital platforms have been used by various actors in the vegetable, root, and tuber crops value chains during and after the lockdown period and how they have contributed to maintain the chains functional.

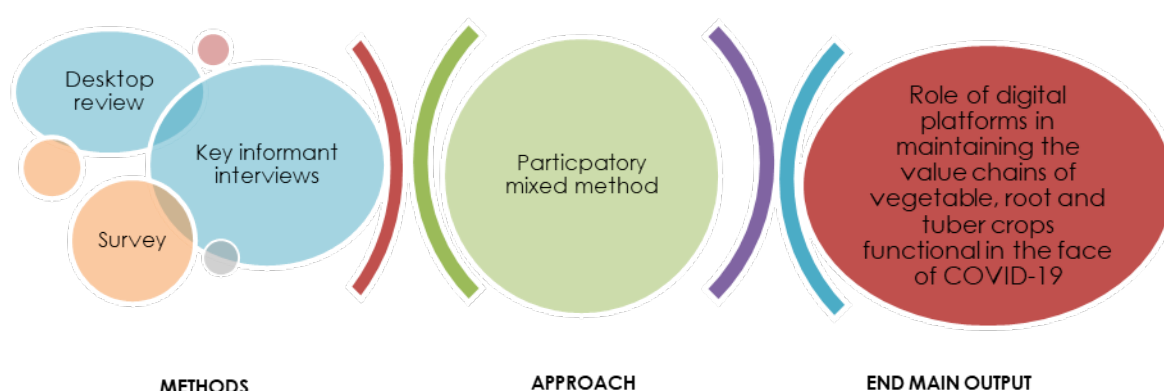
To achieve the above objectives, the research was endeavored to answer the following research questions

- 1) Did the number of digital platforms involved in food value chain increased during COVID-19?
- 2) What were strengths, opportunities, weakness, and threats for existing digital platforms involved in various nodes of food value chains in the face of COVID-19?
- 3) What were the strategies adopted by digital platforms to continue or expand their business operations during and after lockdown?
- 4) How did the food value chain actors benefit from digital platforms during and after lockdown?
- 5) Have digital platforms enhanced access to quality seeds for the planting season under COVID-19 related movement restrictions?
- 6) Have digital platforms improved access to labor and possibly mechanization for the harvesting during the pandemic?

## 2. Methodology

### 2.1 Study area and evaluation approach

The study was conducted in Kenya anchored on three main digital platforms; Web-based portal, Android mobile App and USSD Short code services. Kenya was selected because the ICT penetration was higher compared to other Eastern African countries<sup>1</sup>. The study used participatory research methodologies to capture most significant change stories and photo voice in an integrated manner that included: (i) Desktop research literature search and file/document review; (ii) key informant/Expert interviews and focus group discussion; and (iii) Surveys involving value chain actors such as traders, consumers and farmers Proposed research approach (Figure 1).

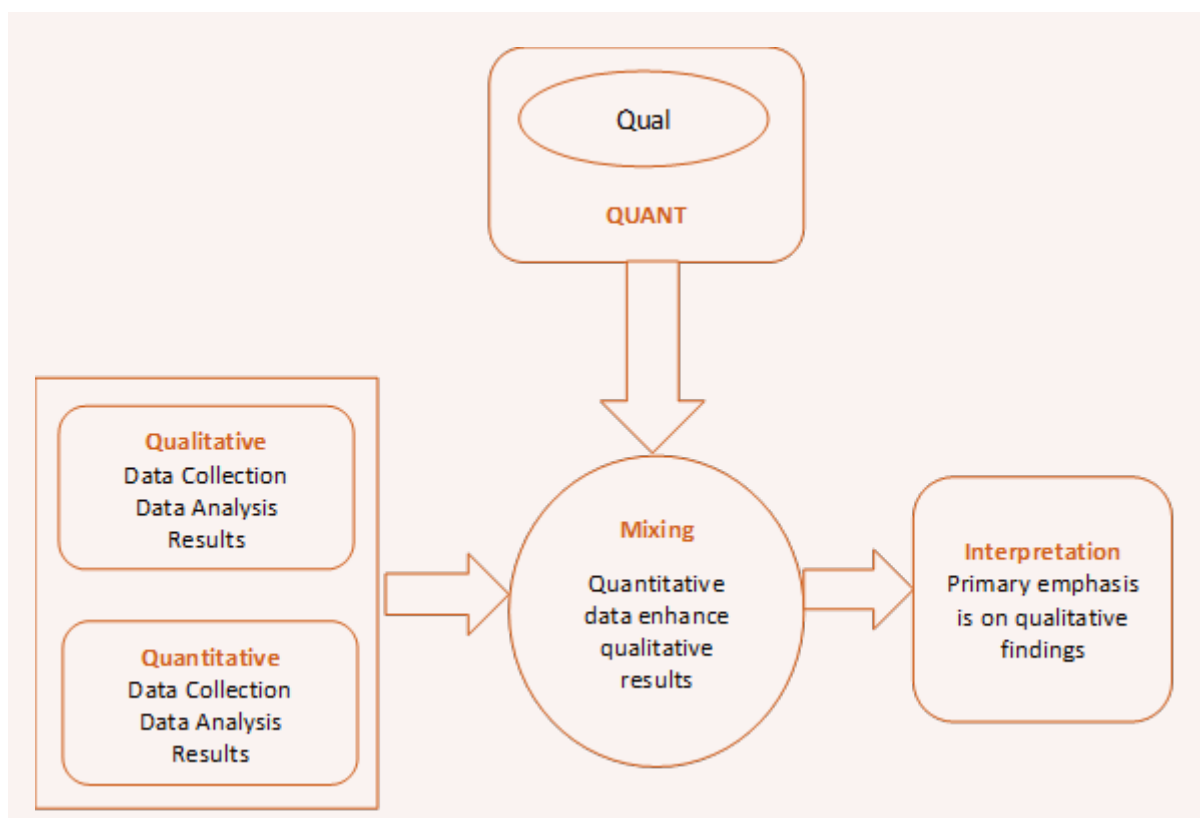


**Figure 1.** Proposed research approach

A mixed-method approach with concurrent nested option as the evaluation design (Figure 2) was used.<sup>2</sup> It entailed a substantial inquiry on the qualitative aspects of the digital platforms in Kenya before and after the COVID-19 pandemic and its effects on the value chain actors. The quantitative measures to be considered was corroborated on the magnitude of change on the target outcome parameters that lend themselves to numeric measures. The advantage of the mixed method approach allowed the triangulation of the quantitative and qualitative approaches to assess the role of digital platforms in maintaining the value chains of vegetable, root and tuber crops functional in the face of COVID-19. This enabled provide the answers to the research questions developed in the study.

<sup>1</sup> Krishnan A., Banga, K. and Feyertag, J. (2020). Platforms in Agricultural Value Chains: Emergence of new business models. <https://set.odi.org/wp-content/uploads/2020/07/Platforms-in-agricultural-value-chains-Business-Models.pdf>

<sup>2</sup> Concurrent nested is proposed since the causal paths are susceptible to systemic and institutional factors (largely qualitative) that will have a huge bearing on the magnitude of the anticipated change (both qualitative and quantitative) in program outcomes.



**Figure 2.** Concurrent nested Design

## 2.2 Study thematic focus and data collection methods

The study was undertaken focusing on the following themes.

## Digital platform landscape assessment

- 1) This was undertaken in the first phase of the study and involved literature review and quick scan through the digital platform websites to map out the existing digital platforms involved in strengthening food value chain in Sub-Saharan Africa. This involved identification of the business models that is being pursued by the private sector led digital platform, targeted value chains and the tools and services offered to support agriculture actors along the value chain.
- 2) Key Informant Interviews conducted with selected digital agricultural platforms such as Soko Kijiji for consumers, Twiga foods (Soko yetu) and Kwik basket who connects farmers, traders and consumers through digital supply chain management, ViaziSoko for farmers and Afrifu who acts as a digital extension service provider to farmers and consumers. These digital companies were interviewed through zoom online platform to identify the platforms' functions, strategies, strengths, weakness, opportunities, threats, and challenges during and after the lockdown among digital platform service providers.

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## Individual coping

In the second phase of the study, the survey was conducted with food value chain actors where digital platforms dominated in fruits, vegetable and potato crops value chain were purposively selected from the landscape assessment to undertake an in-depth study. The study focussed three purposively selected digital agricultural platforms namely Soko Kijiji for consumers, Twiga foods (Soko yetu) for connecting farmers, traders, and consumers and Viasoko for farmers. a mixed method approach was adopted. A short survey (20-30 minutes) and key informant interviews was conducted with key chain actors over the phone. Observational walks were carried out to understand market functions of traders who use digital platforms.

The short survey used Remote Survey Tools (RST) such as phone to collect data from farmers, traders, and consumers. RST was used for collecting farmers' feedback about their experience of using digital platforms and the quality of services which includes accessing agronomic information, quality inputs, credits, and markets. RST was also used for collecting feedback from urban consumers on accessing various types of foods, particularly during lockdown. Similarly, other value chain actors and stakeholders, including traders, government staffs (KEPHIS), institutional buyers and private companies were approached through RST. In face of the COVID-19 situation, the study adopted an innovative approach: few flying enumerators visited the villages following all necessary health measures and ensure that selected farmers successfully participated in the survey. This ensured a good rate of participation while minimizing travels and physical contacts.

In terms of sampling, (Table 1), 355 consumers (100 users of digital platform and 255 non-users of digital platform) and 370 farmers (120 digital platform users and 250 non digital users) were selected for the survey. In sampling of the farmers/consumers', multistage sampling technique was employed. First, 2 counties were purposively selected (1 main producer county for farmers' survey and 1 county for consumers' survey) and then 2 sub counties and 4 wards where there is high concentration of digital platform users were selected. From the selected county, 4 villages were randomly selected and sample frame of the treated was developed from Digital platform database. Thereafter, random draws of treated groups were conducted. A comparison group of farmers (matched in a ratio of 1 to 2), non-treated group was selected from the same locations and had similar characteristics- agro-ecological zones, farming systems, socioeconomic conditions, etc., like those in the treatment sites.

**Table 1.** Summary of the sampling framework

Consumer survey	Sample	Farmers	Sample
1 county with high concentration of digital users	355 (100 users and 255 non-users of digital platform)	1 county with high concentration of digital users	370 (120 users and 250 non-users of digital platform)
Nairobi County		3 sub-counties	
	Distribution of the sample (for users and non-users) was proportionate to size of the users in the list provided by the digital company. Thereafter random sampling was used to select the respondents		Distribution of the sample (for users and non-users) was proportionate to size of the users in the list provided by the digital company. Thereafter random sampling was used to select the respondents

Similarly, we purposively selected 100 traders who are linked to Twiga foods Soko yetu platform.



## Ethical standard

Official approval was not obtained through internal review board for collecting data from the field, but the study was adhered high ethical standard. However, this study was approved by the project and study teams of the International Potato Center (CIP). The study team maintained highest ethical standards using standardized questionnaire modules and informed consent forms which were used in other PIM study which was conducted in Kenya which have received official ethical clearance from internal review board at ILRI. Before each interview, the research objective, confidentiality, voluntary participation, and anonymity of respondents were clearly explained. Verbal consent of each respondent was recorded.

## Challenges in data collection

Despite ending the data collection successfully, we faced several challenges. Amongst some challenges and limitations were:

- 1) COVID 19 related challenges-apprehension among respondents that may affect the response rate especially among farmers despite of following covid measures by the enumerators.
- 2) Access to the information on beneficiaries- due to the data privacy laws in the Country. The digital companies were reluctant to provide information on the contacts of consumers, farmers and traders. The research team worked closely with the digital companies including triggering contractual relationship with the companies though this took longer than anticipated. This was further compounded by digital companies' unwillingness to participate in the physical workshop and the team adopted Key informant interviews to get the information.

## 2.3 Data processing and analysis

After completion of data collection through digital tool (ONA platform), the research team doubled checked the quality of data on the day of collection and transferred data into the cloud. Further, the data was cleaned and ensure that it was fit for use in statistical computations. All discrepancies were corrected accordingly. The data analysts proceeded with analysis of all the variables of interest as well as disaggregated analyses based on different project objectives/variables. The cleaned data were documented for open data access in CG space. The final cleaned data was used for analysis. To analyse data, the evaluation team employed qualitative (descriptive, content, comparative) and quantitative techniques. The summarized statistical plan was presented in (Table 2).

**Table 2.** Summary of statistical methods used

Data analytical methods	Description of what was assessed
<b>Descriptive analysis</b>	Was used to describe and understand the digital platforms including the business models and the target value chains
<b>Content analysis</b>	This started from desktop review and lead to concretize the line of inquiry along with the proposed research question This was triangulated with quantitative data that feeds into the final reporting.
<b>Comparative analysis</b>	Involve: <ul style="list-style-type: none"><li>○ Comparison of statistics digital users and non-digital users as well as those available in literature.</li><li>○ Econometric analysis. This involved the use of PSM technique and SEM.</li></ul>

The variables used for PSM model for farmers is presented in Table 3 and for consumers in Table 4

**Table 3.** Variable in PSM model among farmers

Variables in the model (Consumer)	Short description
<b>Dependent variable</b>	
Adoption of digital platform	Binary variable of Yes/No (usage of the selected digital platform)
Expenditure pattern	Monetary value of vegetable/root and tubers purchased during recent lockdown and in August 2021
<b>Independent</b>	
Age	Age of the main decision maker on food in the household (years)
Gender	Gender of the main decision maker on food in the household (Male/Female)
Education level	Education level of the main decision maker on food in the household
Household size Structure	Household size
Income level	Monthly average income (KES)
<b>Institutional</b>	
Access to credit	Household access to credit
Group membership	Membership to a social group that technology related issues are discussed
Location - Low-income areas	Binary variable on the neighborhood effect
- Middle income areas	Binary variable on the neighborhood effect
- High income areas	Binary variable on the neighborhood effect
Ownership of mobile phone	Binary variable with owning a brick phone
Distance to the market	Distance to the nearest fruit and vegetables and roots and tubers market

**Table 4.** Variable in PSM model among consumers survey variable in PSM model

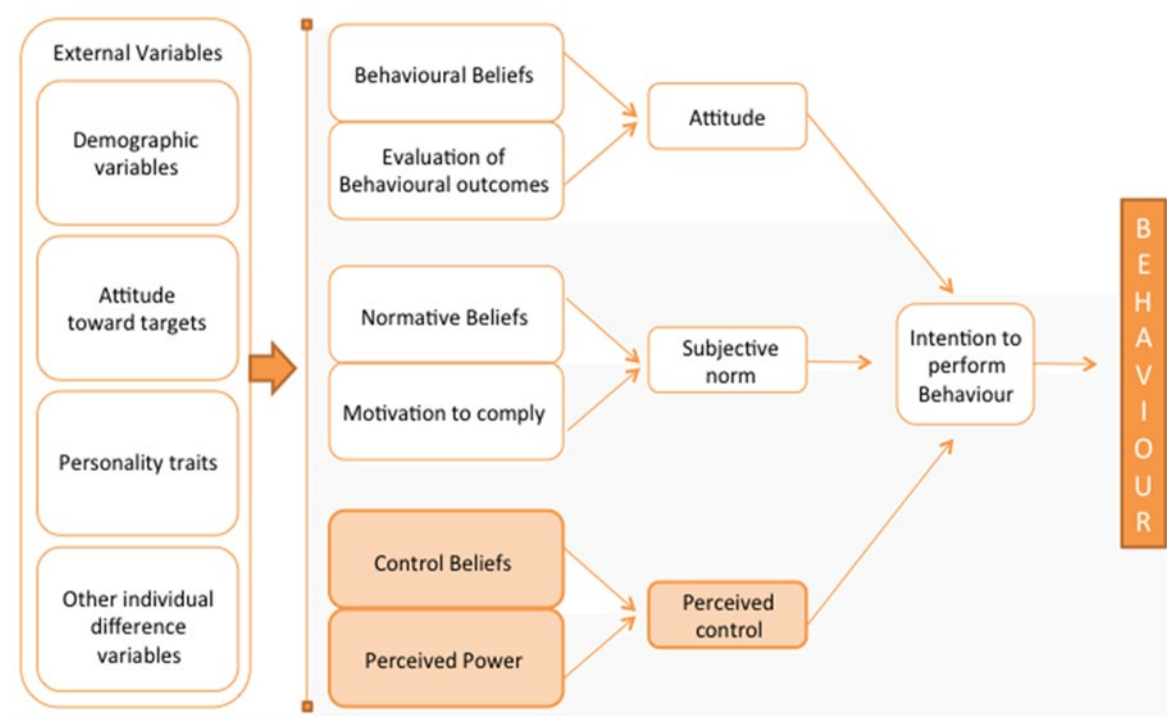
Dependent variable	Short description
Adoption of digital platform (YES/NO)	Binary variable on adoption of digital platform
Expenditure on clean seeds per acre	Amount spend on Clean seeds in the main last season (KES)
<b>Independent</b>	
Age	Age of household head (years)
Gender	Gender of household head (Male/Female)
Education level	Education level of household head
Household size structure	Household size
Income level	Monthly average income (KES)
Off- farm income participation	Age of the main decision maker on food in the household (years)
Land size	Gender of the main decision maker on food in the household (Male/Female)
<b>Institutional</b>	
Access to credit	Household access to credit
Number of contacts with extension service providers in the past 1 year	Continuous
Mobile phone ownership	Binary variable with 1=ownership of brick phone
Group membership	Membership to a group
Access to market	Time taken to the nearest preferred root and tuber market/vegetable

### Farmers models under the theory of planned behaviour

This analysis adopted the theory of planned behavior to investigate how the personality traits behavioral, normative, and control characteristics of individual producers influence the usage of Viazisoko for accessing quality farm inputs and services such as certified seeds, potato-specific fertilizer, approved agrochemicals, spray services, soil testing and mechanization services among other services (Figure 3). Behavioral intent is a fundamental component of this paradigm; behavioral intentions are impacted by one's attitude about the likelihood that the conduct will produce the expected result, as well as one's subjective assessment of the risks and advantages of that outcome.

The TPB has been used to predict and explain a variety of health behaviors and intents, including smoking, drinking, using health services, breast feeding, and substance use, among others. According to the TPB, behavioral success is dependent on both motivation (intention) and ability (behavioral control). It divides beliefs into three categories: behavioral, normative, and control. The TPB is comprised of six constructs that collectively represent a person's actual control over the behavior.

- 1) Attitudes - This refers to the degree to which a person views the behavior of interest favorably or negatively. It requires thinking about the consequences of executing the behavior.
- 2) Behavioral intention - This refers to the motivating elements that drive a specific conduct, with the stronger the intention to perform the activity, the more likely it will be performed.
- 3) Subjective norms - This is the belief that most people approve or disapprove of a particular conduct. It has to do with a person's ideas regarding whether peers and important individuals in his or her life think he or she should partake in the conduct.
- 4) Social norms are the established regulations of conduct in a group of individuals or in a larger cultural environment. In a group of individuals, social norms are regarded normative, or standard.
- 5) Perceived power is the perception of the presence of elements that can help or hinder the performance of a behavior. Each of those characteristics is affected by a person's perceived behavioral control, which is influenced by perceived power.



**Figure 3.** Theory of planned behavior

For this analysis, the personality traits that influence perceived behavioral control and attitude considered were: proactiveness, innovativeness and risk taking. The intention to perform a behavior was represented by the perceived usefulness of ViaziSoko and the behavior was the actual use of ViaziSoko.

### Measurement items for farmers

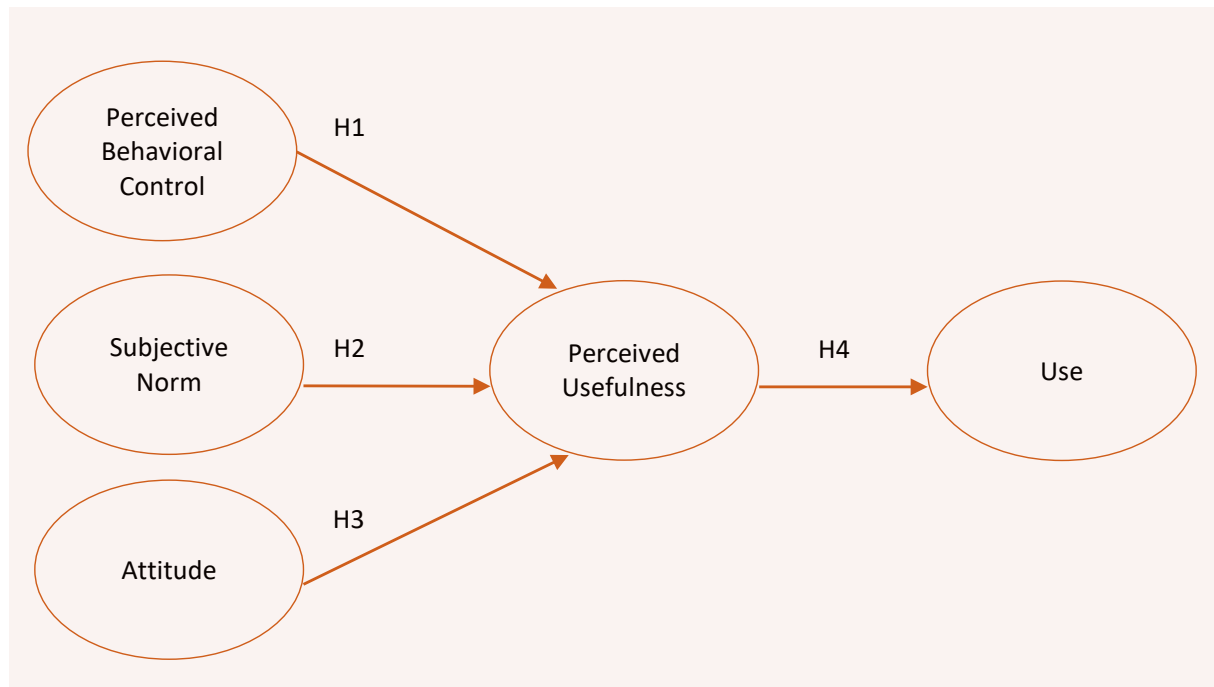
**Table 5.** Measurement items for farmers

Perceived Usefulness	
Perceived_usefulness_1	I find digital platforms useful for farming potatoes
Perceived_usefulness_2	Digital platforms would enable me to spend less money on farming
Perceived_usefulness_3	I find digital platforms safe for my farming potatoes during the period of COVID-19
Perceived_usefulness_4	Digital platforms would enable me to accomplish farming more quickly.
Subjective norms	
Subjective_norm_1	People who influence my behavior think that I should digital platforms for my farming
Subjective_norm_2	I would farm by digital platforms because of the proportion of my friends who use digital platforms for farming
Subjective_norm_3	People who are important to me think that I should use digital platforms for farming
Perceived behavioural control	
Perceived_b_control_1	I have an Internet-enabled mobile phone to access the digital platforms sites via mobile phone
Perceived_b_control_2	Given the resources, opportunities, and knowledge it takes to use digital platforms, it would be easy to use digital platforms
Perceived_b_control_3	I have the knowledge necessary to use digital platforms for my farming
Attitude	
Attitude_1	Farming by digital platforms is a good idea
Attitude_2	Farming by digital platforms is a wise idea
Attitude_3	Am positive about digital platforms farming
Risk taking	
Risk1	I prefer to stick to my current farming practices rather than trying new ones
Risk2	With the current challenging farming environment, I prefer to avoid further investment on my farm
Risk3	I am always ready to try new farming practices
Proactiveness	
Proactiveness1	I respond more quickly to changes in the environment of my farm compared to other farmers
Proactiveness2	I am constantly looking out for new ways to improve my farm.
Proactiveness3	I am among the first farmers to adopt new farming practices in my village
Innovativeness	
Innovativeness1	I like to use new farming practices
Innovativeness2	I often improve my farming practices
Innovativeness3	I like to have the latest information on farming practices

### Econometric models for farmers' responses

The analysis was conducted using two models. Model one analyzed the effect of perceived behavioral control, subjective norm and attitude on perceived usefulness and the effect of perceived usefulness on use of Viazisoko without considering the personality traits (perceived power) of the producers (*Figure 4*). Model two analyzed the effect of perceived behavioral control, subjective norm and attitude on perceived usefulness and the effect of perceived usefulness on use but incorporated the effect of personality traits (innovativeness, risk taking and proactiveness) on attitude and behavioral control of the farmers (*Figure 5*).

