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# Digital inventory management systems and the growth of agro farms in Cross River State, Nigeria

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## Abstract

Digital technologies are increasingly promoted as a way to improve stock handling and coordination on farms, yet evidence from Nigerian agro farms is limited. This study examines how digital tools, mobile applications, and software systems for inventory control relate to the productivity, profitability, and market expansion of agro farms in Cross River State, Nigeria. A cross sectional survey was conducted between February and August 2025 under a positivist, hypothetico deductive approach. A structured questionnaire with five point Likert items was administered to owners and managers of registered crop, livestock, and mixed farms selected through stratified random sampling, yielding 364 valid responses from 450 distributed. Reliability and construct validity were assessed, and hypotheses were tested using multiple regression at the 5 percent level of significance. The results show that IoT systems and digital monitoring systems are positively associated with productivity, with a reported indirect effect through inventory accuracy. Mobile stock tracking applications, cloud based farm inventory systems, and barcode and QR code applications are positively associated with profitability. Web based inventory platforms and enterprise level digital supply chain software are positively associated with market expansion. The study concludes that digital inventory control systems can support agro farm growth and recommends regular staff training and reliable internet connectivity at farm locations. Because the design is cross sectional and relies on self reported measures, the findings indicate association rather than causation.

***Keywords*:** Digital Management Systems, Inventory Control, Agro Farms, Mobile Applications, Productivity, Profitability, Cross River State

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***JEL Classification:*** Q16, Q12, O33

## 1. Introduction

The incorporation of technological management systems in today's agriculture is bringing changes in the process through which agro-farms handle their stock, coordinate activities, and make improvements on farms. With increasing involvement of technology in agriculture, the adoption of digital devices, including IoT systems, mobile applications, blockchain, and software solutions is being seen as a way of improving stock handling and coordination of activities in agro-farms (Klerkx et al., 2019; Ashoka et al., 2023). Digital agriculture has become a trend that is not only practiced by commercial agricultural firms but also by small-scale agro-farms in adopting digital technologies that enhance stock and agricultural supply management (Balachandar et al., 2022). Additionally, Sayem et al. (2023) posited that IoT systems can be used to enhance monitoring and security in agro-farm settings.

There is increasing attention on how digital inventory control systems can impact productivity in agro-farming due to the rising popularity of digital technology in agriculture. The use of digital technology for inventory control can enhance monitoring, faster processing of information, and coordination of farming activities (Ashoka et al., 2023). Singh et al. (2023) reported that digital advisory systems through mobile phones affected farming practices by farmers in Southern India, thereby suggesting that digital systems can help in making operational decisions and efficient farming. Likewise, Balachandar et al. (2022) suggested that digital agriculture with IoT systems and block chain platforms can promote communication and coordination in farming operations. Nevertheless, some of the empirical evidence linking digital inventory control to productivity is largely indirect since research has mainly concentrated on digital agriculture in general and not inventory control in particular. Rotz et al. (2019) have further warned against digital agricultural technologies resulting in differential impacts due to differences in access to technology, infrastructure, and expertise within the agricultural environment.

Literature has shown that mobile inventory application impacts agro-farm profitability. Issues related to excessive inventory, spoilage, inaccurate inventory record keeping, and slow inventory decision-making processes might hinder profitability in an agro-farm setting. According to Yao & Sun (2020), agricultural inventory management using big data systems might allow better reaction to supply-demand situations in agriculture. Similarly, Mashayekhy et al. (2022) observed that the IoT technology could be helpful for enhancing inventory visibility, thus improving inventory management systems. These sources reveal that digital inventory applications could reduce waste and enhance inventory management accuracy, which is positively linked with profitability improvements. There is some additional evidence regarding the impact of digital inventory applications on business operations, but not specifically in the agriculture sector. For instance, Ali et al. (2024) reported that digital supply chain systems increased the effectiveness of inventory management within engineering companies. Furthermore, Meda (2021) described ways in which

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predictive inventory systems could help companies in achieving cost reduction goals and conducting operation planning activities. However, the above-listed evidence cannot serve as direct examples due to their non-agricultural focus.

Moreover, it can be assumed that modern software solutions for managing inventories will also facilitate the growth of agro-farms due to efficient planning, coordination of work and scalability. For instance, Kalimoldayev et al. (2024) stated that digital inventory systems will positively impact the process of optimizing the inventory due to improved planning and monitoring. Moreover, Kukartsev et al. (2023) added that digital twins and inventory automation will help to enhance the coordination of activities and inventory management. Additionally, Flores et al. (2025) mentioned that improvements to inventory management systems in the agricultural supply chain could increase efficiency and improve sustainability of processes. Other sources like Erden (2015), Yoraeni et al. (2025), and Baylosis et al. (2023) discussed the adoption of agricultural and web-based inventory management systems for facilitating the optimization of inventories and information management. Nevertheless, many available resources highlight only the process of adopting and operating inventory systems, but not their direct influence on agro-farm growth. For example, Chen and Zhou (2025) explored digital inventory management systems among liquor enterprises, while Sharma and Reddy (2025) focused on intelligent dairy enterprises.