#### Model 1

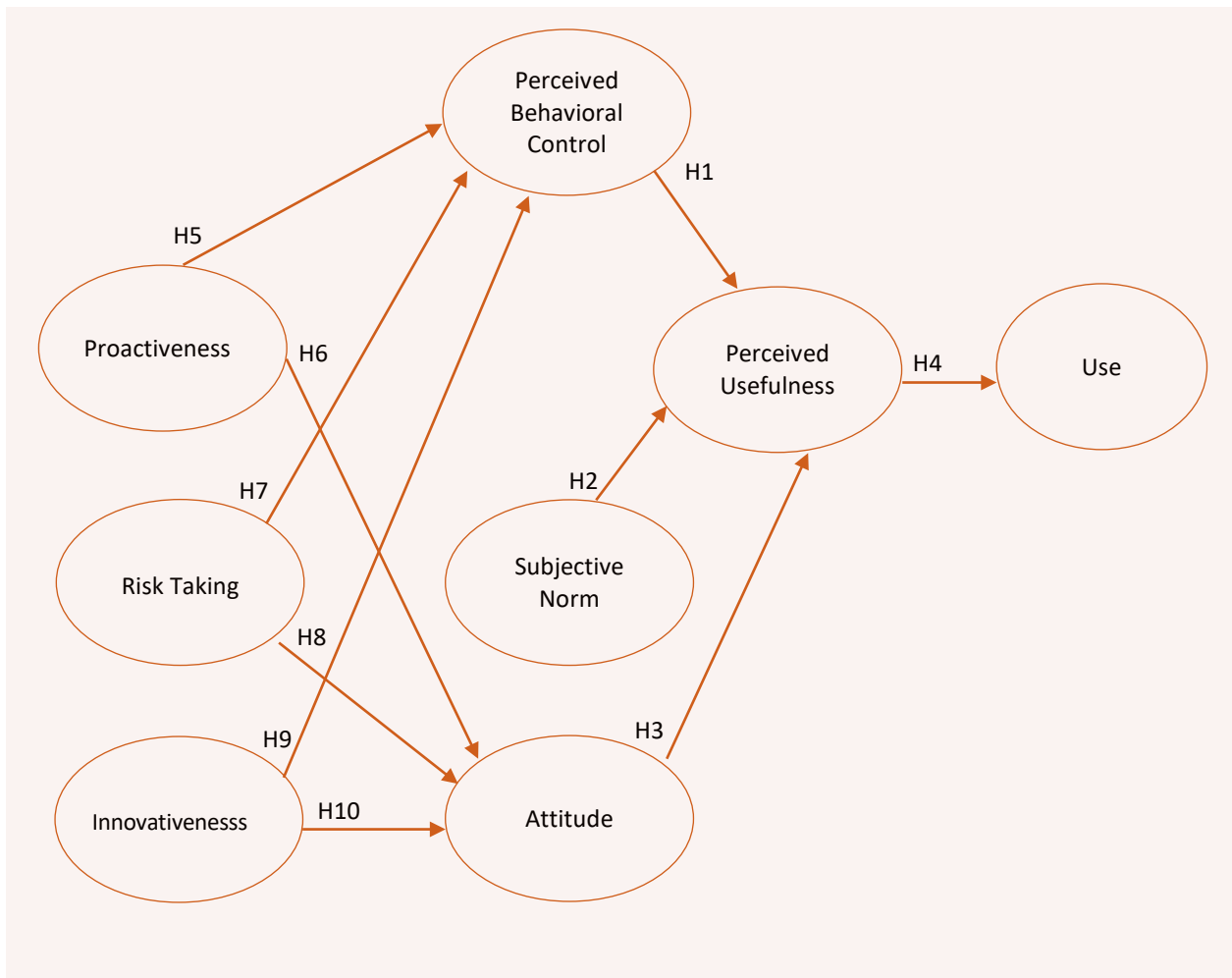


**Figure 4.** Model 1- Effect of perceived behavioral control, subjective norm, and attitude without personality traits

#### Hypotheses

- H1: Perceived behavioral control has a positive influence on perceived usefulness
- H2: Subjective norm has a positive influence on perceived usefulness
- H3: Attitude has a positive influence on perceived usefulness
- H4: Perceived usefulness has a positive influence on use

## Model 2



**Figure 5.** Model two - Effects of perceived behavioral control, subjective norm and attitude on perceived usefulness and the effect of perceived usefulness on use but incorporated the effect of personality traits

### Hypotheses

- H5: Proactiveness has a positive influence on perceived behavioral control
- H6: Proactiveness has a positive influence on attitude
- H7: Risk taking has a positive influence on perceived behavioral control
- H8: Risk taking has a positive influence on attitude
- H9: Innovativeness has a positive influence on perceived behavioral control
- H10: Innovativeness has a positive influence on attitude

For this analysis, the external variables that influence perceived behavioral control considered were: proactiveness, innovativeness and risk taking. The intention to perform a behavior was represented by the perceived usefulness of the digital tool and the behavior was the use of the digital tool.

## Measurement items for consumers

**Table 6.** Measurement items for consumers

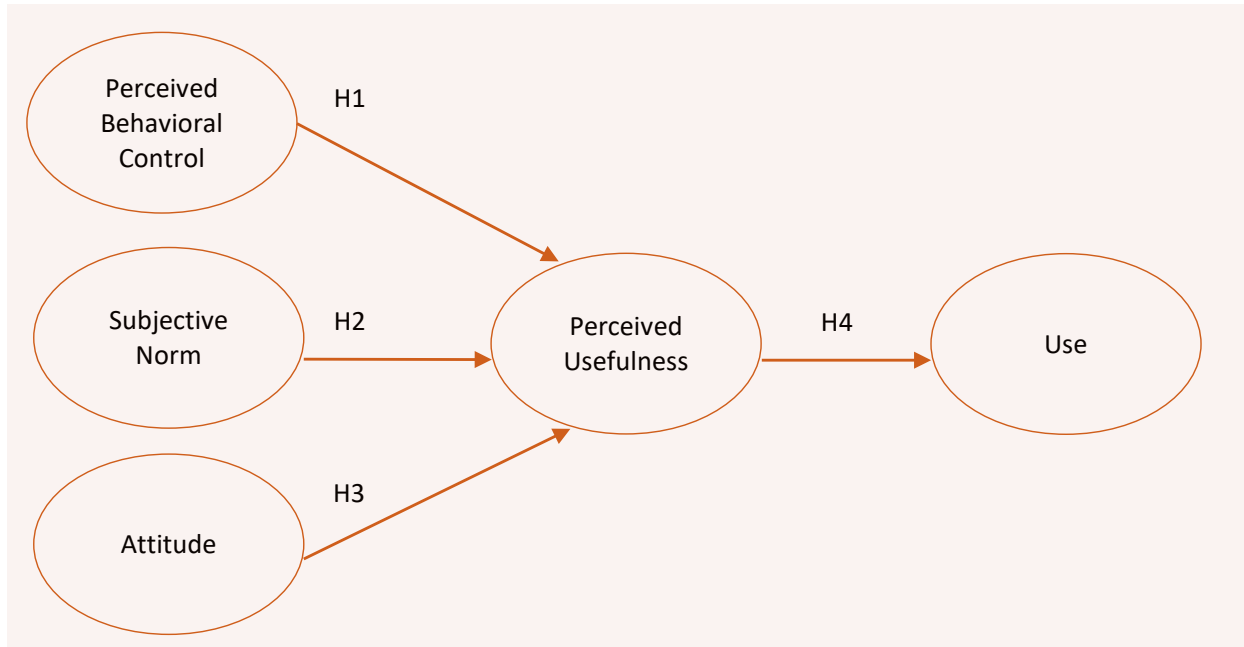
Perceived Usefulness	
PU1	I find digital platforms useful for shopping fruits and vegetables/vegetables
PU2	Digital platforms would enable me to spend less money on shopping
PU3	I find digital platforms safe for my shopping fruits and vegetables/vegetables during the period of COVID-19
PU4	Digital platforms would enable me to accomplish shopping more quickly.
Subjective norms	
SN1	People who influence my behaviour think that I should digital platforms for my shopping
SN2	I would shop by digital platforms because of the proportion of my friends who use digital platforms for shopping
SN3	People who are important to me think that I should use digital platforms for shopping
Perceived behavioural control	
PBC1	I have an Internet-enabled mobile phone to access the digital platforms sites via mobile phone
PBC2	Given the resources, opportunities and knowledge it takes to use digital platforms, it would be easy to use digital platforms
PBC3	I have the knowledge necessary to use digital platforms for my shopping
Attitude	
ATT1	Shopping by digital platforms is a good idea
ATT2	Shopping by digital platforms is a wise idea
ATT3	Am positive about digital platforms shopping
Risk taking	
RT1	I prefer to stick to my current purchasing practices rather than trying new ones
RT2	With the current challenging purchasing environment, I prefer to avoid further investment on my purchasing habits
RT3	I am always ready to try new purchasing practices
Proactiveness	
PROA1	I respond more quickly to changes in the environment of my consumption compared to other consumers
PROA2	I am constantly looking out for new ways to improve my consumption habits.
PROA3	I am among the first consumer to adopt new purchasing practices in my neighbourhood
Innovativeness	
INN1	I like to use new purchasing practices
INN2	I often improve my purchasing practices
INN3	I like to have the latest information on purchasing practices

## Econometric Models for consumers' response

The analysis was conducted using two models. Model one analyzed the effect of perceived behavioral control, subjective norm and attitude on perceived usefulness and the effect of perceived usefulness on use of digital platform without considering the personality traits (perceived power) of the consumers (Figure 6). Model two analyzed the effect of perceived behavioral control, subjective norm and attitude on perceived usefulness and

the effect of perceived usefulness on use but incorporated the effect of personality traits (innovativeness, risk taking and proactiveness) on attitude and behavioral control of the consumers.

### Model 3



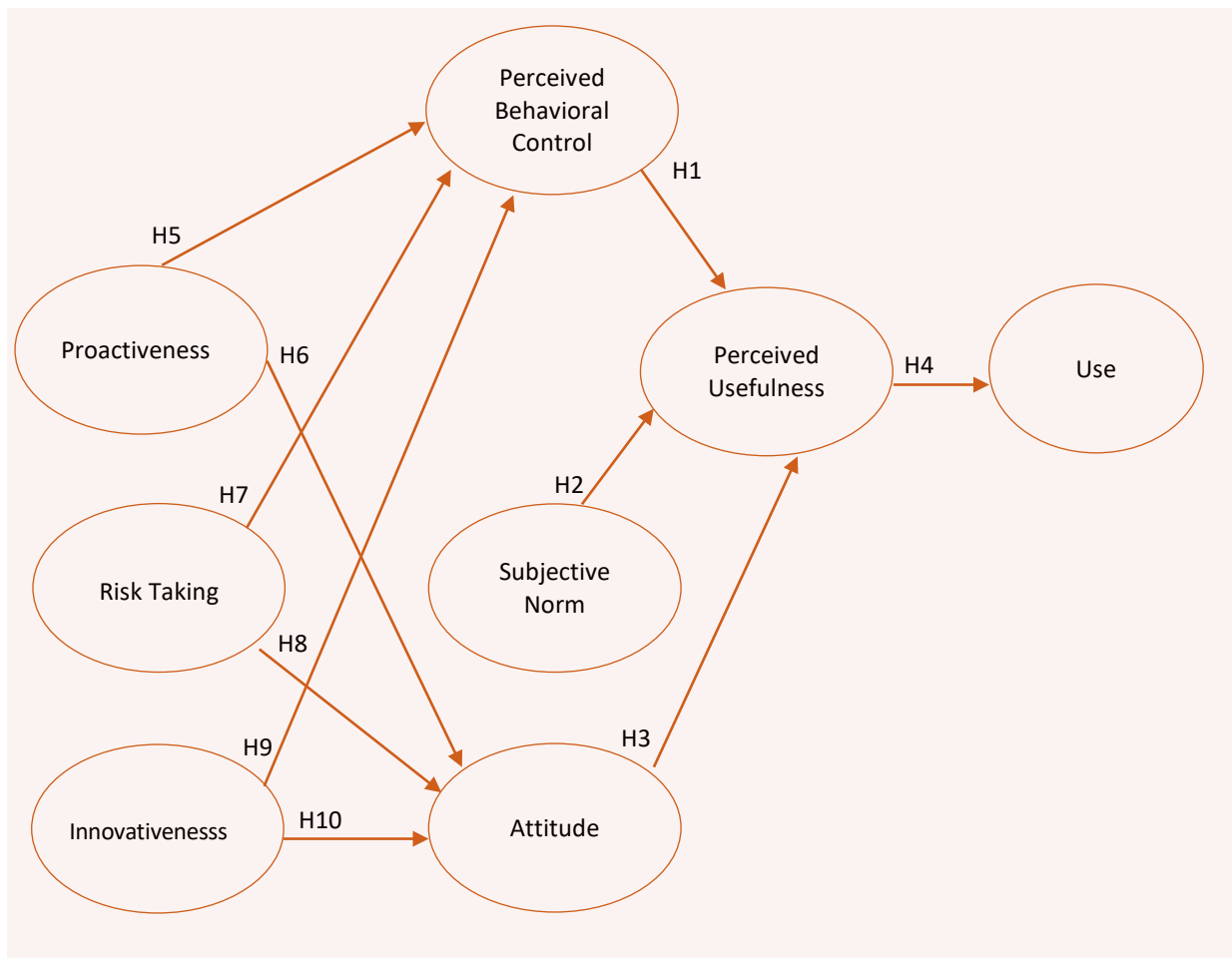
**Figure 6.** Effect of perceived behavioral control, subjective norm and attitude without the personality traits

#### Hypotheses

- H1: Perceived behavioral control has a positive influence on perceived usefulness
- H2: Subjective norm has a positive influence on perceived usefulness
- H3: Attitude has a positive influence on perceived usefulness
- H4: Perceived usefulness has a positive influence on use



#### Model 4



**Figure 7.** Effect of perceived behavioral control, subjective norm and attitude with the personality traits

#### Hypotheses

H1: Perceived behavioral control has a positive influence on perceived usefulness

H2: Subjective norm has a positive influence on perceived usefulness

H3: Attitude has a positive influence on perceived usefulness

H4: Perceived usefulness has a positive influence on use

H5: Proactiveness has a positive influence on perceived behavioral control

H6: Proactiveness has a positive influence on attitude

H7: Risk taking has a positive influence on perceived behavioral control

H8: Risk taking has a positive influence on attitude

H9: Innovativeness has a positive influence on perceived behavioral control

H10: Innovativeness has a positive influence on attitude

## 2.4 Reporting of findings

Qualitative and quantitative findings were triangulated into a final report arranged in a way that speaks to the research questions. Based on the evidence that was generated and own judgment during the study, relevant conclusions and appropriate recommendations were made. To achieve this, collation and triangulation of information emerging from the different sources into a draft synthesized report. Triangulation was used to ensure the reliability of information and to increase the quality, integrity and credibility of the research findings and conclusions. Wherever possible, evaluation findings were based on several lines of enquiry and data sources. The first draft was sent to CIP team for review. After the correction, the report was taken for editorial reviews and there after publications.

## 3. Results and discussions

### 3.1 Landscape mapping of digital platforms

#### 3.1.1 Digital transformation in agricultural value chains in SSA

##### Evolution of digital platforms in agricultural value chains in Sub-Saharan Africa

Agriculture has remained to be the mainstay in the sub-Saharan Africa. Agricultural sector provides employment opportunity for about 60% of the population. More of these jobs are in the overall food system and contributes to approximately 15% of the GDP. However, food production in this region compared to the rest of the world is relatively low. The smallholders in the sub-Saharan Africa have persistently faced challenges relating to agricultural productivity and revenues. Majorly, they face challenges regarding poor access to information on agronomic practices, market links and agro-weather information, lack of inputs and investment capital, and lack of access to farming equipment<sup>3</sup>.

Over the past decade, both public and private sectors have invested in digitizing agriculture in the sub-Saharan Africa. Several digital agriculture platforms and start-up companies have come up with solution with a hope of boosting agricultural productivity, farm income, heightening food security, and food system resilience. Mainly these digital platforms have been aiming at providing solution to the smallholder farmers and the stakeholders to disseminate agronomic advisory services that enhances productivity, agricultural finance access, and access to the market to boost agricultural income<sup>4</sup>.

The deployment of digital solutions in the last mile of agricultural value chains allow agribusiness to address a wide array of business challenges and increase farmer loyalty, operational efficiency and real-time visibility in the last mile. These platforms have been playing crucial roles within the agricultural value chain integration. The digital platforms have been supporting the sub-Saharan agriculture, helping the sector to be more resilient to the impacts of climate change and even the global pandemic crisis such as COVID-19<sup>5</sup>.

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<sup>3</sup> <https://www.brookings.edu/techstream/the-promises-and-perils-of-africas-digital-revolution/>

<sup>4</sup> <https://agra.org/wp-content/uploads/2020/10/Digital-Platforms-for-Agriculture-in-Africa-create-New-Opportunities-for-Access-to-Finance.pdf>

<sup>5</sup> <https://www.vodafone.com/news/digital-society/digital-platforms-have-an-important-role>

However, in the Sub-Saharan Africa (SSA) such agricultural technology (agritech) applications have not been fully embraced in the past until in the era COVID-19 pandemic<sup>6</sup>. For instance, in Kenya as in the other countries ICT penetration reportedly accelerated with the COVID-19 outbreak as compared to the other sub-Saharan African countries. According to the information sources by the Communications Authority of Kenya, there are approximately 40 million internet users in Kenya making it a potential ground for the digital drive. In addition, in recent years, number of digital companies established their business in Kenyan agriculture sector particularly connecting food value chain actors. It is hence necessary to understand how these companies have gained opportunities and challenges faced during pandemic.

Therefore, the current study is looking at the role of existing digital companies in Kenyan agriculture sector and their business opportunities and challenges based on Key Informant Interviews with these companies. This gave a breathing space to many digital companies to initiate and expand their scope of operation in Kenya. This in turn has led to an effective operation during the pandemic to sustain the functionality of agri-food chains and food security for all value chain actors. These digital companies devised coping mechanisms to conform to the changed market environment during the pandemic and they had different performance from the laid strategies. Annex 1 summarizes the mapped digital platforms that provide solutions to the agribusiness value chains.

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<sup>6</sup> <https://www.cgdev.org/blog/why-digitalization-and-digital-governance-are-key-regional-integration-africa>

### 3.1.2 SWOT analysis of existing digital platforms

Strength	Weaknesses
<ul style="list-style-type: none"> <li>• Platforms are cheap or free to be users of the platform and easy to use internet enabled tools for sharing information between service provider and client.</li> <li>• Platforms provides real time information sharing.</li> <li>• Existence of wide array of platforms for clients to choose e.g., Apps, order forms, USSD messaging etc.</li> <li>• Some platforms do not require internet access.</li> <li>• Provide access to quality inputs, extension and credit services to users of the platform by connecting relevant stakeholders in the value chain.</li> </ul>	<ul style="list-style-type: none"> <li>• Content development in the digital platform is expensive and requires technical backstopping from different experts.</li> <li>• Sharing of irrelevant posts by users.</li> <li>• Presence of large number of passive users of digital platforms.</li> <li>• Lack of sustainable, scalable and bankable business model(s) and business plan</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Movement restriction measures placed during the COVID-19 pandemic</li> <li>• Focused approach through groups can be used to create localized content about agricultural practices and marketing to targeted clients.</li> <li>• High penetration of internet enabled gadgets in both urban and rural areas.</li> <li>• Smartphone apps are already available and can be downloaded easily for free without additional cost barriers.</li> <li>• Existence of supporting financial services around the digital ecosystem e.g., availability of internet and mobile banking services for payments.</li> <li>• Platforms increases the number of people using internet thereby enhancing access to financial, banking and other internet enabled services especially amongst farmers.</li> <li>• Availability of high number of users of social media platforms in urban areas.</li> <li>• Increasing number of the young generation who are highly skilled in ICT.</li> <li>• Availability of models for home deliveries e.g., Twiga Business to consume model</li> </ul>	<ul style="list-style-type: none"> <li>• Provision of conflicting/incorrect information by different digital platform service providers.</li> <li>• The surge in the use of mobile and internet payments, without strong cyber security protocols could increase scams and frauds.</li> <li>• High post-harvest losses at aggregation centers of fresh products.</li> <li>• Stigmatization by the vendors particularly due to COVID-19 pandemic.</li> <li>• Lack of consistent in the services promised by digital companies</li> <li>• Lack of trusts development activities within the community</li> </ul>

Source: Key informant interviews (KII)

### 3.1.3 Disruption in agricultural value chain due to COVID-19 in Kenya

In response to the COVID-19 pandemic, Kenya declared a state of emergency on 15th March 2020 after receiving the first case on 12<sup>th</sup> of March 2020. This was followed with the imposition of stringent measures that were intended to slow down the spread and risks of the pandemic. The inter-counties restrictions significantly interrupted the transport system which in turn led to the closure of wet markets for fresh vegetables and fruits and shops selling fresh fruits required to limit their hours. These measures had huge impacts on the country's agricultural sector. The instructions to stay at home during the pandemic affected the agribusiness value chains with increased demand and low supply due to decreased interactions<sup>7</sup>. This move disrupted food supply chains particularly those highly perishable products such as fresh vegetables and fruits. The impact of the move was felt across all actors in the agricultural value chains especially the smaller fresh vegetable and fruits actors in traditional supply chains were unable to access adequate farm inputs, agronomic information and produce market.

The Agricultural value chains and agribusinesses were greatly hit by the measures put in place to contain novel coronavirus<sup>8</sup>. Every actor in the agricultural value chain beginning from the farmers, to intermediaries and agribusiness were challenged by the pandemic. To effectively combat the impacts of the novel coronavirus, the Kenyan government enacted safety measures that would contain the spread of the virus which were strictly adhered to at the onset of the pandemic in March 2020. In Kenya, curfews started on March 29<sup>th</sup>, 2020, cessation of movement into and out of the high-risk regions April 6<sup>th</sup>, 2020, closure of places of worship and non-essential business services April 11<sup>th</sup>, 2020, the policies and containment measures enacted were partial lockdowns on May 7<sup>th</sup>, 2020, closure of borders May 16<sup>th</sup>, 2020, closure of facilities and marketplaces, restrictions on public gatherings, compulsory wearing of masks in public places, bans in cross country travels May 16<sup>th</sup>, 2020. These policies resulted to varying degrees of disruption to the agricultural market system within the country by restricting face-to-face interactions something which made it difficult for farmers and traders to sell their produce and for extension officers to disseminate agricultural information. It is estimated that 90% of fresh fruits and vegetables are sold in these informal food markets which were closed to avoid crowding creating a supply gap<sup>9</sup>.

During this period, the agricultural digital platforms were challenged on their operations and had to devise new operational models to penetrate the market. It is notable that the rise of COVID-19 pandemic fueled the digital transition around the world. The companies had to adopt coping mechanisms to adjust to the "new normal"<sup>10</sup>. With the struggles to access markets, both farmers and consumers adopted digital platforms<sup>11</sup>(Kassa, 2020) which conveniently availed information and market for produce.

In Kenya, the policies and containment measures enacted were partial lockdowns, closure of borders, cessation of movement into and out of the high-risk regions, curfews, closure of facilities and marketplaces, restrictions on public gatherings, compulsory wearing of masks in public places, bans in cross country travels, closure of places of worship and non-essential business services. These policies resulted to varying degrees of disruption to the agricultural market system within the country.

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<sup>7</sup> <https://www.ifpri.org/survey-covid-19s-varied-impacts-fresh-fruit-and-vegetable-supply-chains-senegal>

<sup>8</sup> Chang, H.-H., & Meyerhoefer, C. D. (2021). COVID-19 and the demand for online food shopping services: Empirical Evidence from Taiwan. *American Journal of Agricultural Economics*, 103(2), 448–465.

<sup>9</sup> Ayieko, M. W., & Njeru, T. N. (2020). *Why COVID-19 is another blow for Kenya's food security*. The Conversation. <http://theconversation.com/why-covid-19-is-another-blow-for-kenyas-food-security-135567>

<sup>10</sup> Hossain, S. T. (2018). *Impacts of COVID-19 on the agri-food sector: Food security policies of Asian productivity organization members*.

<sup>11</sup> Kassa, W. (2020). COVID-19 and Trade in Africa: Impacts and Policy Response. Available at SSRN 3619230.

The restrictions disrupted different stages within the agricultural value chain. There has been disruption in food delivery system due to the movement restrictions and market closure. Majority of the food system in Kenya is highly dominated by small independent transporters linking the producers to the consumers and therefore, restrictions in movement slightly affected the operations. As well, there was a disruption in labor supply due to the containment measures limiting face-to-face interactions. There was also disruption in the supply of input which led to price hikes and limited access to credit by farmers since many financial institutions feared the uncertainty in the future of agricultural performance. The impact of these containment measures were low farm income and disruption of food supply posing challenge on poverty and food security that forces the farmers to have coping strategies.

### **3.1.4 Performance of digital platforms during COVID-19**

The arrival of the novel COVID-19 aggravated challenges to Africa's food and agriculture sector to the millions of its citizens especially the smallholder farmer. Concomitantly, the pandemic paved the way and accelerated the innovative efforts to develop and deploy the transformative power of digital technology to counter the economic mayhem because of the pandemic<sup>12</sup>. Despite the negative impacts of COVID-19 on agribusiness performance, the digital platforms effectively used this gap to dominate the market. Kenya had previously made a significant progress in the digital migration ahead of the pandemic to strengthen its agricultural sector and to streamline agriculture. The Kenya's digital economy has gained popularity in several ways in response to the economic mayhem because of the pandemic. The shift has in turn reduced the foot traffic in the supermarkets and other open-air markets by making retailers to move to e-commerce. With the arrival of the pandemic, several smallholders began to trade their products through online platforms<sup>13</sup>. At the same time, the already established digital platforms also ramped up their operations because of the pandemic. As from the time that Central Bank of Kenya announced the use of cashless transactions (mobile money transfer), majority resorted to digital transactions since the transaction charges had been waived<sup>14</sup>. Most of the already established digital platforms such as Twiga Foods, DigiFarm, Viazisoko, Mkulima Young, just to mention a few recorded high sales volume and high number of new users into the platform. On the other side, several start-ups like kwikbasket, Sokokijiji, DigiCow, etc., also entered the market during the COVID-19 period 2020-2021 to fulfil the demand gaps through provision of essential agribusiness services.

### **3.1.5 Strategies adopted by digital platforms to continue or expand their business operations during and after lockdown**

The use of digital platform is accompanied with various challenges that could limit its operation thereby constraining their sustainability. This necessitated the need to develop approaches that would ensure that the platform continues in operation in the presence of the pandemic. Based on Key Informant Interview (KII), the study has identified some of the strategies put in place by the digital companies to expand their contribution to business continuity in the food chain and how they have adjusted to the crisis situation includes:

- 1) Use of social media platforms to tap the many clients who are digitally connected e.g., Soko Kijiji, Jumia feeds food, Twiga foods, (Soko yetu and Twiga digital app), and Viazisoko. These platforms provided, avenues for information seeking, input/product viewing, placing orders and finally input/product delivery to farmers and consumers.

<sup>12</sup> <https://unctad.org/news/digital-platforms-give-lifeline-kenyas-creatives-amid-covid-19>

<sup>13</sup> <https://www.oecd.org/coronavirus/policy-responses/the-role-of-online-platforms-in-weathering-the-covid-19-shock-2a3b8434/>

<sup>14</sup> <https://ieeexplore.ieee.org/document/9243379>

- 2) Extended ordering period e.g., for Twiga food platform, the ordering hours were initially from 9:00 am to 6:00 pm. This period was later extended from 9:00 am to 9:00 pm to accommodate more clients especially those dealing directly with retailers for their supplies to ensure reliability in the food system.
- 3) Proliferation of logistic services to convey products to target markets centers for food delivery and direct takeout to consumers e.g., Soko Kijiji, Uber eats and Glove. During the pandemic there was increase in the use of motorbike and small vehicles to deliver products to consumers. For Viazisoko, for example, involved a subsidiary company to supply certified potato seeds from approved multipliers to small scale farmers. This enhanced access to certified seeds during the pandemic which was important in ensuring that potato farming continued uninterrupted.
- 4) Widening of product portfolios through introduction of new products in the market e.g., Viazisoko and Arifu. For instance, Arifu diversified their library to develop other innovative methods for enabling more users engage with their platform. For example, Arifu offered a free content (the COVID-19 starter pack) to enable smallholder farmer within their circle learn about GAP as well as health and safety measures for protecting themselves during the pandemic. For Viazisoko, they introduced new service that included provision of information on fertilizers, agrochemicals, spraying and mechanization to support farmer access to quality inputs during the pandemic.
- 5) Introduction of Chatbot to engage with clients on various aspects e.g., Arifu developed a web-based content marketplace platform (Chatbot) to distribute content to their target audience (learners) over SMS, WhatsApp, Facebook Messenger or a combination of any of our other channels. For instance, their Chatbot platform enabled agricultural organization to complement their existing in-person training methods, which had been affected by COVID-19 protocols such as movement restrictions and social distancing rules, put in place during the pandemic.
- 6) Development of interactive voice response (IVR) solution, a platform that enables organizations to cater for different clients' needs witnessed before and during the COVID -19 pandemic. For example, Arifu is now working to develop an IVR solution which will enable illiterate learners to engage with content via audio.
- 7) Increased mobile transactions in making payments for goods purchased and services offered. This strategy minimizes the spread of COVID-19 virus through cash transaction. During the pandemic, this approach was fully encouraged and supported by the government where transactions below KES. 1000<sup>15</sup> was costless especially during lockdown.

### **3.2 Digital platforms usage by actors within the vegetable, root and tuber crops value chains**

#### **3.2.1 Farmers (Viazisoko)**

Results in this section relies on responses from farmers who accessed or did not access NPCK Viazisoko digital platform that focusses on online marketing of potato related products and services, and information dissemination

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<sup>15</sup> 1USD = KES 110 as on Nov 2021

## VIAZISOKO

### About the Platform



NPCK ViaziSoko is a digital marketing platform for seed and ware potatoes with focus for online marketing of Potato related products and services, and information dissemination. It was developed by The National Potato Council of Kenya (NCPK) and Partners and launched in May 2017. It was developed with the aim of helping address various challenges faced by potato farmers, other actors and players. NPCK is a Public

Private Partnership (PPP) and a multi-stakeholder organization whose responsibility is to help plan, organize and co-ordinate potato value chain activities with the aim of developing the subsector into a robust, competitive and self-regulating industry.

The platform is available in three forms:

- Web-based portal
- Android mobile App
- USSD Short code services

### How the portal works

The platform follows four simple steps

- Potato farmers, seed potato producers and market outlets are registered to the portal.
- Seed potato producers upload seed availability information on weekly basis to the portal using a web interface.
- Farmers can query for availability of the seed through SMS whose cost is only that for SMS.
- Farmers interested in selling through the portal are required to be in groups that will have an MOU with NPCK to ease the process of supporting the group.

Through the platform, farmers can:

- Query and receive feedback on seed potato information (seed variety available and price per kg)
- Book and order of seeds for next season
- Access to potato recommended fertilizers and approved agrochemicals
- Allows farmers to access information on certified seeds
- Access to weather information and forecast
- Access to extension and advisory services on GAPs
- Access to farm services such as soil testing, mechanization and spraying services
- Farmer linkage to outlet markets.

**NOTE: In order to access the above services, one need to register onto the ViaziSoko digital platform through Dial \*483\*331# and follow the instructions to complete registration process**

### Link

<https://npckViaziSoko.com/>



## Awareness and usage of digital platforms

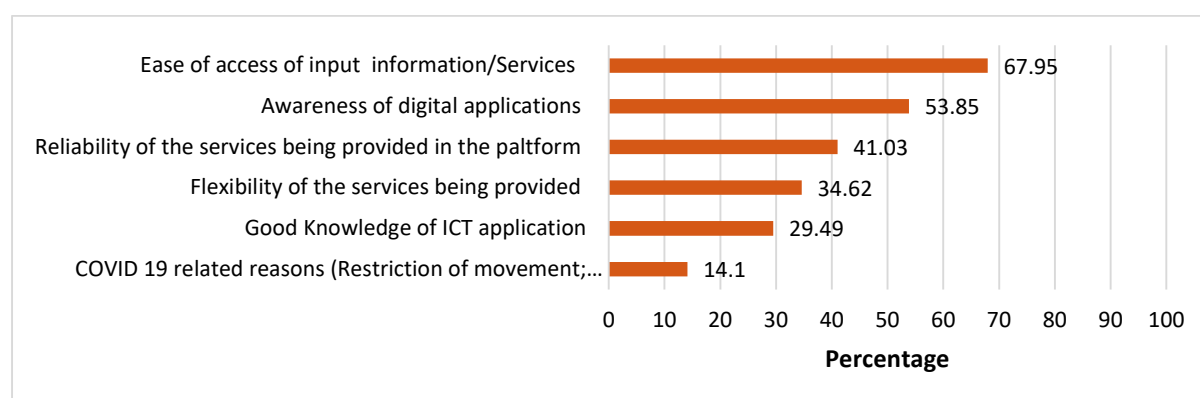
Results on farmers' awareness and usage of digital platforms are presented in (Table 7). Majority of the respondents (68%) were not aware of the existence of digital platforms within the vegetable, root and tuber crops value chains. On the other hand, approximately 32% of the respondents had some knowledge regarding the platforms. These results imply that farmers are reluctant to use the digital platforms despite being aware about them

**Table 7.** Awareness and usage of digital platforms among farmers by farm size

Land groups	Awareness and Usage of digital platform among farmers	
	Aware	Not aware
Marginal (Less than 1 Acre)	0 (0%)	21 (8.37%)
Smallholder (1 – 1.99 Acres)	16 (13.45%)	71 (28.29%)
Medium (2 – 4.99 Acres)	44 (36.97%)	115 (45.82%)
Large (5 Acres and above)	59 (49.58%)	44 (17.53%)
Overall	119 (100%)	251 (100%)

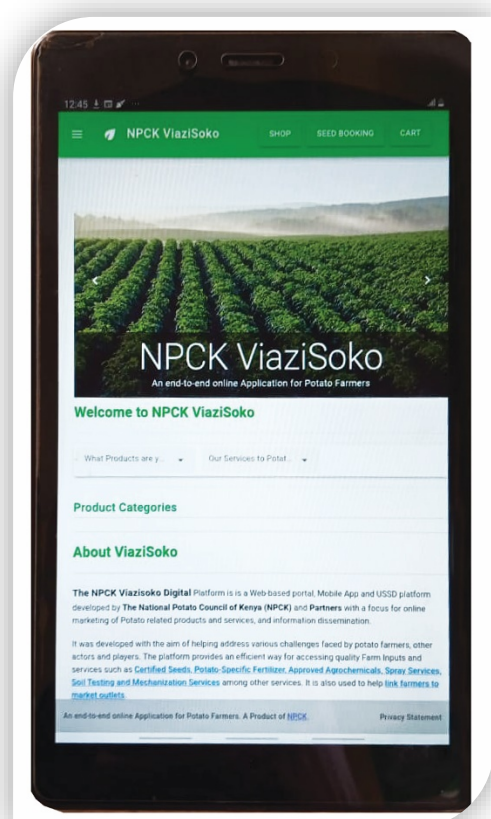
Further probing amongst farmers revealed that the negative attitude towards the platform, lack of mobile phone ownership and inadequate information are the main reasons constraining their use. In terms of motivation to use Viazisoko platform (*Figure 8*), majority (68%) reported ease of accessing input information and services through the Viazisoko platform as the main reason for using the platform among farmers. Analysis by land size revealed that amongst farmers who reported awareness and usage, majority (49.59%) were large scale farmers (farmers operating 5 acres and above) followed by medium scale farmers (36.97%).

Moreover, about 53.85% and 41.03% of the total respondent interviewed reported awareness of the digital platforms and reliability of the services being provided on the platform, respectively as the inspiration factor to use Viazisoko platform. This implies that strategies that could improve the use of digital platforms should focus on enhancing farmers' awareness regarding the platforms and ensure that information regarding inputs and services to use is reliable and provided in an easily to understand approach. However, farmers seem to be inadequately endowed with knowledge on ICT application since this factor only inspired about 29.49% of respondents. This factor could probably explain why some farmers were aware of the digital platform and didn't use them in accessing agricultural inputs and other services.

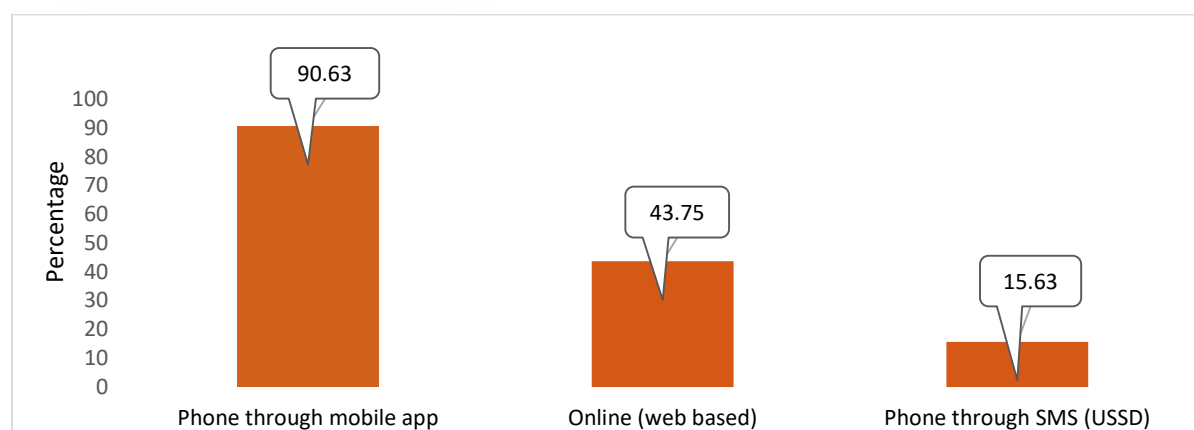


**Figure 8.** Farmer's motivation to use Viazisoko platform (N=78)

## Nature of digital platforms used by farmers



The most preferred nature of digital platform used was phone through mobile app by approximately 90.63% of farmers (Figure 9). This implies that most farmers own or have access to smart phones with installed apps relevant for use in accessing agricultural inputs and services. Moreover, about 44% of respondents used online (web based) platform. This is an indication that there is improved uptake of farm digitization along the agricultural value chain. On the less preferred end, a few farmers (about 15.63%) were found to be using USSD messaging through a mobile phone platform for acquiring agricultural information and services. USSD messaging platform has less services that farmers require and it's technologically challenging to pass information that contain photographic materials through USSD messaging platform. Findings imply that farmers are using multiple ways to access the digital platform with mobile app being the anchoring digital platform.



**Figure 9.** Nature of digital platforms used by farmers

## The role of entrepreneur behavior and farmer attribute in enhancing usage of digital platforms

### Reliability and validity of the constructs for model 1

Convergent validity is achieved when a set of indicators of a construct converge or represents a single underlying construct<sup>16</sup>. This validity was measured using Cronbach's alpha (CA), rho\_A, Composite Reliability (CR) and Average Variance Extracted (AVE). As presented in (Table 8), Cronbach's alpha (CA) ranged from 0.753 to 0.904, rho\_A ranged between 0.783 and 0.905 and composite reliability (CR) ranged between 0.854 and 0.94. These thresholds exceed the acceptable range of 0.60 - 0.70, hence internal consistency reliability was achieved. Convergent validity was also assessed by assessing average variance extracted (AVE) and the values exceed the threshold of 0.5<sup>16</sup>. Multicollinearity among the variables was tested using variance inflation factor (VIF). The results in Table 8 show that there was no collinearity among the constructs since the values were less than 5 which is the threshold<sup>16</sup>.

**Table 8.** Reliability and validity of scale items.

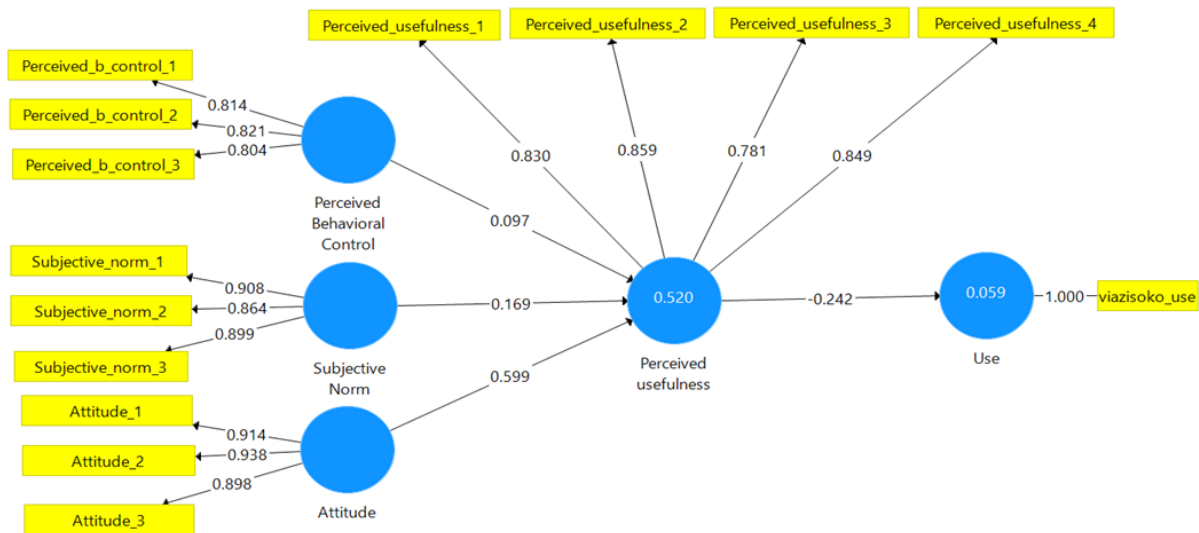
Constructs	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	VIF
Attitude	0.904	0.905	0.94	0.84	1.455
Perceived behavioral control	0.753	0.783	0.854	0.66	1.684
Perceived usefulness	0.85	0.855	0.899	0.689	
Subjective norm	0.87	0.876	0.92	0.793	1.216

Discriminant validity was tested Using the AVE-SV technique and cross loading test. The constructs passed discriminant validity test as the diagonal values were greater than the horizontal and vertical values (Table 9) and all the factor loadings were above 0.6<sup>16,17</sup> (Figure 10).

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<sup>16</sup> Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). A primer on partial least squares structural equation modeling (PLS-SEM) (2nd ed.). Thousand Oaks, CA: Sage.

<sup>17</sup> Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43, 115-135. doi:10.1007/s11747-014-0403-8



**Figure 10.** Coefficient of structural model for model 1.

**Table 9.** Discriminant validity test.

	Attitude	Perceived behavioral control	Perceived usefulness	Subjective norm	Use
Attitude	0.916				
Perceived behavioral control	0.559	0.813			
Perceived usefulness	0.69	0.503	0.83		
Subjective norm	0.218	0.421	0.341	0.891	
Use	-0.269	-0.442	-0.242	-0.256	1

**Note:** Diagonals represent the square root of the average variance extracted (AVE) while the other entries represent the correlations.

The results on cross loading test for constructs of perceived behavioral control, subjective norm and attitude is presented in (Table 10). The findings show that all the bold values of the loading exceeded the suggested threshold of 0.50 and above, hence all the constructs had discriminant validity<sup>17</sup>.

**Table 10.** Cross loading Test for constructs of perceived behavioral control, subjective norm and attitude

	Attitude	Perceived Behavioral Control	Subjective Norm
Attitude_1	0.914		
Attitude_2	0.938		
Attitude_3	0.898		
Perceived_b_control_1		0.814	
Perceived_b_control_2		0.821	
Perceived_b_control_3		0.804	
Subjective_norm_1			0.908
Subjective_norm_2			0.864
Subjective_norm_3			0.899

### Hypothesis testing

To test the four hypotheses of the research model, this study utilized SEM with Partial Least Square (PLS) approach using the SmartPLS version 3.2.6 software<sup>17</sup>. Model fit was analyzed using the standardized root mean square residual (SRMR). The SRMR of 0.0064 met the requirement of SRMR cut-off point of less than 0.08. Hence, the model fitted well to test the hypothesis. The analysis in (Table 11), shows there is a positive relationship between perceived behavioral control, subjective norm and attitude on perceived usefulness. A consumer who is one standard deviation higher on perceived behavioral control, subjective norm and attitude will be 0.097, 0.169 and 0.599 standard deviation higher in perceived usefulness, respectively. Therefore, the hypothesis H1, H2 and H3 are supported. However, perceived usefulness was found to have a negative relationship with use of ViaziSoko digital platform.

**Table 11.** Path coefficients of direct effects of perceived behavioral control, subjective norm and attitude on perceived usefulness and perceived usefulness on use

Path relationship/hypotheses	Std. beta	SE	T values	P Values	Decision
Attitude -> Perceived usefulness	0.599	0.046	13.045***	0.001	Supported
Perceived behavioral control -> Perceived usefulness	0.097	0.049	1.972**	0.049	Supported
Perceived usefulness -> Use	-0.242	0.044	5.461***	0.001	Supported
Subjective norm -> Perceived usefulness	0.169	0.047	3.632***	0.001	Supported

The results indicated that attitude positively and significantly influence perceived usefulness at a 1% significance level ( $p = 0.001$ ). This implies that the more favorable a farmer's opinion of the ViaziSoko is, the more the farmer will view ViaziSoko as useful. Perceived behavioral control influenced perceived usefulness positively and significantly at a 5% significance level ( $p = 0.049$ ) implying that the more a farmer considered himself/herself to have the ability to use ViaziSoko, the higher he/she will consider ViaziSoko as useful. Subjective norm was also found to influence perceived usefulness positively and significantly at 1% significance level ( $p = 0.001$ ). This means that the more positive the farmers' peers' opinion about ViaziSoko is, the more the farmer will view ViaziSoko as useful. The results indicated that perceived usefulness negatively and significantly influenced use. This implies that the more a farmer considered ViaziSoko as useful, the less the likelihood of them using ViaziSoko.