The significance of this research lies in the fact that most agro-farms in Cross River State are being run under conditions that are quite dissimilar from most of those explored previously. As Klerkx et al. (2019) suggest, there is a disparity in digital agriculture practices owing to the variation in institutional capacity, technological capability, and digital literacy. Likewise, according to Rotz et al. (2019), the effectiveness of digital technologies used in agriculture might vary depending on various factors. While most studies have been conducted using highly technologized agricultural production in Asia, Europe, and other developed countries, there is an evident lack of empirical data concerning agriculture in Nigerian states. It appears that the problem requires further investigation, which makes it important to conduct this study. In other words, the primary goal of this paper is to explore the impact of digital management systems on the development of agro-farms in Cross River State by investigating the relationship between digital solutions for inventory management, productivity, profitability, and agro-farm expansion. To this end, the study raised questions that:

i. How does digital tool for inventory control affect productivity?

ii. What effect does mobile application for inventory control affect profitability?

iii. How does software system for inventory control affect the expansion of agro-farms?

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## 2. Literature Review

### 2.1 Use of digital tools for inventory control and productivity of agro-farms

Digital tools for managing inventories involve the usage of technological solutions like IoT systems, mobile-based platforms, blockchain technology, drones, and other digital surveillance mechanisms in order to control, organize, and coordinate the agricultural inputs and outputs in the agro-farm environment (Klerkx et al., 2019; Ashoka et al., 2023). In other words, the main purpose of using these types of technologies in the farming industry involves increasing the precision of stock management, providing efficient monitoring, and enabling quicker transfer of the related data. Since in the case of agro-farming systems, productivity is associated with the efficiency of resource management (including seeds, fertilizers, machines, and harvested product), digital technologies are considered among those that can assist with achieving this goal (Balachandar et al., 2022; Singh et al., 2023). In particular, according to Sayem et al. (2023), the application of IoT agricultural systems can help increase monitoring and operational performance on farms. However, productivity gains from digital technologies do not always refer specifically to inventory management.

As indicated in the literature on digital agriculture, the increase in productivity can be linked to increased access to information and rapid decisions, as well as the ability to coordinate farming practices through digitalization. According to Klerkx et al. (2019), smart farming practices are dependent on data-based systems, which can ensure agricultural efficiency, but their success is contingent on the quality of the infrastructure used and the capacity to adopt them. The same is echoed by Rotz et al. (2019), who state that the results produced by digital technologies for agriculture vary since increases in productivity are contingent upon technological access, institutions, and levels of digital skills. While Ashoka et al. (2023) note that there are benefits of digital technology in agriculture in terms of productivity gains, the study results are more general and not confined to inventory management systems. This led to the formulation of hypothesis that:

H1: Digital tools for inventory control has positive effect on productivity of agro-farms when mediated by inventory accuracy.**2.2 Use of mobile applications for inventory control and profitability of agro-farms**

Inventory management applications using mobile technology may be understood as digital inventory tracking applications run on mobile phones and tablets that help record agricultural inventory items such as seeds, fertilizers, crops harvested and inputs utilized in agriculture. Mobile inventory applications include inventory stock management using mobile applications, farm inventory using the cloud, internet of things inventory management application, barcode/QR code inventory management, and SMS/USSD inventory management of agricultural activities (Mashayekhy et al., 2022; Yao & Sun, 2020; Yoraeni et al., 2025). Digital inventory management

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includes applications such as inventory management using mobile devices that intend to provide real-time information about agricultural inventory, reduce chances of inventory error in recording information, and allow for better decision-making in regards to agricultural activities. The introduction of digital inventory systems within agro-farms is believed to help with improving the overall coordination in the business activities through better tracking of agricultural stock usage patterns. According to Ashoka et al. (2023), digitalization of agricultural technologies could positively impact the process of production, though mobile applications for inventory management were not mentioned separately in their study. Likewise, according to Singh et al. (2023), use of mobile applications could change agronomic decision-making processes. However, it remains unclear whether mobile applications for inventory management could directly affect the profitability of agro-farm business activity.

The use of mobile applications for managing inventory may impact the bottom line through cost reduction, effective resource management, and agricultural waste minimization, even if most literature on the topic does not provide any empirical proof of this assumption. Flores et al. (2025) suggest that innovations in agricultural inventory management systems minimize waste and promote sustainable development practices in the supply chain, which may lead to positive financial outcomes; however, the effect on profitability is not examined empirically. According to Kalimoldayev et al. (2024), digital inventory systems facilitate proper inventory management through planning and resource monitoring, even though this argument is largely conceptual. Indirectly, other pieces of evidence in non-agriculture settings can be used to prove a positive impact on profitability and cost reduction. For instance, Ali et al. (2024) demonstrate that using digital systems to manage inventory improves its efficiency in manufacturing organizations, while according to Meda (2021), predictive inventory systems in retailing decrease operational inefficiency. Nevertheless, this type of evidence is not sufficiently strong since mobile applications have not been discussed as well as profitability in agriculture. As Rotz et al. (2019) emphasize, the effect of technological innovation depends on access to infrastructure and resources. Hence the hypothesis that:

H2: The use of mobile applications for inventory control has a positive effect on profitability of agro-farms.

### 2.3 Use of software for inventory control and expansion of agro-farms

Inventory management software is defined in existing literature as an integrative technological platform employed to organise and optimise information related to inventory processes in agriculture and the supply chain. This class of software encompasses inventory management websites, cloud applications, digital twins, prediction algorithms, and digital supply chains software applications (Yoraeni et al., 2025; Baylosis et al., 2023; Meda, 2021). From the perspective of agro-farms, implementation of such software is presumed to assist in planning of input materials, tracking of stock levels, and coordinating of resources, thus creating a favourable

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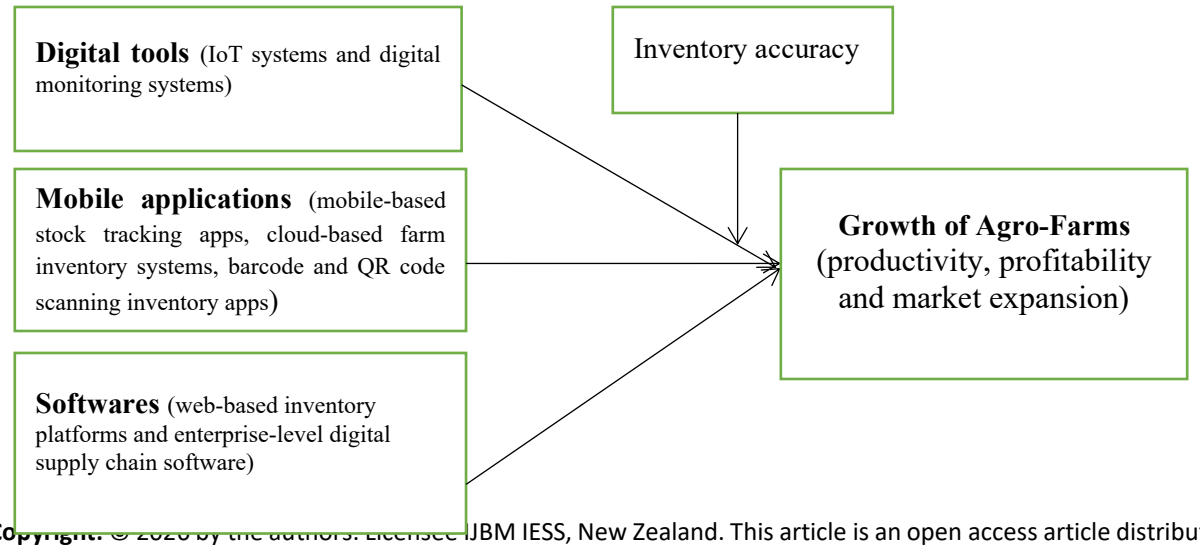
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environment for business growth and expansion. As stated by Kalimoldayev et al. (2024), inventory optimisation software enables effective planning and control of resources. Further, Kukartsev et al. (2023) mention that the use of digital twin software can lead to more accurate inventory modelling and organisational coordination. However, no specific information exists concerning application of such software in the context of agro-farm development and growth. Overall, the connection between these two variables remains poorly established due to lack of evidence of business scaling and expansion facilitated by the use of inventory software.

Research indicates that software-based inventory management systems might be helpful for the growth of agro-farms indirectly due to increased efficiencies, less wastage, and improved supply chain integration. For instance, Flores et al. (2025) claim that new improvements within the framework of agricultural inventory management systems could minimize wastages and increase the level of sustainability in supply chains. However, the authors do not measure direct business growth capacity. Ali et al. (2024) prove that there are positive impacts of digital supply chain systems on the effectiveness of inventory management and scalability within organizational activities. However, the analysis is conducted based on engineering firms, and not agriculture. Similarly, Sharma and Reddy (2025) state that there are positive impacts of digital systems on transparency and operational intelligence within farm operations, but they are limited only to dairy production. Research by Chen and Zhou (2025) indicates that there are positive effects of digital inventory management systems on operational efficiency among industrial enterprises. Still, it is unclear how those advantages can be transferred into agriculture. The research by Rotz et al. (2019) indicates that the effects of digital agriculture depend heavily on technological infrastructure and the context of implementation. Thus, we formulated the hypothesis that:

H3: The use of software for inventory control has positive effect on market expansion of agro-farms.