### Results of model 2

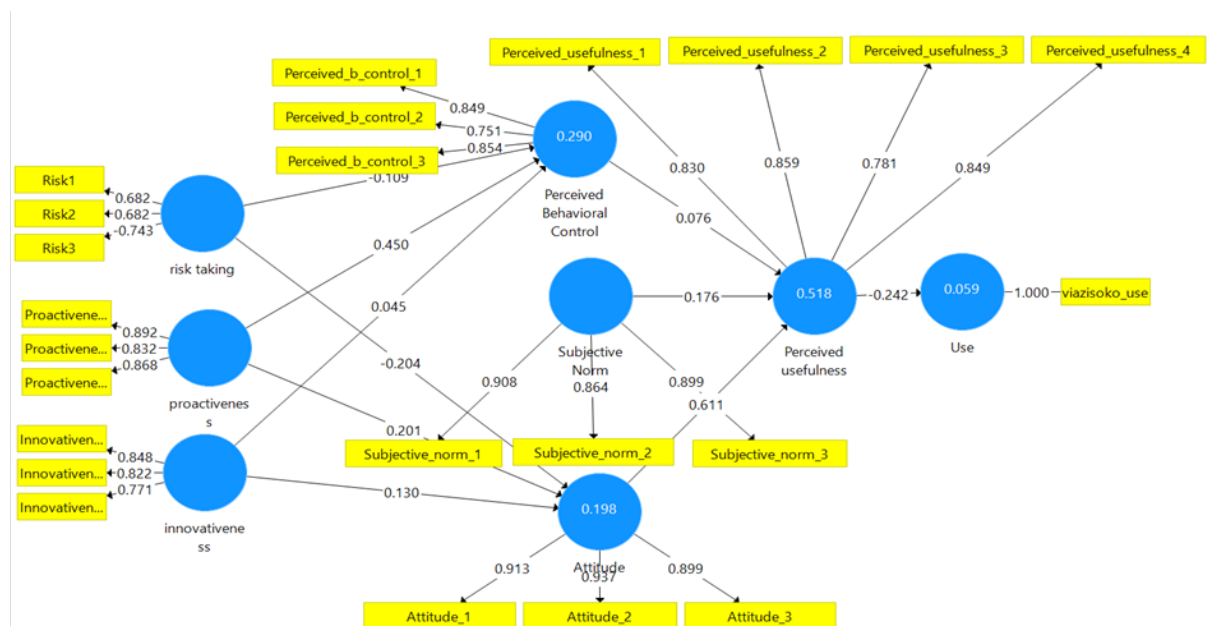
#### Reliability and validity of the constructs

Convergent validity is achieved when a set of indicators of a construct converge or represents a single underlying construct<sup>16</sup>. This validity was measured using Cronbach's alpha (CA), rho\_A, Composite Reliability (CR) and Average Variance Extracted (AVE). As presented in Table 12, Cronbach's alpha (CA) ranged from 0.745 to 0.904, rho\_A ranged between 0.744 and 0.905 and composite reliability (CR) ranged between 0.855 and 0.94. These thresholds exceed the acceptable range of 0.60 - 0.70, hence internal consistency reliability was achieved. Convergent validity was also assessed by assessing average variance extracted (AVE) and the values exceed the threshold of 0.5<sup>16</sup>. Multicollinearity among the variables was tested using variance inflation factor (VIF). The results in Table 12 show that there was no collinearity among the constructs since the values were less than 5 which is the threshold<sup>16</sup>.

**Table 12.** Reliability and validity of scale items.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	VIF
Attitude	0.904	0.905	0.94	0.84	1.426
Perceived behavioral control	0.753	0.754	0.859	0.672	1.634
Perceived usefulness	0.85	0.855	0.899	0.689	1
Subjective norm	0.87	0.876	0.92	0.793	1.203
Innovativeness	0.745	0.744	0.855	0.663	2.08
Proactiveness	0.83	0.832	0.898	0.747	1.735
Risk taking	-0.097	0.499	0.202	0.494	1.48

Discriminant validity was tested Using the AVE-SV technique and cross loading test. The constructs passed discriminant validity test as the diagonal values were greater than the horizontal and vertical values (Table 9) and all the factor loadings were above 0.6<sup>17,16</sup> (Figure 11).



**Figure 11.** Coefficient of structural model for model 2.

**Table 13.** Discriminant validity test

	Attitude	Perceived Behavioral Control	Perceived usefulness	Subjective Norm	Use	Innovativeness	Proactiveness	Risk taking
Attitude	0.916							
Perceived behavioral control	0.547	0.82						
Perceived usefulness	0.691	0.482	0.83					
Subjective norm	0.218	0.411	0.34	0.891				
Use	-0.269	-0.461	-0.242	-0.256	1			
Innovativeness	0.375	0.398	0.408	0.173	-0.205	0.814		
Proactiveness	0.372	0.526	0.426	0.35	-0.291	0.647	0.864	
Risk taking	-0.363	-0.327	-0.361	-0.137	0.215	-0.564	-0.426	0.703

**Note:** Diagonals represent the square root of the average variance extracted (AVE) while the other entries represent the correlations.

The results on cross loading test for constructs of proactiveness, attitude, risk taking, perceived behavioral control, subjective norm and attitude is presented in Table. The findings show that all the bold values of the loading exceeded the suggested threshold of 0.50 and above, hence all the constructs had discriminant validity<sup>17</sup>.).

**Table 14.** Cross loading Test for constructs of proactiveness, attitude, risk taking, perceived behavioral control, subjective norm and attitude

	Attitude	Perceived Behavioral Control	Perceived usefulness	Subjective Norm	Innovative ness	Proactive ness	Risk taking
Attitude_1	0.913						
Attitude_2	0.937						
Attitude_3	0.899						
Innovativeness_1					0.848		
Innovativeness_2					0.822		
Innovativeness_3					0.771		
Perceived_b_control_1		0.849					
Perceived_b_control_2		0.751					
Perceived_b_control_3		0.854					
Perceived_usefulness_1			0.83				
Perceived_usefulness_2			0.859				
Perceived_usefulness_3			0.781				
Perceived_usefulness_4			0.849				
Proactiveness_1						0.892	
Proactiveness_2						0.832	
Proactiveness_3						0.868	
Risk1							0.682
Risk2							0.682
Risk3							-0.743
Subjective_norm_1				0.908			
Subjective_norm_2				0.864			
Subjective_norm_3				0.899			

### Hypothesis testing

To test the ten hypotheses of the research model, this study utilized SEMwithPLS approach using the SmartPLS version 3.2.6 software<sup>17</sup>. Model fit was analyzed using the standardized root mean square residual (SRMR). The SRMR of 0.083 met the requirement of SRMR cut-off point of less than 0.08. Hence, the model fitted well to test the hypothesis.

**Table 15.** Path coefficients of direct effects of model constructs for farmers

Path relationship/hypothesis	Std Beta	SE	T Values	P Values	Decision
Attitude -> Perceived usefulness	0.611	0.045	13.515***	0.001	Supported
Perceived Behavioral Control -> Perceived usefulness	0.076	0.048	1.585	0.114	Not Supported
Perceived usefulness -> Use	-0.242	0.044	5.539***	0.001	Supported
Subjective Norm -> Perceived usefulness	0.176	0.042	4.194***	0.001	Supported
Innovativeness -> Attitude	0.13	0.08	1.629*	0.104	Supported
Innovativeness -> Perceived Behavioral Control	0.045	0.076	0.594	0.552	Not Supported
Proactiveness -> Attitude	0.201	0.067	3.02***	0.003	Supported
Proactiveness -> Perceived Behavioral Control	0.45	0.058	7.7***	0.001	Supported
Risk taking -> Attitude	-0.204	0.091	2.234**	0.026	Supported
Risk taking -> Perceived Behavioral Control	-0.109	0.066	1.661*	0.097	Supported

The results indicated that proactiveness was related positively and significantly to perceived behavioral control at 1% significance level ( $p = 0.001$ ) (Table 15). This means that the more a farmer is usually predisposed to creating or controlling a situation rather than just responding to it after it has happened, the more they likely they will have the perception of the ease of using ViaziSoko. On the other hand, risk taking was found to negatively influence perceived behavioral control at 10% significance level ( $p = 0.097$ ) implying that the more a farmer is prone to willing to take risky action in the hope of a desired result the less likely they are to have the perception of the ease of using ViaziSoko.

Risk taking also displayed a negative relationship with attitude at a 5% significance level ( $p = 0.026$ ) implying that the more a farmer is inclined to taking risks the less likely they will have a favorable opinion of ViaziSoko. However, innovativeness and proactiveness were found to have a positive relationship with attitude at 10% ( $p = 0.104$ ) and 1% ( $p = 0.003$ ) significance levels respectively. This implies that the more a farmer is disposed to introduce or use new ideas or methods and acting in anticipation of future problems, needs, or changes, the more they will view ViaziSoko as useful.

#### **Whether farmers started using the services or increased the service due to the pandemic**

Table 16 shows results on whether farmers started using the services or increased the service in the digital platform due to the COVID-19 pandemic. Generally, all digital platform services were already in use by the farmers differently before the pandemic mainly in accessing seeds (10.26%).

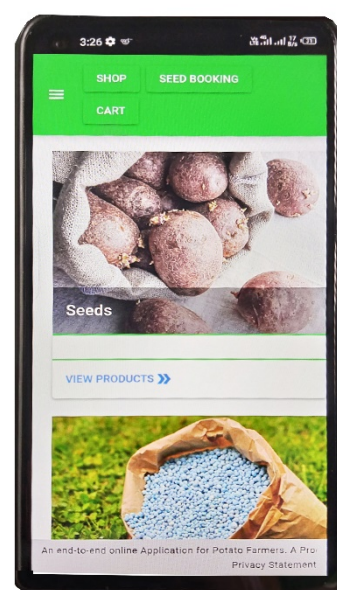


**Table 16.** Use of digital platform services in regard to the pandemic (%)

Type of digital platform service	Was already using the digital service before the pandemic. (Yes=1)	Would have used the digital platform to access the digital service regardless of the pandemic (Yes=1)	Yes, I have increased this practice in response to the pandemic (Yes=1)	Yes, I have started this practice in response to the pandemic (Yes=1)
Quality seeds	10.26	19.23	3.85	32.05
Fertilizer	2.56	0.00	1.28	6.41
Access to Pest and disease advisory services	6.41	5.13	1.28	10.26
Access to extension and advisory services on GAPs	3.85	5.13	1.28	12.82
Access to weather information and forecast	3.85	3.85	3.85	0.00
Access to mechanisation Services	1.28	0.00	0.00	1.28
Access to spraying Services	3.85	0.00	2.56	7.69
Access to soil testing services	5.13	2.56	0.00	2.56
Access to information on approved agrochemicals	6.41	3.85	0.00	7.69
Access to market/output information	3.85	10.26	0.00	12.82

Comparatively, most farmers indicated that they stated using digital platform services in response to the pandemic, with services such as access to quality seeds, pest and disease advisory, extension & advisory services on GAPs, spraying as well as access to information on approved agrochemicals and market attracting majority of the farmers. For example, 10.26% of the respondents were using quality seeds service before the pandemic. Majority of the respondents (32.05%) started using quality seeds in response to the outbreak of the pandemic while 19.23% of the respondents reported that they could have use quality seeds despite the pandemic.

These results suggest that due to the negative influence of COVID-19 on agricultural production, most of the farmers were forced to seek these services to increase their productivity.



### Frequency of use of the digital platforms in the context of COVID-19

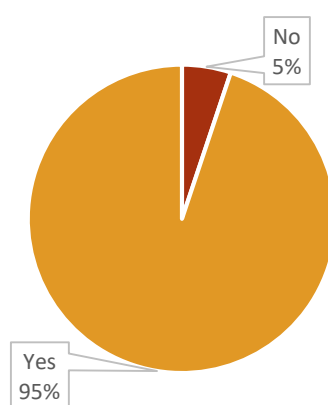
Results on the frequency of use of the digital platforms in the context of COVID-19 are presented in Table 17. The results revealed that except for quality seeds service, farmers increased the frequency of accessing the various service through the digital platform during COVID-19 lockdown and further increased in the past one year after COVID-19 lockdown. The greatest increase in the frequency was observed in the services related to access to market/output information 3.85% (from 19.23% to 23.08%), extension and advisory services on GAPs 6.41% (from 16.67% to 23.08%) as well as pest and disease advisory services 6.41% (from 12.82% to 19.23%) respectively. Possibly, this could be attributed to the difficulties associated with access to various services without using digital platforms in the presence of severe impact of COVID-19 on agricultural production and marketing. Access to quality seeds had the highest frequency before COVID-19 and during COVID-19. This could be attributed to convenience of the digital platforms in providing access to quality seeds which became more important during the COVID-19 pandemic partly because of the movement restriction by the government provided the most convenient platform for accessing quality seeds.

**Table 17.** Frequency of use of the digital platforms in the context of COVID-19 (%)

Type of Service	Before COVID -19 (Before March 2020)	During COVID -19 lockdown (Between March 2020 to July 2020)	In the past one year
Quality seeds	41.03	48.72	30.77
Fertilizer	6.41	3.85	8.97
Access to Pest and disease advisory services	12.82	12.82	19.23
Access to extension and advisory services on GAPs	12.82	16.67	23.08
Access to weather information and forecast	7.69	7.69	11.54
Access to mechanisation Services	1.28	1.28	2.56
Access to spraying Services	6.41	6.41	12.82
Access to soil testing services	7.69	8.97	7.69
Access to information on approved agrochemicals	10.26	11.54	14.10
Access to market/output information	14.10	19.23	23.08

### Continued use of ViaziSoko platform for accessing various services after the pandemic

Approximately 95% of the total farmers interviewed confirmed that they will continue using ViaziSoko digital platform beyond the COVID-19 pandemic (*Figure 12*). This implies that majority (95%) of the farmers will keep on using the digital platform after the COVID-19 pandemic. Coupled with awareness creation, there exist potential to increase the usage of the digital platform in accessing potato related products and services as well as market information after the pandemic.



**Figure 12.** Proportion of farmers that will continue to use Viazisoko platform

### Role of digital platforms in accessing quality potato seeds in the context of COVID-19

This sub section presents findings on how farmers procured their inputs before and during the COVID-19 period. Table 18 provide results on various sources where farmers procured their inputs. Farmers procured their inputs mainly from the agrovet in the neighborhood and nearest town before the COVID-19 pandemic (65.95%, 47.03%), during COVID-19 pandemic with lockdown (66.49%, 44.86%) and without lockdown (66.22%, 46.49%) respectively. The digital platforms showed an increasing trend across the three periods of analysis. However, this platform did not play a major role in accessing quality potato seeds with 3.24%, 5.68% and 7.03% of the total respondent interviewed reported using it as a source of input supply before COVID-19, and COVID-19 with and without lockdown respectively. These findings show the gradual role of digital platform in bridging the gap in terms of input access by farmers during the pandemic. Additionally, procurement of inputs from sales agents and other sources reduced from 3.24% and 4.1% for the period before COVID-19 pandemic to about 2.97% and 2.7% respectively, afterwards. COVID-19 protocols, such as restriction on movement and social distancing, are likely to restricted majority of sales agents from reaching out to most farmers. The other sources for procuring inputs specified by farmers included fellow farmers, ADC, Ebenezer agro-dealer, Twiga agent and cover mix.

**Table 18.** Sources where farmers procured inputs before and during pandemic (%)

Sources	Percentage accessed before COVID-19	Percentage accessed during COVID-19 with Lockdown	Percentage accessed during COVID-19 without lockdown
Agrovet in the neighborhood	65.95	66.49	66.22
Digital platform	3.24	5.68	7.03
Agrovet in the nearest town	47.03	44.86	46.49
Sales agents	3.24	2.97	2.97
Other specify	4.05	2.7	2.7

### Proportion of input procured by farmers from suppliers

The proportion of inputs procured from different suppliers varied (Table 19). The largest proportion of inputs procured by farmers were obtained from agrovet in the neighborhood followed by agrovet in the nearest town. For instance, approximately 55.78%, 57.80% and 55.44% of inputs procured were obtained from the agrovet in the neighborhood as the main supplier before COVID-19, during COVID-19 with or without lockdown respectively. Similarly, through agrovet in the nearest town, roughly 39.26% of inputs were procured before COVID-19, 36.81% during COVID-19 with lockdown and 38.55% during COVID-19 without lockdown. The implication of this results is that, irrespective of the COVID-19 scenario, the neighborhood agrovet was preferred probably because of the low cost of transaction in terms of travelling and transportation costs. The results further indicate that the proportion of inputs procured using the digital platform improved progressively from the period before to the period during COVID-19 pandemic with and further without lockdown. The increase in proportions of inputs procured through the emerging source of digital platform demonstrates the increasing role of the platform playing in the potato supply chain.

**Table 19.** Proportion of inputs procured by farmers from different sources (%)

Sources	Proportion accessed before COVID-19	Proportion accessed during COVID-19 Lockdown	Proportion accessed during COVID-19 without lockdown
Agrovet in the neighborhood	55.78	57.80	55.44
Digital platform	0.85	1.72	2.89
Agrovet in the nearest town	39.26	36.81	38.55
Sales agents	1.54	1.73	1.73
Other suppliers	1.70	1.68	1.39

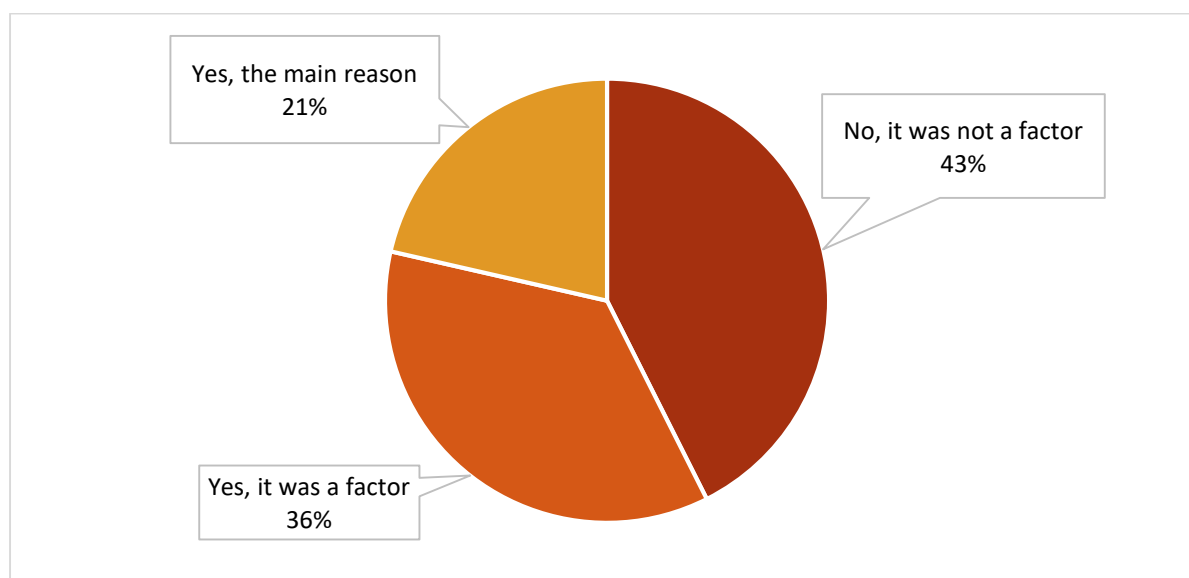
### Quantity of certified potato seed procured by farmers

Findings revealed that there was significance different in land size before and during COVID-19 (Table 20). Overall, seed rate increase during the COVID-19 (from 325.68 Kg per acre to 365.40 Kg per acre). Similar findings were reflected amongst users and non-user where users reported high seed rate during COVID-19 compared to their counterparts. Probably, this could be attributed to the use of digital platform which ensured that farmers could book and order certified potato seeds for the next season over the phone. Likewise, the use of digital platforms enabled farmers to access extension and advisory services on GAPs among them included the required seed rate.

**Table 20.** Quantity of certified potato seed procured by farmers

Period	Land size and quantity of seeds purchased	NON-USERS	USERS	Overall	T-val	P value
Before COVID	Land size under potato	1.36	1.98	1.48	-4.230	0.000***
	Quantity per acre (Kg)	310.71	365.28	325.68	-1.047	0.297
During COVID	Land size under potato	1.31	1.86	1.41	-4.035	0.000***
	Quantity per acre (Kg)	347.12	392.11	365.40	-0.645	0.521

Farmers were catechized on the effect of COVID-19 on the quantity of certified seeds purchased and it was evident that 57% of the farmers attributed the changes to COVID-19 pandemic (*Figure 13*). Discussion with farmers revealed that prevalence of the pandemic was the main factor for the change (21%) as farmers accessed more certified seeds attributed to opportunistic behaviors to provide food for the market. In addition, the uncertainties experienced along the food supply chain during the pandemic enhanced farmers to increase potato production as a way of ensuring self-food sufficiency

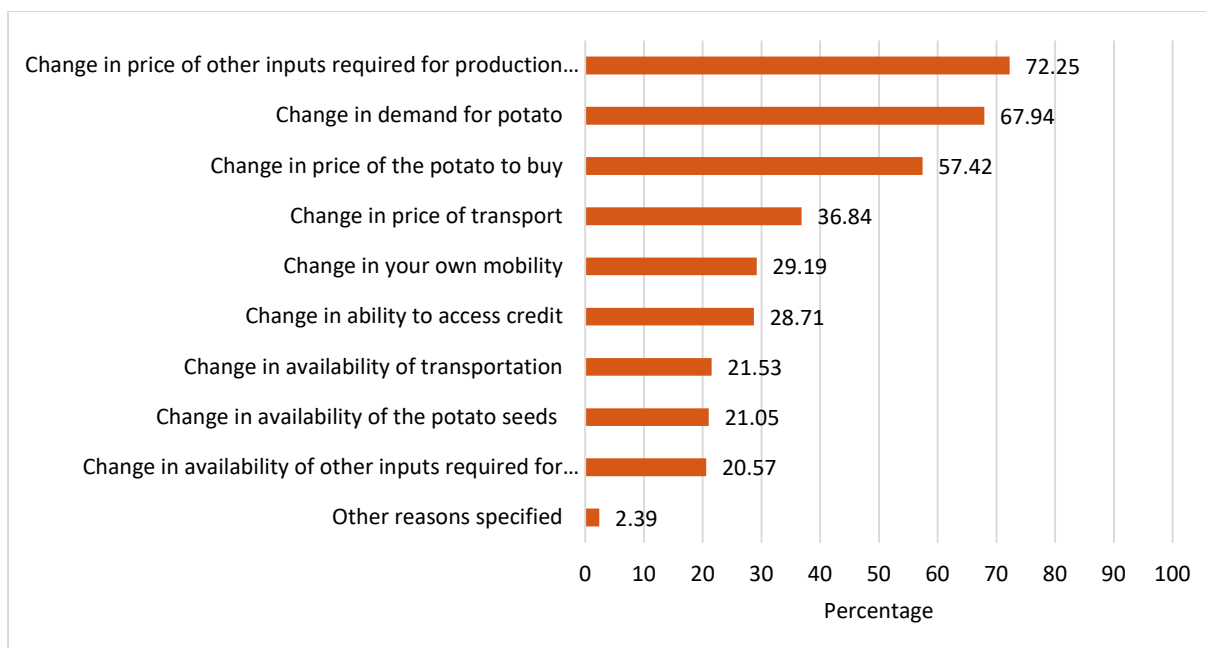


**Figure 13.** Effect of COVID-19 on quantities of certified potato seeds procured

Farmers were further interrogated on aspects of COVID-19 that influenced the change in the quantity of certified potato seeds procured and results are presented in (*Figure 14*). Majority of respondents (about 72.25%) reported that the change in price of other inputs (e.g., fertilizer) required for potato production reduced the amount of certified potato seeds procured during the



COVID-19 pandemic. This implies that less of 'other inputs' could be afforded to complement certified potato seeds thereby reducing its purchases. In addition, the change in demand and price for potatoes purchased relatively affected the quantities of certified potato seeds procured, with approximately 67.94% and 57.42% respectively of the farmers affirming these reasons. However, a few respondents felt that the pandemic affected the availability of the potato seed (at 21.05%), transportation (at 21.53%) and other inputs required for potato production (at 21.10%).



**Figure 14.** Aspect of the pandemic that led to these changes in quantity of potato sold

The PSM model was used to determine the impact of digital platform on the quantity of seeds purchased and the results are presented in Table 21 and Table 22

**Table 21.** Logit regression results of factors affecting the quantity of potato certified seeds purchased by farmers.

Variables	Coefficient	Standard Error	z-Value
Gender of the household head	1.3251	.5303342	2.50**
Level of education	.6691634	.1995511	3.35***
Age of the household head	-.0121074	.0171482	-0.71
Participation in off farm activities	1.010822	.4157169	2.43**
Household size	.0440868	.088746	0.50
Household income	.0406106	.1571781	0.26
Land size	-.0180315	.032245	-0.56
Access to credit	.1103659	.426285	0.26
Extension contacts	.0858724	.0459789	1.87*
Access to extension	1.953998	.4395772	4.45***
Distance to the market	.00072	.0046976	0.15
Ownership of brick phone only	-2.373074	1.076437	-2.20**
_cons	-6.731857	1.514855	-4.44***

**Note:** Number of observations = 370; Log likelihood = -94.688165; log-likelihood  $\chi^2$  (12) = 191.75, Prob >  $\chi^2$  = 0.0000; Pseudo R<sup>2</sup> = 0.5031; \*\*\*, \*\* and \* denote significant at 1%, 5% and 10% levels, respectively, 1= the comparison group is ownership

Findings presented in (Table 21) shows a log likelihood ratio of -94.688165 indicating how the model quickly converges. The likelihood ratio chi-square statistic (LR  $\chi^2$  (12) = 191.75, p = 0.0000) and Pseudo R<sup>2</sup> of 0.5031 show that the model wholly and significantly fits the data well, and in that the decision to adopt the digital platforms was attributed to the explanatory variables considered in the logit model. The findings of adoption model revealed that adoption is influenced positively by gender, education level, participation in off farm income activities and extension. The ownership of brick phone by the household head negatively influenced the adoption of the Viazisoko digital platform.



### Impact of adoption of digital platform on the quantity of potato seeds used.

Model results on the impact of digital platform adoption on the quantity of quality and certified potato seeds used by farmers during the COVID-19 lockdown period estimated with Nearest Neighborhood Matching (NNM), Stratification Matching (SM) and Kernel Based Matching (KBM) are shown in Table 22.

**Table 22.** Impact of adoption of digital platform on the quantity of potato seeds purchased.

Matching Algorithms	Sample size		Att	Standard Error	T-test
	Users	Non-Users			
Nearest Neighborhood Matching	78	32	51.538	239.666	0.215
Stratification Matching	78	125	83.232	215.404	0.386
Kernel Based Matching	78	125	34.863	184.754	0.189

**Note:** t-values are calculated using bootstrap with 50 replications.

The average treatment effect on the treated (ATT) for the quantity of quality certified seeds purchased was 51.54 kg in NNM, 83.23 kg in Stratification and 34.86 kg in KBM though not significant. These findings can be argued that access to ViaziSoko digital platform enhanced the purchase of certified seeds amongst potato farmers during the COVID-19 lockdown period. However, using 50 times bootstrapping for testing of the statistical significance, the results showed that there was no significant difference in the purchase of quality potato seeds via the digital platform during the COVID-19 across the three matching algorithms. The low increase in the quantity of certified potato seeds could be argued in terms of their cost implications. Accessing certified potato seeds from ViaziSoko digital platforms is costly in terms of cost per Kg and in terms of transaction cost. Also, accessing potato seeds via a digital platform has procedures starting from booking which takes quite some time thus farmers might have diversified the channels and qualities thus only purchasing a few from the ViaziSoko digital platform. Replanting of the previous season seeds and own multiplication could explain a section of the insignificant purchase from ViaziSoko digital platform.

### Role of digital platforms in access to labor services and mechanization


- 1) Improved linkage between farmers and consumers e.g., the use of Soko Kijiji platform enhanced direct business transactions between farmers and final consumers for various agricultural products. This platform also reduces transaction costs along the food value chain and increases transparency between market participants (especially through elimination of middlemen).
- 2) Improved linkage between farmers and input suppliers e.g., ViaziSoko and the DigiFarm, which is powered by Safaricom in Kenya. This platform provides one-stop access to cheaper farm inputs, loans, learning content on farming and enhances access to agricultural markets.
- 3) Access to farm mechanization through sharing of farm machineries and equipment e.g., Hello tractor platform.
- 4) Creation of employment opportunities especially for new generation of technology-savvy farmers. For example, the use of motorbike riders to supply products to consumers directly and to the food aggregation centers. Such platforms include kwik basket, Soko kijiji, viazi soko (viazi king), Million farmers, Twiga Foods in Kenya etc.
- 5) Access to labor services e.g., ViaziSoko who provide spraying services.

### 3.2.2 Traders (Twiga platform)

Results in this section relies on responses from traders who accessed Twiga foods digital platform that focusses on online procurement of supplies related products and services across the different values chains. This section also addresses the different procurement strategies, sales and distributions, payment and financing as well as business adaptation strategies.

**TWIGA FOODS LIMITED**

**About the Twiga Foods**



Twiga Foods is a business-to-business marketplace platform that sources produce directly from farmers and delivers it to urban retailers. Twiga is a mobile-based supply platform for Africa's retail outlets, kiosks, and market stalls. The company is using a mobile-based, cashless, business-to-business (B2B) supply platform to access distribution into the millions of small and medium-sized vendors in African urban markets. This removes the need for many intermediaries, significantly lowering the cost of food for consumers.

**Composition of Twiga Foods**

Twiga has about 100 suppliers, 8,000 farmers, 500 agents, 400 products, 12 cities, 700 employees and delivering to 10,000 vendors daily. Founded in 2013, Twiga is based in Nairobi, Kenya.

**How the portal works**

Twiga Foods is a mobile-based supply platform for small- and medium-sized fruit and vegetable vendors.

- Twiga Foods staff register farmers on the app. Farmers only need a feature phone to receive harvest receipts.
- On the supply side, Twiga deals directly with farmers to match the demand from retailers. Twiga collects the produce straight from the farms, and farmers are paid via mobile money platform M-Pesa within 24 hours of collection.
- On the demand side, Twiga registers merchants in Nairobi who then place an order with a sales representative or directly on Twiga's app. Upon receiving the order, Twiga dispatches via its distribution vehicles free of charge and in 24 hours.
- To optimize delivery, Twiga maps its vendors using geographic information system (GIS) mapping and leverages its AI-enabled distribution platform to see who is ordering, where they are located, what the conditions of the road are, and how to best organize deliveries to maximize efficiency.

**Services offered by Twiga Foods**

Twiga digital platform has deals with services namely:

- Soko Yetu
- SOKOLYTICS
- Sokoloan
- Soko Call
- SokoBot (Twiggy)
- Twiga Agent

**NOTE: Twiga has reduced typical post-harvest losses in Kenya from 30% down to 4% for produce sold through the Twiga platform.**

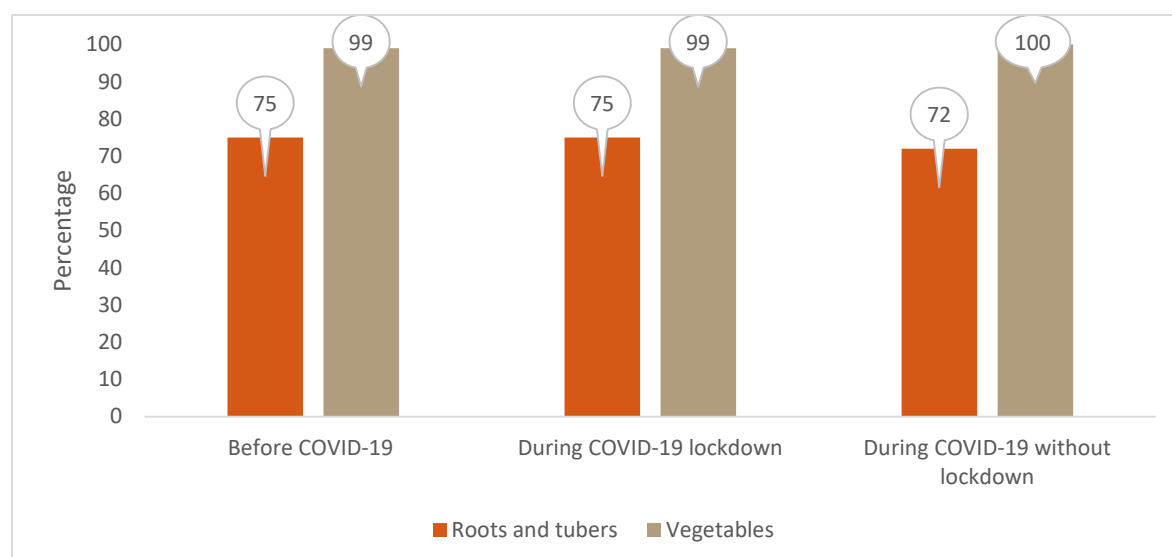
**Link**

<https://twiga.com/>



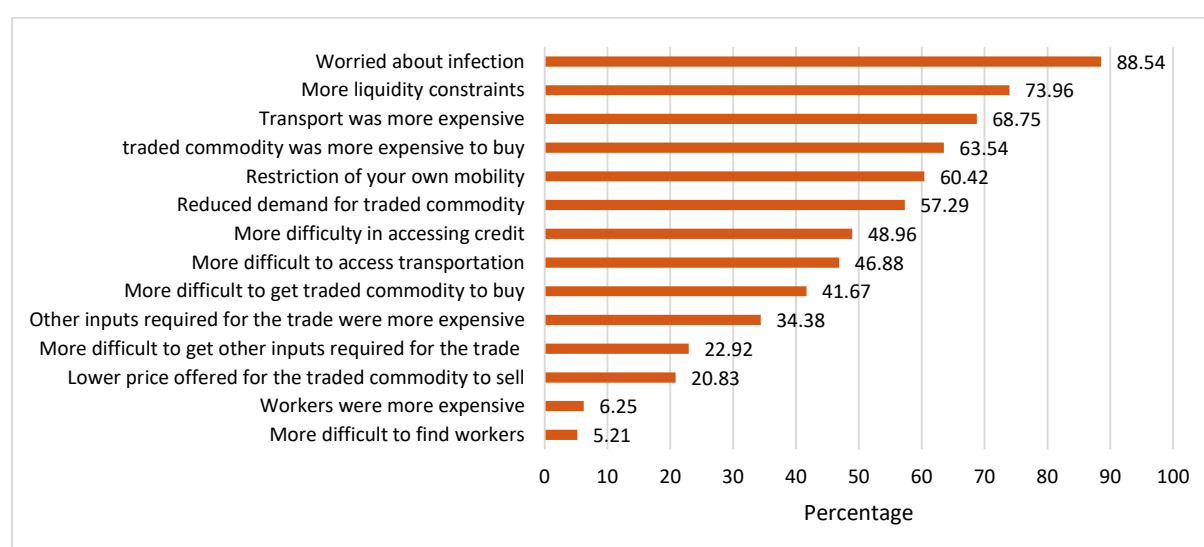
### Traders for root and tubers, and vegetables before and during the pandemic

The proportion of traders for roots and tubers differed from those of vegetables (*Figure 15*). Findings revealed that majority of respondents interviewed were vegetable traders before and during COVID-19 period with some supplementing their businesses with roots and tubers. On average, in the period before and during COVID-19, the traders were dealing with 16 different products.



**Figure 15.** Proportion of traders in roots and tubers, and vegetables on Twiga food platform

In terms of effects of COVID-19 on business operations, about 96% of the traders interviewed agreed that pandemic had influenced their businesses. Several aspects of the COVID-19 which affected businesses are presented in (*Figure 16*). Fear or worry of getting infected with COVID-19 was the major threat (88.54%) probably because most of the businesses were being conducted in designated marketplaces with several people. Additionally, there was more liquidity constraints (73.96%) and, transportation of the trading commodities was more expensive (68.75%). However, manpower was never a problem as workers being more expensive and more difficult to find workers was only reported by 6.25% and 5.21% of respondents respectively.



**Figure 16.** Aspects of the pandemic that affected the business

### Procurement of product supplies

Traders procured their supplies from different sources before and during COVID-19 (Table 23). Findings revealed that most of the traders procured their supplies from Nakuru before and during COVID-19 (77.97% and 88.52%). Other traders procured their supplies from Nyandarua, Meru and Narok. Other sources of supplies included Kirinyaga, Kisii, Laikipia, Nyahururu and Uganda. The increase in supplies during COVID-19 for Nakuru was because of supplies from Twiga foods which ensured that traders accessed supplies even when there was lockdown.

**Table 23.** Places where traders procured their products

Place	Before COVID-19	During COVID-19 lockdown
Nakuru	77.94	88.52
Meru	4.41	4.92
Bomet	0	0
Nyandarua	5.88	4.92
Narok	1.47	1.64
Nairobi	0	0
Tanzania	0	0
Others	10.29	0

Others include Kirinyaga, Kisii, Laikipia, Nyahururu and Uganda

### Point of product sale by traders in (%)

The study further sought to establish places where traders were selling their products. Findings revealed that traders sold vegetables and fruits to different sources before and during COVID-19 (Table 24). Most of traders in Nakuru were selling direct to consumers before and during COVID-19 (76.62% and 79.45%). The amount of vegetables and fruits sold to direct consumers, brokers/agents and sold to other outlets increased during COVID-19. On the other hand, amount sold to small traders and retailers reduced. The reduction could be attributed to the increase in direct sales to customers due to the use of digital platforms which directly linked consumers to traders.

**Table 24.** Point of product sale by different traders in (%)

Type of buyer	Before COVID-19	During COVID-19
Brokers/agents in your own county	1.30	1.37
Small traders in your own county	10.39	6.85
Large wholesale traders in your own county	0	0
Retailers in your own county	3.90	2.74
Brokers/agents in another county	0	0
Small traders in another county	0	0
Large wholesale traders in another county	0	0
Retailers in another county	0	0
Small scale processors	0	0
Medium-large scale processors	0	0
Directly to consumers	76.62	79.45
Buyer abroad	0	0
Other	7.79	9.59

## Business adaptation and pivoting strategies

### Procurement strategies through digital platforms

Results revealed that most traders (91%) have ever procured their supplies over phone and through online platform (81%) (Table 25). The study further sought to establish if the adoption of the various strategies was in response to the pandemic. Most of the traders started using online platform (90.12%) and social media (82.35%) in response to the pandemic. These findings imply that the digital platforms greatly supported the procurement of trading commodities to the traders especially during the COVID-19 period. Despite being the most adopted strategy in response to the pandemic, most traders (15.25%) reported to cease or reduce the use of phone to procure their supplies.

**Table 25.** Procurement strategies through digital platforms

Procurement strategies	If ever used	If used in response to the pandemic			Future continual use (those who will cease or reduce using)
		started	increased	(started + increased)	
Procurement of supplies (roots and tubers, and vegetables) over the phone	91	40.66	24.18	64.84	15.25
Procurement of supplies (roots and tubers, and vegetables) through social media	17	82.35	11.76	94.11	12.5
Procurement of supplies (roots and tubers, and vegetables) through online platforms	81	90.12	3.70	93.82	10.53

### Procurement strategies through procurement tools

Results revealed that about 71% traders had ever procured their supplies using the third-party logistics in procurement and through own means of transport (45%) (Table 26). The study further sought to establish if the adoption of the various strategies was in response to the pandemic. Most of the traders started and increased the use of formal agreement with suppliers (52.94% and 47.06%) and use of third-party logistics in procurement (45.07% and 21.13%) in response to the pandemic. These findings imply that these procurement tools greatly supported the procurement of trading commodities to the traders especially during the COVID-19 period. The study pursued the future continued use of the procurement tools and it was revealed that no trader is likely to use his own means of transport in future.

**Table 26.** Procurement strategies through procurement tools

Procurement strategies	If ever used	If used in response to the pandemic			Future continual use (those who will cease or reduce using)
		Started	Increased	(Started + Increased)	
Having formal agreement with suppliers	17	52.94	47.06	100	11.76
Using own means of transport	45	4.44	13.33	17.77	100
Use of third-party logistics in procurement	71	45.07	21.13	56.20	6.38

## Sales and distribution

Results in Table 27 show that the main sales and distribution strategies used ever before COVID-19 were sales and distribution over the phone (91%) and use of third-party logistics in sales and distribution (63%). Moreover, the survey revealed that major sales and distribution strategies used in response to the pandemic are sales and distribution through Twiga and other social media (54.55%) and online platform (66.67%).

**Table 27.** Sale and distribution

Sale and distribution strategies	If ever used	If used in response to the pandemic			Future continual use (those who will cease or reducing using)
		Started	Increased	(Started + Increased)	
Sale and distribution over the phone	91	20.88	25.27	46.15	7.14
Sale and distribution through social media	11	54.55	18.18	72.73	0
Sale and distribution through online platforms	18	66.67	5.56	72.23	0
Having formal agreement with customers	8	37.50	25.00	62.50	0
Using own means of transport for sale and distribution	45	17.78	15.56	33.34	13.33
Use of third-party logistics in sale and distribution	63	17.46	31.75	49.21	6.45

Despite being the least adopted strategy, use of own means of transport as sales and distribution strategy (13.3%) was reported as a strategy for future continual use. Results imply that for the traders to achieve their sales and distribution targets amid the pandemic, digitalization of their business is the way to go.



## Payment and financing

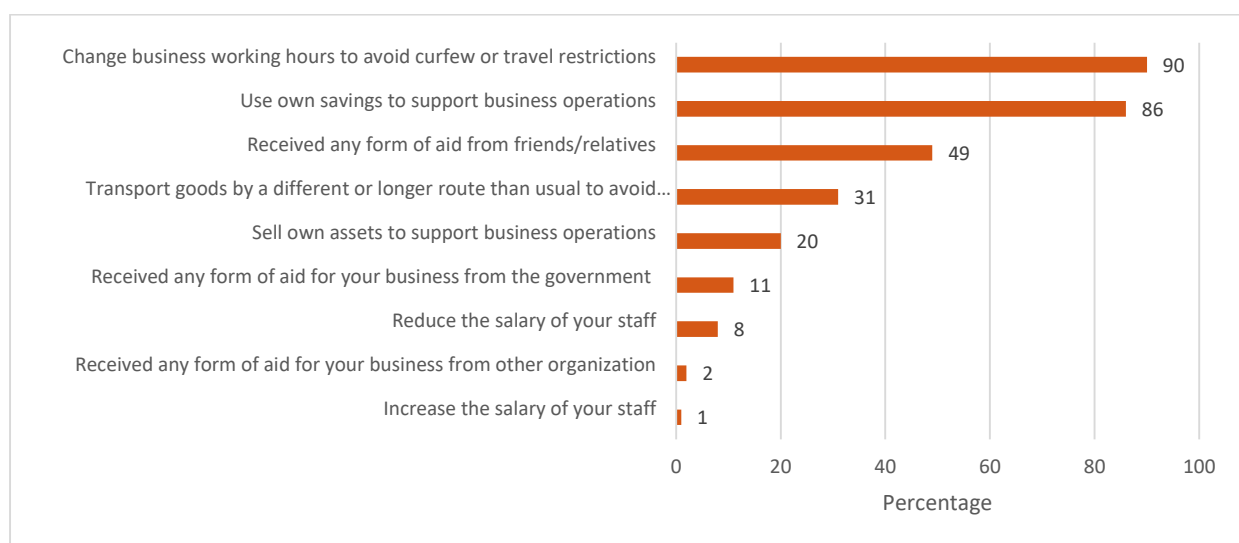
Results revealed that majority of traders (86%) had ever made or received payment electronically followed by advancing products as in-kind/trade creditors (73%) and lending cash to business partners (72%). The study further pursued if the adoption of the various payment and financing strategies were in response to the pandemic (Table 28). Most of the traders started or increased making or receiving payments electronically (30.23% and 36.05%) in response to the pandemic. Findings further revealed that 65% of traders confirmed to stop or reduce the borrowing cash for working capital strategy in future.

**Table 28.** Payment and financing strategies used by traders (%)

Payment and financing strategies	If ever used	If used in response to the pandemic			Future continual use (those who will cease or continue using)
		Started	Increased	(Started + Increased)	
Making or receiving payments electronically	86	30.23	36.05	66.28	15.79
Borrowing cash for working capital	53	22.64	15.09	37.73	65.00
In-kind /trade credit	55	18.18	12.73	30.91	35.29
Lending cash to business partners	72	12.50	11.11	26.61	23.53
Advancing products as in-kind/trade creditors	73	6.85	13.70	20.55	40.00

## Business adaptation strategies

Respondents indicated various business adaptation strategies to COVID-19 (Figure 17). Approximately 88% and 90% agreed that change of business working hours to avoid curfew and travel restrictions and use of own savings to support business operations respectively are main business adaptation strategies to the pandemic. The least used business adaptation strategies included increasing the salary of staff (1%) and receiving any form of aid support for the business (2%). The results imply that to improve business activities in the face of COVID-19 situation, lockdown and travelling restrictions should be reviewed and business owners should channel more of their savings to the business to reduce the effect of COVID-19 on the financial performance of the business.



**Figure 17.** Business adaptation strategies used by traders during the pandemic

### 3.2.3 Consumer purchasing behavior before and during COVID-19 period

Results in this section relies on responses from consumers who accessed or did not access Soko Kijiji Groceries and other digital platform that focusses on online marketing of fresh vegetables and fruits, what motivated them as well as the nature of the digital platform. This section also addresses the level of usage, weekly expenditure on vegetables and fruits and the willingness of the consumers to use the digital platform in future.

## SOKO KIJJI GROCERIES

### About the Platform



**SOKO KIJJI Groceries.**  
**FEEDING CITIES.**

*SOKO KIJJI GROCERIES* is an Online grocery shop that brings convenience to customers by delivering fresh vegetables at their Home and Office doorsteps within the shortest time possible at a click of a button. It was founded by Africa Fruits and Veggie and Soko Kijiji in 2016. Africa Fruits and Veggie is an aggregator of fruits, and vegetables for local and export market. Working with smallholder across rural Kenya as producers. Soko Kijiji Groceries was developed as a result of key learning s from observed inefficies in fresh grocery distribution. To address this, Soko Kijiji does four major things

- Production company for exports markets
- Aggregation for export markets
- Aggregation for local markets
- Digitalization

### How it works

The platform follows three simple steps

- A customer downloads the Soko Kijiji application and makes order and either pays in advance or upon receipt of the goods
- A Soko Kijiji market clerk received the order and collects the products from registered traders
- A Soko Kijiji rider delivers the product to the customer at a fee.

### Target markets

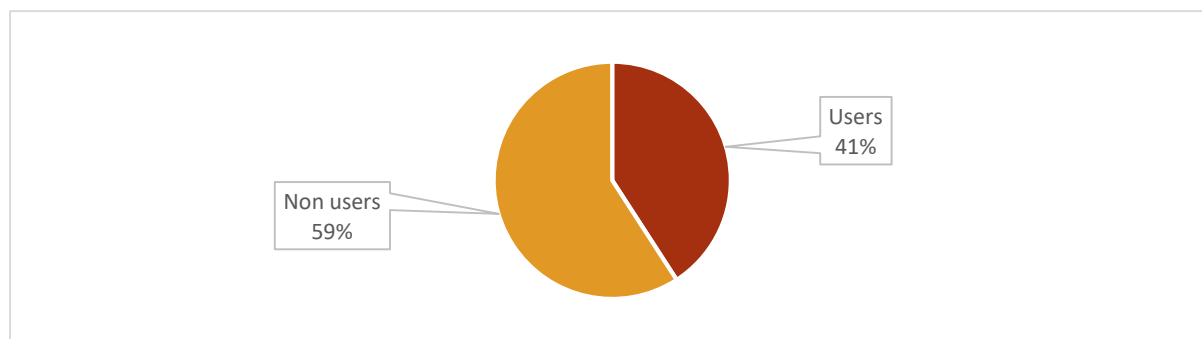
Currently Soko Kijiji is operating in 8 major open-air markets in Nairobi County. These markets include Kangemi, Westlands, Toi market, Kisumu Ndogo, City Market, Wakulima market, Gikomba and Githurai. How Soko Kijiji is looking to expand its operations to select major markets in Kenya and Rwanda in the next five years. Expansion mainly targets Kawangware market, Wakulima market, Kongowea market and Rwanda between 2022 to 2025.

### Link

<https://sokokijiji.co.ke/>

### Use of digital platform

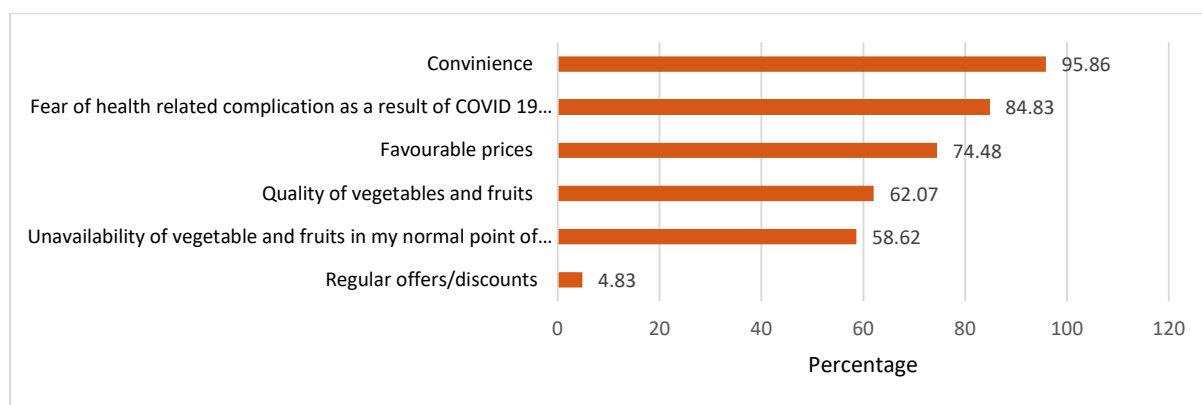
On average, 41% of the consumers used digital platforms to purchase vegetables and fruits during the COVID-19 period (*Figure 18*). These results demonstrate the need to enhance promotional campaigns on importance of using digital platforms in food procurement amongst consumers.



**Figure 18.** Consumer use of digital platform

### Motivation to use the digital platform to purchase vegetables and fruits

Consumer motivation to use digital platform in procuring roots and tubers, and vegetables is presented in (*Figure 19*). Results indicated that convenience (95.86%) and fear of health-related complication due to COVID-19 (84.83%) were the major factors which motivated the use of digital platform. Further interrogation revealed that delivery of food at consumers' doorstep reduced social gathering which was one of the stringent measures of the COVID-19 used by the Ministry of Health to curb the spread of pandemic. Equally. About 74% of consumers indicated that digital platforms had favorable product prices compared to other outlets attributed to reduced number of middlemen along the food value chain.

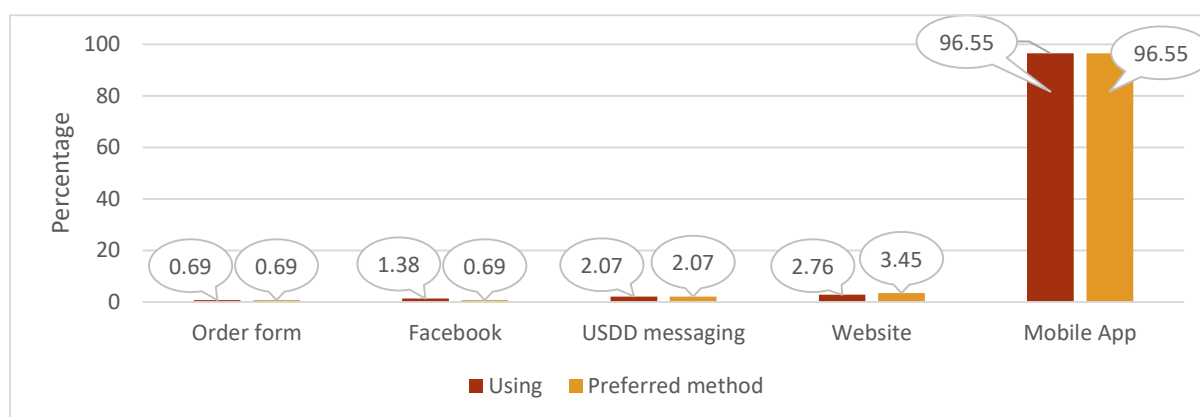


**Figure 19.** Motivation for purchasing vegetables and fruits through digital platforms

Other motivations behind the use of digital platforms were attributed to better quality of vegetable and fruits (62.07%) and unavailability of vegetable and fruits at their normal point of purchase points (58.62%). It was also evident that discounts and offers which digital platform provided was a motivational reason although this factor inspired few consumers (4.83%).

### Nature of the digital platform

The use of mobile application was the most popular digital platform (at 96.55%) used by consumers to purchase vegetables and fruits (Figure 20). The increased use of mobile application could be attributed to the availability and ease of use. Other digital platform applications used by consumers included website (2.76%), USSD messaging (2.07%) and Facebook (1.38%). In addition, t-test results revealed that there was no significant difference, at 5% level, between the digital platforms consumers used verses those they preferred. This implied that consumers were rational in their choice of the digital platforms.

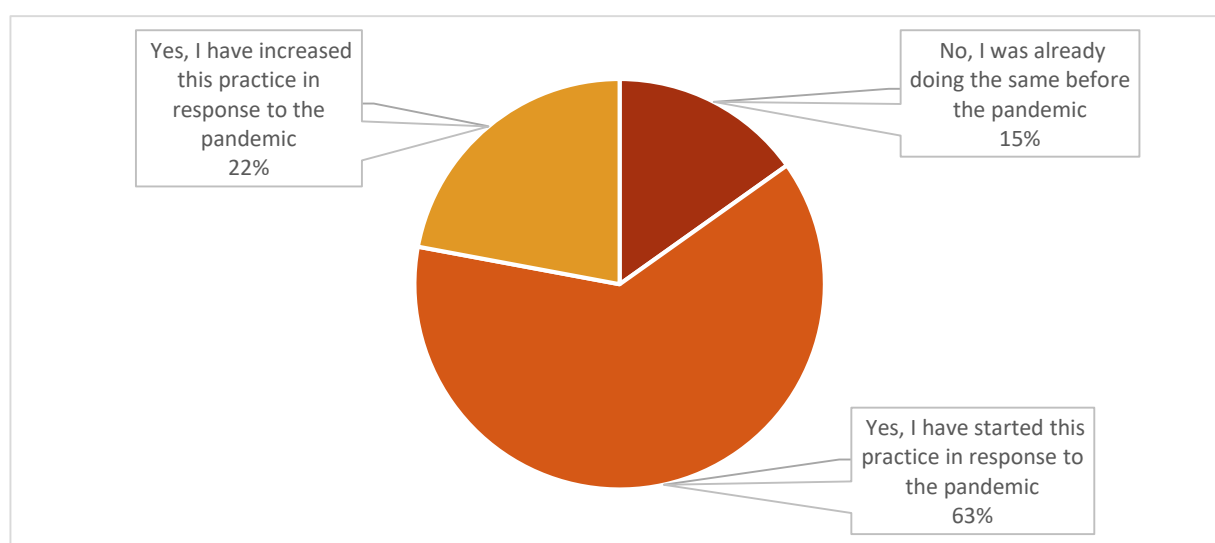


**Figure 20.** Nature of digital platform used amongst consumers

### Level of usage of digital platforms by consumers

#### Whether consumers started or increased the use of digital platforms

Findings on the level of usage of the digital platforms are presented in (Figure 21). Out of consumers who used digital platforms to purchase roots and tubers, and vegetables, 63% started during the COVID-19 period, 22% increased the use in response to the pandemic while 15% had already been using the digital platform even before the pandemic. These findings imply that about 85% increase use of the digital platform (85%) can be attributed to the pandemic.

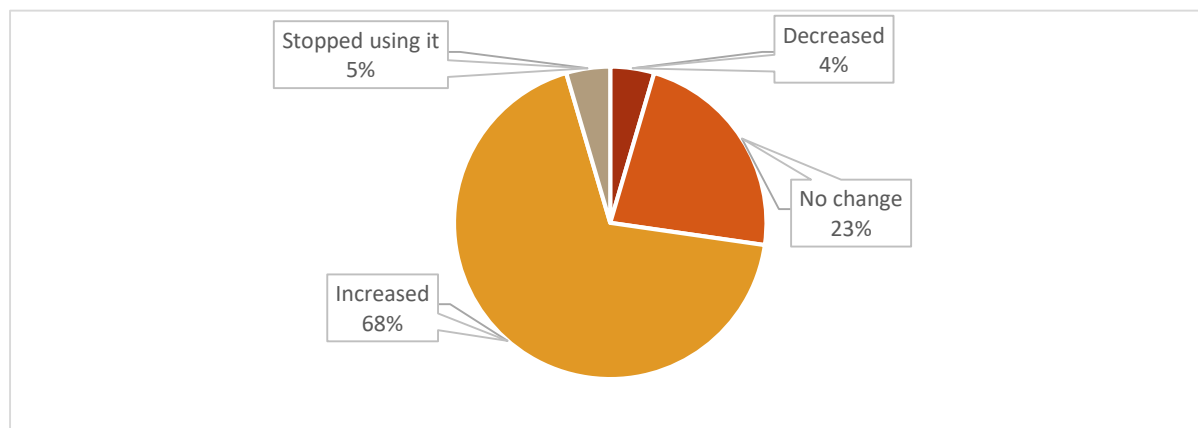


**Figure 21.** Level of usage of digital platform by consumers



### Consumer behavior regarding the use of digital platform during the pandemic

Findings on consumer behavior regarding the use of digital platforms during the pandemic are presented in (Figure 22). Survey findings revealed that there was a 68% increased use of digital platform during the pandemic. About 23% of the consumers did not change their behaviors regarding the use of digital platform. However, there were reported cases of decreased use of the digital platforms 4% and 5% stopped using the digital platform. This implies that digital platforms supported several households in terms purchase of fruits and vegetables.



**Figure 22.** Consumer behavior regarding the use of digital platform during the pandemic

### Frequency of use of digital platform

Findings revealed that the use of digital platforms to purchase fruits and vegetables was not popular before COVID-19 (46.90%) and for those who used it, mainly was when need arises (27.59%) or weekly (15.86%) (Table 29).

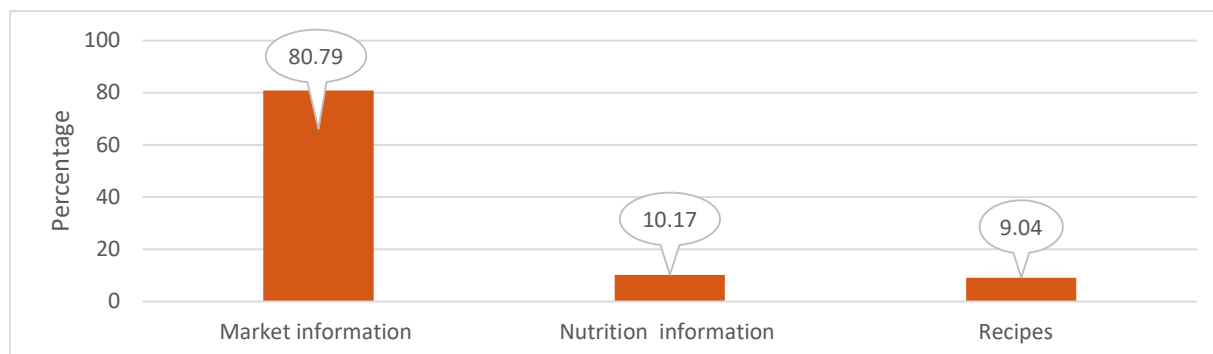
**Table 29.** Frequency of use of digital platform

Frequency	Before COVID-19	During COVID-19 lockdown	Current period
When needed	27.59	60	67.59
Weekly	15.86	28.97	23.45
Twice in a week	4.83	4.83	2.07
Once after every week	2.07	2.76	2.76
Once in a month	1.38	1.38	1.38
Did not use	46.9	1.38	1.38
3 times in a week	0.69	0	0
Daily	0.69	0.69	1.38

During COVID-19 lockdown, there was increased frequency in use for weekly and when needed basis among consumers indicating its relevance during the pandemic, the need of digital platforms increased to 60% of the consumers reported the use of digital platforms when needed during lockdown and 28.97% on weekly basis. Currently, the use of digital platforms when needed has increased more (67.59%) on when needed basis.

### Information accessed through the digital platform

Majority of the consumers (80.79%) were using digital platforms for accessing market information (*Figure 23*). Findings also revealed that consumers were benefitting in terms of nutritional information and recipes from the digital platforms.



**Figure 23.** Information accessed through the digital platform

The survey further revealed that the continued use of digital platforms for purchase of fruits and vegetables stands at 99.31%.

### Consumer willingness to adopt digital platform

The study sought to establish the willingness of consumers to adopt digital platforms in future and findings are presented in (Table 30). Findings revealed that the probability of adoption of digital platforms by consumers reduces with an increase in age and education level household head as well as the household dependency ratio. A unit increase in age reduces the willingness of consumers to adopt digital platforms by 2.70%. Since digital platforms revolve around online applications and websites, it could probably be interpreted those aged consumers are reluctant to use digital platforms due to inadequacy of technical knowhow required for their operation. Likewise, aged consumers have developed trust overtime with the local traders and probably this could be why they are not willing to adopt the digital platforms. In terms of education level, the findings revealed that a unit increase in education level reduces the probability of adopting digital platforms by 15.30%. This could imply that more educated consumers tend to have varied options of acquiring vegetables and fruits thus reducing their major focus only digital platform as a purchase point. Elsewhere, an increase in the dependency ratio by one unit reduces the chances of or willingness of adopting the digital platform by 11.59%. This could be attributed to the increased burden brought about by the increased pressure on the household income something which require them to have a guaranteed source of income. On the other hand, there was a direct relationship between group membership (where they discuss food/digital related issues) and the adoption of the digital platforms. From the findings, a unit increase in group membership increases the consumers' willingness to adopt the digital platform by 39.24%. This could be attributed to the increased social networking or association amongst consumers thus providing them with knowledge on varied digital platforms to choose from.

**Table 30.** Consumer willingness to adopt digital platform

	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-0.02697	0.00987	-2.73	0.006***	-0.04632	-0.00762
Education level of the Household head	-0.15304	0.09131	-1.68	0.094*	-0.332	0.025931
Depend ratio	-0.11591	0.06869	-1.69	0.092*	-0.25053	0.018718
Gender of the Household head	0.210426	0.19779	1.06	0.287	-0.17723	0.598085
Residential area	0.221386	0.21757	1.02	0.309	-0.20503	0.647805
Group membership (where they discuss food/digital related issues)	0.392366	0.23894	1.64	0.101*	-0.07595	0.860684
Access to credit	0.085986	0.22584	0.38	0.703	-0.35666	0.528631
Middle income neighbourhood	0.336761	0.227953	1.48	0.14	-0.11002	0.783541
High income neighbourhood	0.536921	0.485768	1.11	0.269	-0.41517	1.489009
Distance to the market	0.005046	0.017441	0.29	0.772	-0.02914	0.039229
Smartphone only	-0.28692	0.261141	-1.1	0.272	-0.79875	0.224909
Both cell phone and smartphone	0.402621	0.322139	1.25	0.211	-0.22876	1.034001
_cons	1.36952	0.689652	1.99	0.047**	0.017828	2.721213

**Note:** \*\*\* denotes 1% and \* denotes 10%, Log likelihood = -127.87751 Pseudo R2 = 0.1058, N=208Point of purchase of vegetables

Findings indicates that before COVID-19, designated market was the most preferred point of purchase of vegetables and fruits by consumers (76.56%) followed by local retailers in the neighborhood (49.26%) and supermarkets (25.22%) respectively (Table 31). Digital platforms were never embraced like the other channels as only 13.35% of the respondents reported to have been using it before the pandemic. With the arrival of COVID-19 accompanied with lockdown, the preference for the channels reduced except for the digital platform. Reduced use of supermarket, local retailer in the neighborhood and designated markets during COVID-19 could be attributed to the strict measures which were put in place to curb the spread of COVID-19 among them including lockdown and restricted movement.



As a result of this, digital platforms got popular due to their high level of convenience and increased from the 13.35% to 38.53%. In the event of boosting the household income, a crop of citizens who suffered unemployment as a result of the pandemic invented streetcar booth as a new purchase point for vegetables and fruits. The new purchase point provided market for about 2.83% of the consumers. Findings further revealed that currently, consumers are reverting to designated markets (59.15%) and local retailer in the neighborhood (40.85%). Digital platform (40.28%) and street cars (3.10%) continued to gain popularity amongst consumers. Supermarkets continued to lose popularity even after the COVID-19 restrictions have been relaxed

**Table 31.** Point of purchase of vegetables and fruits (%)

	Before COVID-19	During COVID-19 lockdown	Current period
Supermarket	25.22	20.68	13.52
Local Retailer in the neighborhood	49.26	47.59	40.85
Digital platform	13.35	38.53	40.28
Designated market	76.56	53.26	59.15
Street cars	0.00	2.83	3.10

#### Proportion of consumer purchases from different market outlets

Finding in Table 32 indicates different proportions of vegetables and fruits purchased from different purchase points. Results revealed that before COVID-19, designated market accounted for the largest proportion of vegetables and fruits (60.26%) purchased by consumers followed by local retailer in the neighborhood at 23.89%. During COVID-19 lockdown, a reduction in proportion of vegetables and fruits purchased was observed in supermarkets (from 10.76% to 7.87%) and designated market (from 60.26% to 45.40%). On the other hand, an increase in proportion purchased was reported by local retailer in the neighborhood (from 23.89% to 24.37%) and digital platforms (from 5.09% to 20.53%). From the findings, it is also evident that in the current period consumers have reduced the proportion of vegetables and fruits they purchase from supermarket, local retailer in the neighborhood and street cars and instead increased the proportions bought from digital platforms and designated market.

**Table 32.** Proportion of consumer purchases from different market outlets

	Before COVID-19	During COVID-19 lockdown	Current period
Supermarket	10.76	7.87	5.30
Local Retailer in the neighborhood	23.89	24.37	19.03
Digital platform	5.09	20.53	25.49
Designated market	60.26	45.40	48.81
Street cars	0.00	1.83	1.37

### Weekly average expenditure on vegetables and fruits by use of digital platform

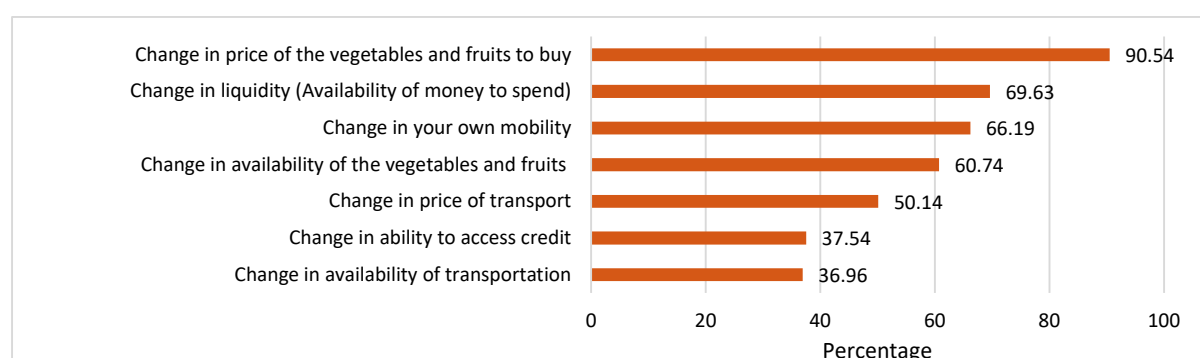
Table 33 presents the weekly average expenditure on vegetables and fruits by use of digital platform and non-users. The weekly expenditure increased across all the categories of consumers (both users and non-users) from before COVID-19 to during COVID-19 lockdown then again started stabilizing in the current period. From the findings, it was evident that non-users spent less on vegetables and fruits in a week as compared to users across the three tie periods. During COVID-19 lockdown, the highest weekly expenditure (KES 3273.44) <sup>18</sup> was reported by those consumers who increased the use of digital platform in response to the pandemic followed by those who started this practice in response to the pandemic (KES 2591.76). These findings imply that those consumers who increased the practice in response to the pandemic had high incomes compared to others during COVID-19 lockdown.

**Table 33.** Weekly average expenditure on vegetables and fruits by use of digital platform

	Before COVID-19	During COVID-19 lockdown	Current period
No, I was already doing the same before the pandemic	1756.82	1886.36	1786.36
Yes, I have started this practice in response to the pandemic	2722.42	2591.76	2647.09
Yes, I have increased this practice in response to the pandemic	2453.13	3273.44	2632.81
Non-users	1160.31	1223.86	1237.48
Total	1714.24	1800.31	1758.61
F	48.64	33.77	33.38
P	0.00	0.00	0.00

### Did the pandemic contribute to the change in quantity bought before COVID and during COVID?

About 51.16% of consumers who experienced a change in weekly expenditure before and during COVID-19 agreed that pandemic contributed to the change in quantities bought. The study further pursued how COVID-19 has contributed to changes in quantities purchased before and during the pandemic (*Figure 24*). Consumers listed several factors which contributed to the change in quantity of vegetables and fruits bought between the two-time intervals. Findings revealed that change in price of vegetables and fruits was the main contributor (90.54%) to the change in quantity bought before and during COVID-19. This could be attributed to the lockdown and the inter-counties restricted movement/transportation thus led to less supply of vegetables and fruits thus leading to increased/change prices.



**Figure 24.** Contributions of COVID-19 to change in quantities purchased before and during the pandemic

<sup>18</sup> Exchange rate was 1 \$UD = KES 110

To supplement this analysis, the PSM method was used to analyze the impact of usage of digital platform on weekly expenditure during the pandemic and the results are presented in Table 34 and Table 35. Table 34 shows a log likelihood ratio of -147.29519 indicating how the model quickly congregates. The likelihood ratio chi-square statistic (LR  $\chi^2$  (10) = 185.58,  $p = 0.0000$ ) and Pseudo R<sup>2</sup> of 0.3865 indicate that the model significantly fits the data well, and in that the decision to adopt the digital platforms was attributed to the explanatory variables considered in the logit model. The results indicate that higher level of education, large household size, participation in group related activities and longer distances to the markets influenced positively adoption of digital platforms by consumers. Household in high income areas had higher probability of adopting digital platforms as opposed to their counterparts in the middle- and low-income areas.

**Table 34.** Logit regression results of factors affecting the average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period.

Variables	Coefficient	Standard Error	z-Value
Age of the household head	-.0139254	.021045	-0.66
Level of education	1.948912	.3476296	5.61***
Household size	.2962539	.1077495	2.75***
Gender of the household head	.3060779	.3176254	0.96
Group membership	1.419618	.4834443	2.94***
Access to credit	.2514024	.3876796	0.65
Distance to the nearest market	.0934621	.035484	2.63***
Cellphone	-.17194	.313161	-0.55
Neighborhood effect (Low-income areas)	-3.081417	.7698864	-4.00***
Neighborhood effect (middle income areas)	-.9601147	.4528193	-2.12**
_cons	-12.98414	2.286732	-5.68***

**Note:** Number of observations = 355; Log likelihood = -147.29519; log-likelihood  $\chi^2$  (10) = 185.58, Prob >  $\chi^2$  = 0.0000; Pseudo R<sup>2</sup> = 0.3865; \*\*\*, \*\* and \* denote significant at 1%, 5% and 10% levels, respectively

Impact of digital platform adoption on average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period

Table 35 show model results on the impact of digital platform adoption on average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period estimated with NNM, Stratification, RM and KBM. Only RM and KBM indicate a significant impact of digital platform adoption on the on average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period.

**Table 35.** Impact of digital platform adoption on average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period

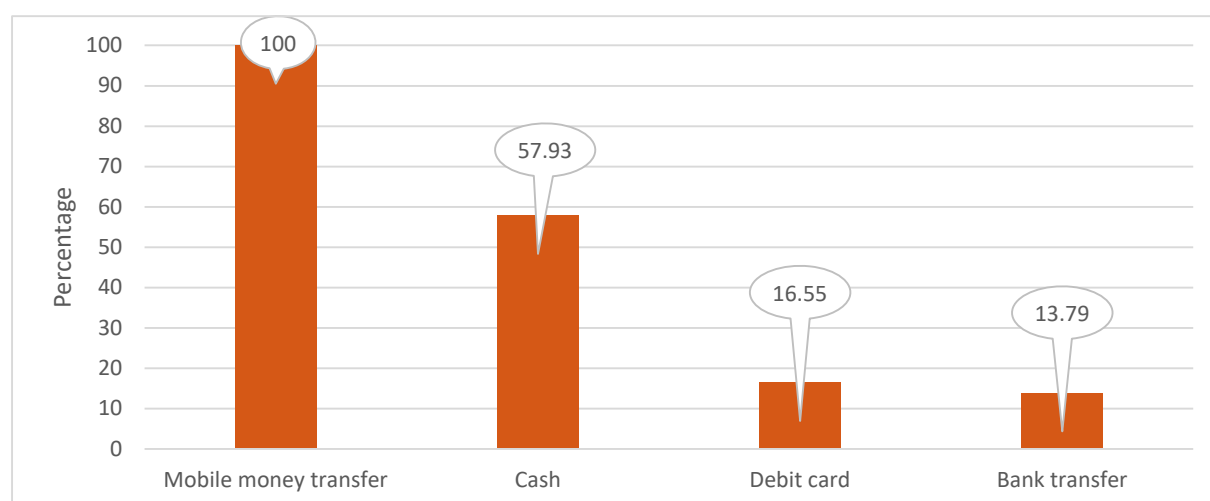
Matching Algorithm	Sample Size		ATT	Standard Error	t-Statistics
	Users	Non-Users			
Nearest Neighborhood Matching	145	53	716.897	449.885	1.594
Stratification	145	154	561.927	414.437	1.356
Radius matching	22	24	1764.444	1017.519	1.734*
Kernel Based Matching	145	154	895.932	255.798	3.503***

**Note:** \* and \*\*\* denote significant at 10% and 1% levels, respectively; t-values are calculated using bootstrap with 50 replications.

The ATT for the average household weekly expenditure on vegetable and fruits was KES 716.90 in NNM, KES 561.93 in Stratification, KES 1764.44 in RM and KES 895.93 in KBM. All the ATT values for the four different matching algorithms revealed that adoption of digital platform increased the average household expenditure on vegetables and fruits in a week during the COVID-19 lockdown period. A t-statistical test using 50 times replications revealed that only ATT findings for KBM and RM were significant at 1% and 10% respectively. From this data, it can be argued that access to Soko Kijiji Groceries and other of digital platforms increased the average household weekly expenditure on vegetables and fruits by between KES 895.93 and KES 1764.44. This in turn ensured that the households were food secure despite the strict measures which were put in place by the Kenyan government to curb the spread of the pandemic. This justifies the hypothesis that the digital platforms have supported the food systems during the COVID 19 pandemic.

### Mode of payment using the digital platform

Findings revealed that all consumers used mobile money transfer as a mode of payment to pay for the vegetables and fruits purchased through the digital platform (*Figure 25*). The most popular mobile money transfer during procurement of roots and tubers, and vegetables was MPESA. Other mode of payments used were cash (57.93%), debit card (16.55%) and bank transfer (13.79%).



**Figure 25.** Consumers' modes of payment using the digital platform

### Role of entrepreneurial behavior in influencing usage of digital platform purchase among consumers.

#### Reliability and validity of the constructs of consumer model 1

Convergent validity is achieved when a set of indicators of a construct converge or represents a single underlying construct<sup>16</sup>. This validity was measured using Cronbach's alpha (CA), rho\_A, Composite Reliability (CR) and Average Variance Extracted (AVE). As presented in Table 2, Cronbach's alpha (CA) ranged from 0.613 to 0.935, rho\_A ranged between 0.886 and 0.936 and composite reliability (CR) ranged between 0.755 and 0.958. These thresholds exceed the acceptable range of 0.60 - 0.70, hence internal consistency reliability was achieved. Convergent validity was also assessed by assessing average variance extracted (AVE) and the values exceed the threshold of 0.5<sup>16</sup>. Multicollinearity among the variables was tested using variance inflation factor (VIF). The results in

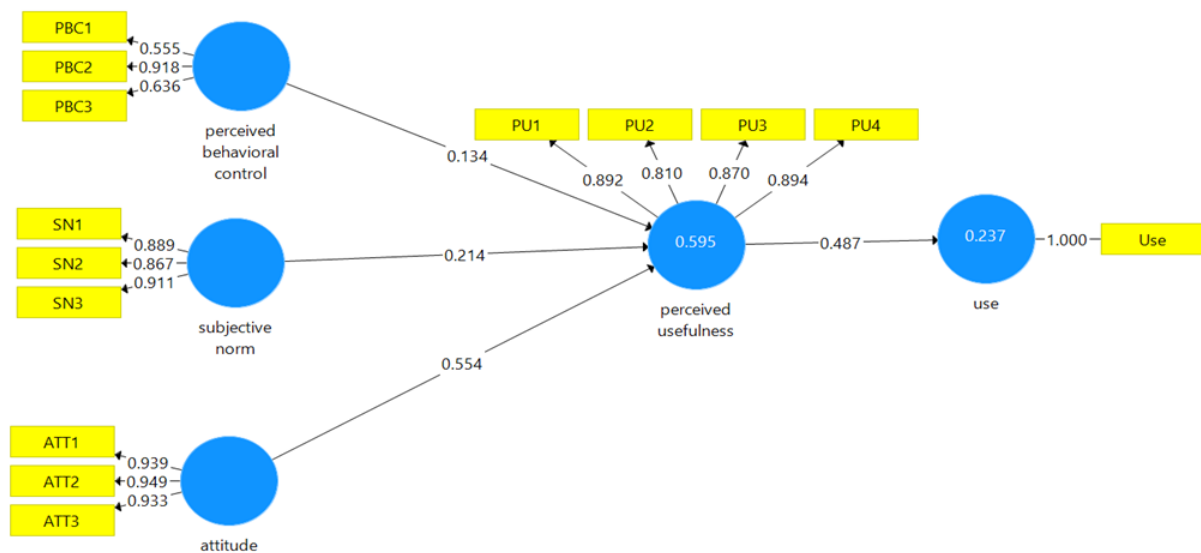


Table 36 show that there was no collinearity among the constructs since the values were less than 5 which is the threshold<sup>16</sup>.

**Table 36.** Reliability and validity of scale items.

Constructs	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	VIF
Attitude	0.935	0.936	0.958	0.885	1.645
Perceived behavioral control	0.613	0.935	0.755	0.518	1.656
Perceived usefulness	0.89	0.893	0.924	0.752	
Subjective norm	0.868	0.886	0.919	0.791	1.378

Discriminant validity was tested Using the AVE-SV technique and cross loading test. The constructs passed discriminant validity test as the diagonal values were greater than the horizontal and vertical values (Table 37) and all the factor loadings were above 0.6<sup>16</sup> (Figure 26).



**Figure 26.** Coefficient of structural model for model 2.

**Table 37.** Discriminant validity test.

	Attitude	Perceived behavioral control	Perceived usefulness	Subjective norm	Use
Attitude	0.941				
Perceived behavioral control	0.589	0.72			
Perceived usefulness	0.732	0.561	0.867		
Subjective norm	0.464	0.469	0.534	0.889	
Use	0.379	0.216	0.487	0.363	1

**Note:** Diagonals represent the square root of the average variance extracted (AVE) while the other entries represent the correlations.



The results on cross loading test for constructs of perceived behavioral control, subjective norm and attitude is presented in Table 38. The findings show that all the bold values of the loading exceeded the suggested threshold of 0.50 and above, hence all the constructs had discriminant validity<sup>17</sup>.

**Table 38.** Cross loading Test for constructs of perceived behavioral control, subjective norm and attitude

	Attitude	Perceived behavioral control	Subjective norm
ATT1	0.939		
ATT2	0.949		
ATT3	0.933		
PBC1		0.555	
PBC2		0.918	
PBC3		0.636	
SN1			0.889
SN2			0.867
SN3			0.911

### Hypothesis testing

To test the four hypotheses of the research model, this study utilized SEM with Partial Least Square (PLS) approach using the SmartPLS version 3.2.6 software.<sup>17</sup> Model fit was analyzed using the standardized root mean square residual (SRMR). The SRMR of 0.078 met the requirement of SRMR cut-off point of less than 0.08. Hence, the model fitted well to test the hypothesis. The analysis in Table 39, shows there is a positive relationship between perceived behavioral control, subjective norm, attitude and perceived usefulness. A consumer who is one standard deviation higher on perceived behavioral control, subjective norm and attitude will be 0.134, 0.214 and 0.554 standard deviation higher in perceived usefulness, respectively; therefore, the hypothesis H1, H2 and H3 are supported. The hypothesis H4 was also supported ( $p = 0.001$ ), whereby a consumer who is one standard deviation higher in perceived usefulness is 0.487 standard deviation higher in use.

**Table 39.** Path coefficients of direct effects of perceived behavioral control, subjective norm and attitude on perceived usefulness and perceived usefulness on use

Path relationship/hypotheses	Std. beta	SE	T values	P Values	Decision
Attitude -> perceived usefulness	0.554	0.051	10.889***	0.001	Supported
Perceived behavioral control -> perceived usefulness	0.134	0.052	2.566**	0.011	Supported
Perceived usefulness -> use	0.487	0.034	14.292***	0.001	Supported
Subjective norm -> perceived usefulness	0.214	0.044	4.923***	0.001	Supported

Attitude positively and significantly influence perceived usefulness at a 1% significance level ( $p = 0.001$ ). This implies that the more favorable a consumer's opinion of the vegetables purchasing digital tool is, the more the consumer will view the tool as useful. Perceived behavioral control influenced perceived usefulness positively and significantly at a 5% significance level ( $p = 0.011$ ) implying that the more a consumer considered himself/herself to have the ability to use the vegetables purchasing digital tool, the higher he/she will consider the tool as useful. Subjective norm was also found to influence perceived usefulness positively and significantly at 1% significance level ( $p = 0.001$ ). This means that the more positive the consumer's peers' opinion about the vegetables purchasing digital tool is, the more the consumer will view the tool as useful. The results also indicated that perceived usefulness positively and significantly influenced use at a 1% significance level ( $p = 0.001$ ). This means that the more a consumer considered the vegetables purchasing digital tool as useful, the more likely he/she will use the tool.

## Reliability and validity of the constructs-Model 2

Convergent validity is achieved when a set of indicators of a construct converge or represents a single underlying construct<sup>16</sup>. This validity was measured using Cronbach's alpha (CA), rho\_A, Composite Reliability (CR) and Average Variance Extracted (AVE). As presented in

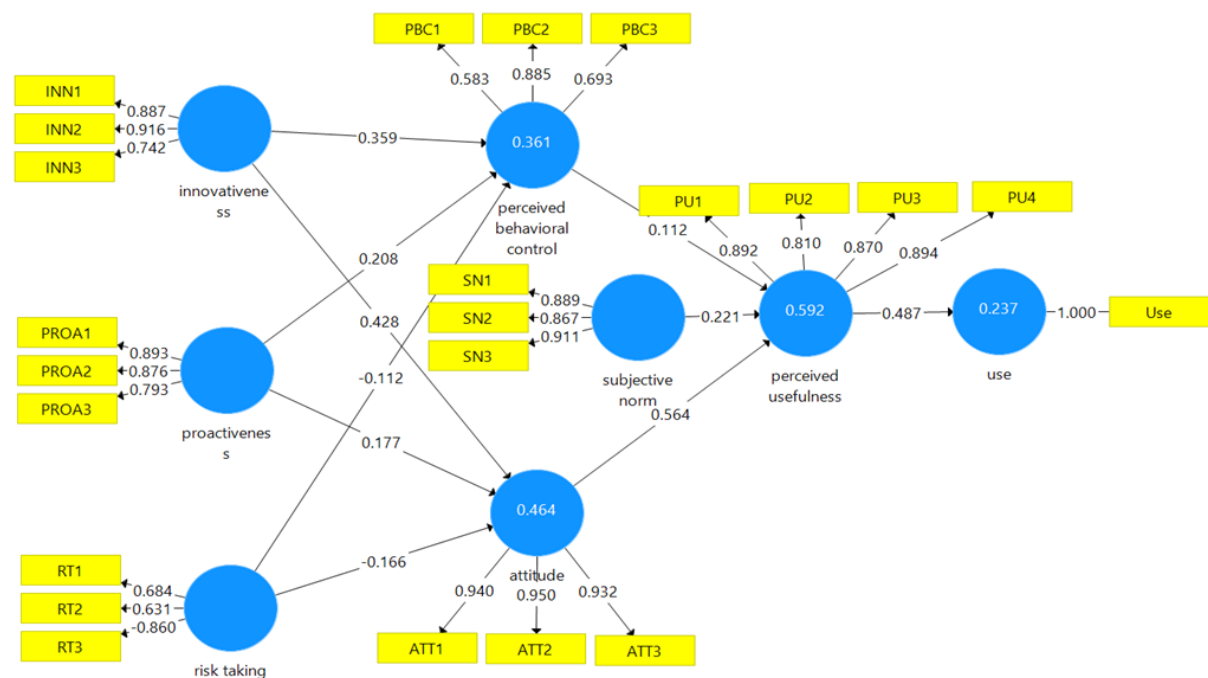
Table 40, Cronbach's alpha (CA) ranged from 0.613 to 0.935, rho\_A ranged between 0.68 and 0.935 and composite reliability (CR) ranged between 0.77 and 0.958. These thresholds exceed the acceptable range of 0.60 - 0.70, hence internal consistency reliability was achieved. Convergent validity was also assessed by assessing average variance extracted (AVE) and the values exceed the threshold of 0.5<sup>16</sup>. Multicollinearity among the variables was tested using variance inflation factor (VIF). The results in

Table 40 show that there was no collinearity among the constructs since the values were less than 5 which is the threshold<sup>16</sup>.

**Table 40.** Reliability and validity of scale items.

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)	VIF
Attitude	0.935	0.935	0.958	0.885	1.628
Innovativeness	0.807	0.825	0.887	0.726	2.432
Perceived behavioral control	0.613	0.781	0.77	0.535	1.616
Perceived usefulness	0.89	0.893	0.924	0.752	1
Proactiveness	0.817	0.839	0.89	0.731	1.901
Risk taking	-0.37	0.68	0.129	0.535	1.702
Subjective norm	0.868	0.886	0.919	0.791	1.367

Discriminant validity was tested Using the AVE-SV technique and cross loading test. The constructs passed discriminant validity test as the diagonal values were greater than the horizontal and vertical values (Table 41) and all the factor loadings were above 0.6<sup>17,16</sup> (Figure 27).



**Figure 27.** Coefficient of structural model for model 2

**Table 41.** Discriminant validity test.

	Attitude	Innovativeness	Perceived behavioral control	Perceived usefulness	Proactiveness	Risk taking	Subjective norm	Use
Attitude	0.941							
Innovativeness	0.655	0.852						
Perceived behavioral control	0.579	0.573	0.731					
Perceived usefulness	0.732	0.692	0.54	0.867				
Proactiveness	0.551	0.685	0.509	0.579	0.855			
Risk taking	-0.525	-0.638	-0.443	-0.537	-0.491	0.731		
Subjective norm	0.464	0.526	0.457	0.534	0.556	-0.351	0.889	
Use	0.379	0.343	0.203	0.487	0.342	-0.196	0.363	1

**Note:** Diagonals represent the square root of the average variance extracted (AVE) while the other entries represent the correlations.

The results on cross loading test for constructs of proactiveness, attitude, risk taking, perceived behavioral control, subjective norm and attitude is presented in Table 42. The findings show that all the bold values of the loading exceeded the suggested threshold of 0.50 and above, hence all the constructs had discriminant validity<sup>17</sup>.

**Table 42.** Cross loading Test for constructs of proactiveness, attitude, risk taking, perceived behavioral control, subjective norm and attitude

	Attitude	Innovativeness	Perceived behavioral control	Proactiveness	Risk taking	Subjective norm
ATT1	0.94					
ATT2	0.95					
ATT3	0.932					
INN1		0.887				
INN2		0.916				
INN3		0.742				
PBC1			0.583			
PBC2			0.885			
PBC3			0.693			
PROA1				0.893		
PROA2				0.876		
PROA3				0.793		
RT1					0.684	
RT2					0.631	
RT3					-0.86	
SN1						0.889
SN2						0.867
SN3						0.911

## Hypothesis testing

To test the ten hypotheses of the research model, this study utilized Structural Equation Modeling (SEM) with Partial Least Square (PLS) approach using the SmartPLS version 3.2.6 software<sup>17</sup>. Model fit was analyzed using the standardized root mean square residual (SRMR). The SRMR of 0.083 met the requirement of SRMR cut-off point of less than 0.08. Hence, the model fitted well to test the hypothesis. The analysis in Table 43, shows there is a positive relationship between proactiveness and attitude on perceived behavioral control and attitude. Perceived behavioral control, subjective norm and attitude had a positive relationship on perceived usefulness. Perceived usefulness was found to have a positive relationship with use. Therefore, hypotheses H1, H2, H3, H4, H5, H6, H9 and H10 were supported. However, H8 ( $p = 0.346$ ) and H7 ( $p = 0.388$ ) were not supported.

**Table 43.** Path coefficients of direct effects of model constructs for consumers

Path relationship/hypothesis	Std Beta	SE	T Values	P Values	Decision
Attitude -> perceived usefulness	0.564	0.052	10.906***	0.001	Supported
Innovativeness -> attitude	0.428	0.08	5.362***	0.001	Supported
Innovativeness -> perceived behavioral control	0.359	0.085	4.211***	0.001	Supported
Perceived behavioral control -> perceived usefulness	0.112	0.052	2.145**	0.032	Supported
Perceived usefulness -> use	0.487	0.035	13.898***	0.001	Supported
Proactiveness -> attitude	0.177	0.068	2.585***	0.01	Supported
Proactiveness -> perceived behavioral control	0.208	0.074	2.813**	0.005	Supported
Risk taking -> attitude	-0.166	0.176	0.944	0.346	Not Supported
Risk taking -> perceived behavioral control	-0.112	0.13	0.864	0.388	Not supported
Subjective norm -> perceived usefulness	0.221	0.043	5.103***	0.001	Supported

Proactiveness and Innovativeness were found to positively influence perceived behavioral control at 5% ( $p = 0.005$ ) and 1% ( $p = 0.001$ ) significance levels respectively. This implies that the more a consumer typically acts in anticipation of future problems, needs, or changes and uses new ideas or methods, the more they will think of themselves as having the efficacy to use the digital vegetable purchasing tool. Proactiveness and innovativeness also positively influences attitude at a 1% ( $p = 0.01$ ) and 1% ( $p = 0.001$ ) significance levels respectively. This means that if a consume is characteristically more inclined towards acting in anticipation of future problems, needs, or changes and using of new ideas or methods, he/she will have a more positive opinion of the digital vegetable purchasing tool.

Attitude positively influence perceived usefulness at a 1% significance level ( $p = 0.001$ ). This implies that the more favorable a consumer's opinion of the vegetables purchasing digital tool is, the more the consumer will view the tool as useful. Perceived behavioral control influenced perceived usefulness positively at a 5% significance level ( $p = 0.032$ ) implying that the more a consumer considered himself/herself to have the ability to use the vegetables purchasing digital tool, the higher he/she will consider the tool as useful. Subjective norm was also found to positively influence perceived usefulness at 1% significance level ( $p = 0.001$ ). This means that the more positive the consumer's peers' opinion about the vegetables purchasing digital tool is, the more the consumer will view the tool as useful. The results also indicated that perceived usefulness positively influenced use at a 1% significance level ( $p = 0.001$ ). This means that the more a consumer considered the vegetables purchasing digital tool as useful, the more likely he/she will use the tool.

## 4. CONCLUSION AND RECOMMENDATIONS

### 4.1 Conclusion

Even though the level of awareness of digital platforms is low, farmers are reluctant to use them within the vegetable, root and tuber crops value chains. Negative attitude towards the platform, lack of mobile phone ownership and inadequate information are the main reasons constraining the use of digital platforms. The ease of accessing input information and services, technical knowhow of the platform and reliability of the services being provided on the platform are the major motivation factors for the use of Viazisoko platform among farmers. High preference for mobile phone (through app) and online (web based) platform indicates improved uptake of farm digitization along the agricultural value chain. The major services sought by farmers through the digital platform includes access to quality seeds, pest and disease advisory, extension and advisory services on GAPs, spraying as well as access to information on approved agrochemicals and market. Even though these services were already in use, most farmers stated using them in response to the pandemic. Besides, farmers increased the frequency of accessing the various service through the digital platform during COVID-19 lockdown and further increased after the lockdown. Similarly, farmers are more likely to continue using Viazisoko digital platform beyond the COVID-19 pandemic. Irrespective of the pandemic, farmers procured their inputs mainly from the agrovet in the neighborhood and nearest town. However, the digital platform showed a gradual role in input access by farmers during the pandemic. The digital platform enhanced access to farm mechanization and labor services, created employment opportunities and improved linkage between farmers and consumers as well as between farmers and input suppliers. Though mechanization, access to certified seeds and access to labor services are at infancy, there is evidence of strong strides of the digital platforms providing an alternative model to support the food systems during and post COVID 19.

Majority of traders mostly deal with vegetable products with some supplementing their businesses with roots and tubers. The pandemic had greatly affected businesses, with liquidity constraints, traders' fear of being infected with the pandemic and high transportation cost for trading commodities identified as the major threats. Despite this, the digital platforms greatly supported procurement of trading commodities, especially during the COVID-19 period and trader are less likely to use their own means of transport in future. The use of social media is the major sales and distribution strategy used in response to the pandemic. Most of the traders started and increased making or receiving payments electronically with majority showing no intention to borrow cash for working capital in future.

Convenience, fear of health-related complication, favorable product prices and availability of better quality of vegetable and fruits inspired the use of digital platforms among consumers. Like farmers, consumers prefer using mobile application in purchasing vegetables and fruits, with the greatest increase in the use attributed to the pandemic. The major information accessed through the digital platform by consumers relate to market information. Consumer willingness to adopt digital platforms in future is negatively influenced by their age, education level and household dependency ratio and positively influenced by membership to a group. Comparatively, digital platforms have shown increasing preference and volume transacted as a point of vegetable purchase among consumers. The weekly expenditure increased, and users of digital platforms spent more on vegetables and fruits in a week compared to the non-users. The evidence crystallizes the empirical foundation of the importance of digital platforms in shaping the food systems during the pandemic in the backdrop of the rising number of digital service providers in the food value chain.

## 4.2 Recommendations

To enhance the performance of the digital platforms the following recommendations is derived from the study:

- Design for digital platforms need to integrate sustainable models to avoid collapsing of the platforms due to heavy reliance on external support and inadequate revenue models. Adoption of a self-sustainable business approach (e.g. fee-based services or paid membership schemes) as well as re-orienting the business approach towards public private partnerships and diversifying product/service portfolio by integrating different services and value chains, backward and forward integration to create new revenue streams provides some of the options for consideration by service providers.
- Develop a framework for embedding farmer oriented in existing local extension services to support practical implementation of agronomic recommendations.
- Enhancing entrepreneur behavior of farmers and consumers is critical in adoption of agri-digital solutions.
- Building agile business with flexibility to adjust to various shocks beyond the pandemic. Focusing on the transition post COVID will be critical in maintaining the business space of the digital platforms by building strong market offering.
- Partnering with already tested business models for acceleration through financing by financial institutions as well as donor communities is critical for sustainability of digital platforms especially the platforms with little or no commercial orientation.
- Strong bio-security measures in the context of COVID-19 are important in enhancing trust especially in product handling by the agricultural digital service providers.
- Combined county permits to allow one easily transaction in any county with fresh produce among digital platforms with strong cross county distribution of products to traders. This has implication in increasing cost of business.
- Product differentiation is key in making the digital platforms competitiveness. Strong focus of the digital platforms in providing unique products and solutions in ever-changing environment is key in keeping pace with consumers dynamic needs, key among them Enhance interactiveness between agricultural digital solutions and clients e.g., chatbot
- Integrating youth entrepreneurs and higher education students to support development of ICT related agri-solutions e.g., accessible database by use of USSD code for vendors to easily authenticate the quality of the produce as well as data science. This will facilitate creation of robust learning curve to trigger development of marketable and viable agricultural digital services.

## 5. ANNEXES

### Annex 1: Agricultural Digital Platforms

Digital platform	Year of establishment	Country of Operation including specific regions/Counties/districts	Brief description (Highly summarized) of the service	Target value chains	Business model	Referee including web link	Active
DigiFarm	2018	Kenya	Digifarm is an agribusiness solution tailored for small-holder farmers, providing them with financing, information on different crops and animals in addition to quality, discounted inputs. Farmers can enroll to and access Digifarm by dialing *283#.	All crops and livestock	Embedded services model	<a href="https://www.safaricom.co.ke/business/digifarm">https://www.safaricom.co.ke/business/digifarm</a>	Yes
NPCK Viazisoko	2018	Kenya	The Portal is a web-based SMS platform that collects, processes, and disseminates seed and ware potato information. The information on variety, prices, location, and telephone contact of seed and other relevant information will be made available to farmers through SMS. In addition, the platform provide access to seed and markets	Irish potato	Shared revenue on sales between NPCK and suppliers for using platform	<a href="https://www.npckViazisoko.com/">https://www.npckViazisoko.com/</a>	Yes
MbeguChoice	2015	Kenya	MbeguChoice helps Kenyan farmers, extension workers and agro-dealers better understand available seed varieties suitable for different agro-ecologies	Crop seed	Fee embedded into Association membership fee	<a href="http://www.mbeguchoice.com/">http://www.mbeguchoice.com/</a>	Yes

Seed Sector Platform Kenya	2015	Kenya	Interactive industry databases for crop varieties, agro-dealers and private sector industry participants	Crop seed	Fee embedded into Association membership fee	<a href="http://www.seedsectorplatformkenya.com/">http://www.seedsectorplatformkenya.com/</a>	Yes
Cassava Carp Mobile App	2018	Uganda	The platform (both web-based and mobile app) offers services to its users such as farmer profiling, garden profiling, cassava garden inspection and certification management.	Cassava	NIL	<a href="http://www.cassava-carp.org/frontend">http://www.cassava-carp.org/frontend</a>	Yes
UshuariKilimo	2015	UjuziKilimo is currently available in central, Rift Valley and Nyanza regions of Kenya.	UjuziKilimo uses technology to provide real-time, precise and actionable agricultural information to farmers using sensors and mobile phone technologies. It is an agro-advisory and extension service system that allows any actor in the agriculture Centre (e.g., farmers, extension officers, policy makers, traders) to ask for advisory services to an agricultural extension officer using web or mobile phone calling +254-020 2611 248 or sending a free SMS	All crops	Shared SMS fee (Shared between service provider and telco); All costs are inclusive in the analysis services payment. The follow-up information and SMS messages are Free	<a href="https://www.ujuzikilimo.com/">https://www.ujuzikilimo.com/</a>	Yes
DigiShop Franchisees	2014	Kenya	Digishop is an online store. it is an input dealer in a digital form which will have access to good quality inputs. Farmers pride provides marketing support and agronomic practices, vet services, soil test, insurance to smallholders. The members will get business management training and continuous professional development;	All inputs and extension services	A franchise model to input dealers and smallholders for establishing a business to sell their products	<a href="http://farmersprideafrica.com/">http://farmersprideafrica.com/</a>	Yes



			access to new and innovative products and services; access to finance				
Scratch Off Labels (mPedigree)		Kenya and Tanzania	Scratch-off sticker labels for packages of all certified crop and vegetable seeds to reduce issue of fake seed	Certified seeds	Label fee and SMS fee profits are shared between service provider and regulator, paid for by seed companies	<a href="https://mpedigree.com/news/scratch-card-check-medicine-real/">https://mpedigree.com/news/scratch-card-check-medicine-real/</a>	Yes
FarmDrive	2014	Kenya	conduct credit assessment for smallholders using digital bookkeeping platform. The enterprise's technology enables farmers to track their productivity, expenses and revenues which are analysed to reveal performance patterns. The information helps financiers to make lending decisions based on the credit profiles of the borrowers.	All crops		<a href="https://farmdrive.co.ke/">https://farmdrive.co.ke/</a>	Yes
Esoko	2008	Ghana, Malawi, Burkina Faso, and Tanzania	Connects farmers to essential services such as weather forecast, agronomic advisory services, market linkage, and insurance through SMS, voice SMS and call center.	All crops		<a href="https://esoko.com/">https://esoko.com/</a>	Yes
Twiga Foods digital tool	2014	Currently in Nakuru, Eldoret, Kisumu, Kajiado, Nairobi, and Machakos	social enterprise Twiga Foods has developed a tool that vendors can use to order stocks. It procures the produce directly from farmers at a guaranteed price and delivers it to the vendors. The vendors are allowed to make flexible payments using mobile money depending on what they sell during the day.	Bananas, potatoes, tomatoes, onions, watermelon, carrots, and oranges.		<a href="https://twiga.com/">https://twiga.com/</a>	Yes

Seed Tracker	2018	Brazil, Nigeria, Tanzania	Seed tracker (ST) is an ICT tool digitally linking the seed value chain actors, tracks seed production, and organize information. It includes tracking of seed production, pre-planting planning, field registration, crop management, harvesting, quality assessment and quality assertion. The platform also links seed producers and the service providers.	Cassava and yams	Subscription fee	<a href="https://seedtracker.org/">https://seedtracker.org/</a>	Yes
iShamba	2014	Kenya	iShamba is a call center and a messaging service composed of agricultural experts. An individual can send SMS through 21606 or call to get help on their inquiries. Further, the platform provides agri tips for both crops and livestock, gives updates on the market prices, weather updates, and farmer events.	All crops and livestock	Embedded on the annual subscription fee	<a href="https://shambashapeup.com/">https://shambashapeup.com/</a> <a href="https://ishamba.com/">https://ishamba.com/</a>	Yes
Sidai	2011	Kenya	Sidai is a fully vertically integrated company supplying quality livestock and crop inputs and training to farmers and pastoralists across Kenya. Sidai offers farmers solutions to the challenges they face growing crops and livestock productively and profitably. Sidai's professional staff, combined with the company's quality products and services, ensure Sidai customers farm successfully	All crops and livestock		<a href="https://www.sidai.com/">https://www.sidai.com/</a>	
myAgro	2011	International	myAgro uses a mobile technology platform to provide access to fertilizer and seed packages on layaway. In addition, the enterprise also provides technical training, market access to premium buyers and	All crops		<a href="https://www.myagro.org/">https://www.myagro.org/</a>	Yes

			access to asset loans for appropriate small-scale farm equipment.				
Agriculture & Climate Risk Enterprise (ACRE Africa)	2009	Kenya, Rwanda, and Tanzania	By working with farmers via a peer-to-peer network of trusted locals to better understand the needs of farming communities and to educate farmers on insurance, ACRE Africa can offer tailored microinsurance products. The company then works with local partners to help distribute these insurance products – which are accessible and affordable. ACRE Africa, which works with smallholder farmers in Kenya, Rwanda and Tanzania, and has projects in several other African countries, has committed to reaching one million low-income farmers on the continent through its products.	All crops		<a href="https://acreafrica.com/">https://acreafrica.com/</a>	Yes
M-Farm	2010	Kenya	Jamila Abass is CEO and co-founder of M-Farm, a virtual co-operative for subsistence farmers in Kenya to help them reach buyers and access vital market information via SMS. Through M-Farm, farmers in the same areas can share their experiences and advice, pose questions to industry experts, and connect with each other to combine crops and find larger buyers. Abass was elected for the 2013 Ashoka Fellowship, 2015 Aspen New Voices Fellow, and as Quartz Africa Innovator.	All crops		<a href="https://www.mfarm.co.ke/">https://www.mfarm.co.ke/</a>	Yes
Farmcrowdy	2016	Nigeria	Farmcrowdy is Nigeria's First Digital Agriculture Platform that empowers rural farmers by providing them with improved seeds, farm inputs, training on modern	All crops		<a href="https://www.farmcrowdy.com/">https://www.farmcrowdy.com/</a>	Yes

			<p>farming techniques and provides a market for the sale of their farm produce. This gives the farmers the capacity to farm more acres and by extension leads to increased food production and security in Africa. Since launching in 2016, Farmcrowdy has empowered over 25,000 farmers and engaged with over 182,000 farmers across Nigeria. We are committed to expanding our reach to continue to empower local farmers, positively impact their lives and their families while boosting food production and sustainability in Nigeria. Onyeka Akumah is founder of FarmCrowdy, Nigeria's first digital agriculture platform that connects small-scale farmers with sponsors who invest in the full farm cycle. Sponsors' funds are used to secure farmland and insure farmers and their produce from seed through to harvest. Once the crops are sold at market, profit is split between the farmer, farm sponsors, and Farmcrowdy. Sponsors can receive updates throughout the farming process via text, pictures, and video. The company has more than 1,000 sponsors across Nigeria, the United States, and the United Kingdom that support more than 2,000 small-scale farmers across eight states in Nigeria.</p>				
TruTrade	2012	Kenya	<p>TruTrade's Trade Transparency Service (TTS) formalizes value chain transactions and improves efficiency, so that rural agricultural markets work better for everyone.</p>			<a href="http://www.trutradeafrica.net/">http://www.trutradeafrica.net/</a>	Yes

AKF - Digital Savings Groups	2016	Tanzania	<p>DSGs are groups of 15-30 members who pay into a common platform, at any time, from the “mobile wallet” of their choice. Savings are pooled for purposes of issuing loans within the group. Members can take loans of up to three times their savings balance for periods of up to three months, generating a profit that is shared amongst members at the end of an annual cycle. The groups receive no external funds. A randomized approvals process, which is facilitated by the DSG platform and is applied to the issuance of all loans, ensures fairness and full participation in decision making. This in turn ensures that DSGs are safe and transparent for members. No member can access critical functions on the platform outside of meetings, including office bearers. DSG groups meet once every two weeks to review the savings and loan repayment activity since the last meeting, check their financial statements, and issue new loans. Loans can only be issued in meetings.</p>			<a href="https://www.akdn.org/akf-digital-savings-groups-dsg">https://www.akdn.org/akf-digital-savings-groups-dsg</a>	Yes
Agrinfo	2016	Tanzania	<p>Agrinfo, a female-led aerial drone surveillance enterprise in Tanzania, is working with women in the country to identify their crop cultivation needs and provide solutions that will reduce pest infestation and diseases.</p>	All crops		<a href="https://www.agrinfo.co.tz/">https://www.agrinfo.co.tz/</a>	Yes
Digital Green	2006	India and Ethiopia	<p>a video-based approach to deliver extension services to women in India and Ethiopia;</p>			<a href="https://www.digitalgreen.org/about-us/">https://www.digitalgreen.org/about-us/</a>	Yes

Talking book		Ghana	audio device (established through a partnership between Amplio, the Mennonite Economic Development Associates and Literacy Bridge Ghana) is enhancing the delivery of practical and easy-to-learn extension services in Ghana.				
Selina Wamucii	2015	Kenya	Selina Wamucii is a market-access solution for farmers that integrates with cooperatives, producer organizations, agro-processors, small and medium enterprises, and other organizations that work directly with family farmers.	Fruit and vegetables, grains, cereals, spices, seeds, seedlings, fertilizers, equipment, machinery and agro-commodities.	Sell their products	<a href="https://www.selina.wamucii.com/about-us/">https://www.selina.wamucii.com/about-us/</a>	Yes
Farmers Market Kenya	2014	Kenya	Farmers Market Kenya (FMK) is a free online marketplace where the buyers and traders interact to trade on farm products and services. Their services are available through the internet and the farmers can post free ads of their farm produce and to acquire inputs at an affordable pricing.	All crops		<a href="https://www.fmk.co.ke/">https://www.fmk.co.ke/</a>	Yes
Farmbiz Africa	2010	Kenya	It is a premier farming website that avails farmer's news service that cover information regarding seeds, pest control, and farming methods. It also highlights briefs regarding new markets and high-return business formulas.	All crops	Advertisement subscription fee	<a href="http://www.farmbizafrica.com">www.farmbizafrica.com</a>	Yes
Mkulima Young	2012	Kenya	It is an online marketplace "for farmers developed by a farmer for farmers". In this	All crops	Shared revenue	<a href="http://www.mkulimayoung.com">www.mkulimayoung.com</a>	Yes

			platform, the farmers are connected to the markets. The seller lists their products, and the seller views the products on offer then contacts the seller.		between Mkulima Young and farmers for using their platform.		
Farmingtech solutions limited (Digicow Dairy App)	2016	Kenya	<p>Farmingtech is a digital company that develops mobile phone technologies within the agricultural sector enabling the agricultural value chains to increase productivity and profitability.</p> <p>DigiCow Dairy App which was developed in 2019 helps farmers to keep digital records and analyzed reports, receive alerts through the app or SMS on the gestation dates.</p> <p>Tegea IVR system is another platform for interactive voice-based training where the farmers receive phone call services. The system automatically calls the farmer and deliver prerecorded audio based on the pre-selected database.</p> <p>Digital AI allows farmers to request and be linked to inseminator within their location when their cow is on heat.</p>	Livestock		<a href="https://digicow.co.ke">https://digicow.co.ke</a>	Yes
WeFarm	2015		<p>WeFarm is an independent, mission driven company that builds a trusted digital platform empowering a global community for the success of small-scale farmers. The community of scale-farmers connect through an online platform using WeFarm app or through WeFarm SMS to access marketplaces. The platform can be</p>			<a href="https://about.wefarm.com/about">https://about.wefarm.com/about</a>	

			accessed anytime freely even without internet access.				
Farm Radio International	1979	International with presence in 41 countries worldwide	Farm Radio International was initiated in 1975 by a Canadian farm radio broadcaster, George Atkins. Since 1979, the Canadian charity has focused on using radio to strengthen the African farming communities. They offer resources and training to improve the rural radio programs and run targeted projects that use radio to meet the targeted results.	All crops	Non-profit	<a href="https://farmradio.org/">https://farmradio.org/</a>	Yes
Agri Experience	2012	Kenya	Agri Experience is an African based platform that focuses of strong seed system development in sub-Saharan Africa. Since it was founded in 2012, Agri Experience have developed strong reputation and have been known for high quality and experience-based field analysis, recommendations, and implementation support for seed systems development.	All crops		<a href="https://agri-experience.com/">https://agri-experience.com/</a>	Yes
uLima Apps	2018	Kenya	uLima is a digital platform designed to provide a link between farmers, agro-dealers, and broader agricultural community. The mobile platform provides access to crop and livestock management information, agroweather information, market for produce, and customized crop and livestock calendars.	All crops		<a href="https://ulima.co">https://ulima.co</a>	Yes
Glovo	2015	International presence in 24 countries	Glovo is an app that connects the users to the businesses and offer courier services. The users place their order through the	All crops		<a href="https://glovoapp.com/ke/en/">https://glovoapp.com/ke/en/</a>	Yes



			app, and it gets delivered at their convenience.				
Uber Eats	2014	International	Uber Eats is an online food ordering company where the app users can view menu from the restaurant of their choice, place orders, and pay for the food which gets delivered to them.	Food delivery		<a href="https://www.ubereats.com/ke/city/nairobi-nairobi">https://www.ubereats.com/ke/city/nairobi-nairobi</a>	Yes
Bolt food	2021	Kenya	Bolt Food, an international digital company was launched in Kenya on March 2021. The platform allows the users to order their restaurant favorites direct to their doorsteps. The users need to download the app, choose the favorite dish from the restaurant nearby, inform the courier where to leave the order, confirm the order then pay for it.	Food delivery		<a href="https://food.bolt.eu/en-us/">https://food.bolt.eu/en-us/</a>	Yes
Sokokijiji	2020	Nairobi	Sokokijiji is an online grocery shop that serves customers conveniently through delivery of fresh fruits and vegetables at doorstep.	Fresh fruits and vegetables	Revenue from on the sale of products	<a href="https://sokokijiji.co.ke/">https://sokokijiji.co.ke/</a>	Yes
Keekapu	2018	Kenya	Keekapu Grocers is an online store that engages in planting and partnering with the farmers to produce quality output in the guidance of qualified agronomists. They source the quality products from farmers, package them, and do home deliveries.	All crops		<a href="https://keekapu.com">https://keekapu.com</a>	Yes
Enric Farm Fresh	2016	Nairobi	Enric Farm Fresh is an online marketplace within Nairobi-Kenya connecting farmers to homes and business through home and office deliveries. The customers can shop for the fresh produce through the online	All crops		<a href="https://www.enricfarmfresh.co.ke/about-us/">https://www.enricfarmfresh.co.ke/about-us/</a>	Yes

			platform, and they get the deliveries anywhere around Nairobi.				
Emart.co.ke	2016	Kenya	Emart.co.ke is an online supermarket that allows customers to shop from anywhere and gets their products delivered at doorstep within the same day.	Grocery and other household items		<a href="https://www.emart.co.ke/">https://www.emart.co.ke/</a>	Yes
ATF Greens	2020	Nairobi	ATF Green Limited is an online marketplace in Kenya that allows the customers to place their orders and get them delivered at convenience. It is a platform that was created in response to the coronavirus pandemic to enable clients to place their orders online and receive the deliveries without interruption.	All crops		<a href="https://atfgreens.com/">https://atfgreens.com/</a>	Yes
Duka Chap		Kenya	Duka Chap is a digital agribusiness marketplace offering fresh groceries, meat supplies, dry foods, and household goods through an online platform.	All crops	Cost-based model	<a href="http://www.dukachapchap.co.ke">www.dukachapchap.co.ke</a>	Yes
Kalimoni greens	2005	Kenya	Kalimoni Greens is an online organic home delivery supermarket. The family-owned business practices agroecology to improve yields for balanced nutrition. The organic food they supply are from their three farms in Nairobi, Kiambu and Aberdares and sold through their online grocery platform.	Fresh fruit and vegetables, fresh meat, groceries, cleaning products and organic farm inputs.		<a href="https://www.kalimongreens.com/">https://www.kalimongreens.com/</a>	Yes
Gobeba Shopping			GoBEBA is an On-demand ordering and delivery services that majors in home deliveries for personal shoppings and help small businesses to get their supplies at			<a href="https://www.gobeba.com/company/">https://www.gobeba.com/company/</a>	

			doorstep. An individual makes an order online and then send the shopping list.				
Farmgate Connections			Farmgate Connections is a group of farmers joined together to provide a solution to small scale farming and produce market. They offer high quality output at a low cost and share the savings with the customers.			<a href="https://farmgateconnections.com/">https://farmgateconnections.com/</a>	
Apollo Agriculture	2016	Kenya	Apollo Agriculture provides a mobile-based platform for the farmers to cover their working capital, data analysis for higher crop yields and to buy necessary agricultural inputs and farm equipment. It covers farm inputs, agronomic advices, crop insurance and agricultural finance, and market access.	All crops	Sale of farm products and margins on financing	<a href="https://www.apolloagriculture.com/">https://www.apolloagriculture.com/</a>	Yes
Tulaa	2016	Kenya and Ghana	Tulaa is a digital platform that enables mobile lending and commerce platform for the small holders in sub-Saharan Africa. The platform enables the farmers to buy inputs, access best agronomic advisory services, and market for their products.	All crops	Embedded in the loan interests		Yes
Farmshine	2017	Kenya	Farmshine is an online marketplace for the agricultural products. It provides a platform that links farmers to suppliers and other service providers so as to enhance traceability, market efficiency, pooled purchasing, and higher value crops.	All crops		<a href="https://www.farmshine.io/">https://www.farmshine.io/</a>	Yes

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