**Figure 1. Conceptual Framework**




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## 3. Methodology

### 3.1 Research Design

This study adopted a survey research design to examine the effect of digital management systems on the growth of agro-farms in Cross River State, Nigeria. The study was guided by a positivist research philosophy, which assumes that social and operational phenomena can be observed, measured, and analysed using objective indicators (Ali, 2024; Park et al., 2020). The study specifically focused on three key relationships: digital tools for inventory control and productivity, mobile applications for inventory control and profitability, and software systems for inventory control and mark expansion of agro-farms. A hypothetico-deductive approach was followed, where relationships derived from existing literature were tested using empirical data collected from agro-farm operators in the study area.

### 3.2 Sampling and Data Collection

Primary data were collected using a structured questionnaire administered to owners and managers of agro-farms. The questionnaire was distributed both physically and electronically to ensure wider coverage and inclusion of respondents with varying levels of digital access. Data collection was carried out over a defined period (February to August 2025) to capture current practices in digital inventory management within agro-farming operations. The target population consisted of registered and active agro-farm operators involved in crop production, livestock farming, and mixed farming activities. A stratified random sampling technique was used to ensure representation across different types and sizes of agro-farms. This approach was adopted to reduce sampling bias and ensure that both small-scale and medium-scale farms were included in the study. A total of 450 questionnaires were distributed, and 364 valid responses were returned, representing an 80.89% response rate.

A pilot test was conducted using 200 agro-farm operators outside the final sample frame to assess clarity, relevance, and reliability of the research instrument. Feedback from the pilot study led to minor adjustments in wording and structure of the questionnaire. To reduce the risk of common method bias, Harman's single-factor test was applied, and the results indicated that no single factor accounted for the majority of the variance, suggesting that common method bias was unlikely to significantly affect the findings. Non-response bias was assessed by comparing early and late respondents using independent sample tests, and no significant differences were observed, indicating that non-response bias was not a major concern in the dataset.

**Table 1. KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .824 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 14594.562 |

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| | | |
|---|---|---|
| | Df | 1225 |
| | Sig. | .000 |

Source: SPSS 25.0

The KMO value of 0.824 indicates adequate sampling adequacy, while Bartlett's Test of Sphericity was significant ($\chi^2 = 14594.562$, $p < 0.001$), showing that the data were suitable for factor analysis.

### 3.3 Research Instruments

The research instrument was a structured questionnaire designed around three main constructs aligned with the study objectives: digital tools for inventory control, mobile applications for inventory control, software systems for inventory control, and agro-farm growth indicators (productivity, profitability, and expansion). Each construct was measured using multiple items adapted from validated scales in digital agriculture and inventory management literature, with slight modifications to reflect the agro-farm context in Nigeria. Digital tools for inventory control were measured using items adapted from studies on IoT and agricultural monitoring systems (Mashayekhy et al., 2022; Ashoka et al., 2023). Mobile applications for inventory control were measured using items informed by mobile-based agricultural systems and digital advisory tools (Singh et al., 2023; Yao & Sun, 2020). Software systems for inventory control were measured using items adapted from studies on web-based systems, digital twins, and inventory optimisation platforms (Kukartsev et al., 2023; Yoraeni et al., 2025). Agro-farm growth was measured using indicators of productivity, profitability, and expansion derived from agricultural performance and supply chain studies (Flores et al., 2025; Kalimoldayev et al., 2024). All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), ensuring consistency in responses and ease of interpretation. The instrument was evaluted for construct validity and reliability (see Table 2).

### 3.4 Data Analysis Techniques

The collected data were coded, screened, and analysed. Data on the demographic characteristics of respondents were analysed using descriptive statistics. The inferential statistics was employed to enable a logical deduction. Multiple regression analysis was used to test hypotheses at 5% level of significance. Prior to the main analysis, the data were examined for completeness, missing values, and entry errors to ensure accuracy and consistency. Reliability analysis was conducted using Cronbach's Alpha coefficient. A Cronbach's Alpha value of 0.70 or higher was considered acceptable for internal consistency (Nawi et al., 2023; Stensen & Lydersen, 2022). Construct validity was conducted. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were used to assess the suitability of the data for factor analysis (see Table 1). A KMO value above 0.50 and a significant Bartlett's Test ($p < 0.05$) were considered evidence that factor analysis was appropriate.

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**4. Data Analysis and Results**In this section, results are interpreted accordingly. Note that ION= IoT systems; DMS= Digital monitoring systems; MST= Mobile-based stock tracking apps; CFS= Cloud-based farm inventory systems; BQR= Barcode and QR code scanning inventory apps; WIP= Web-based inventory platforms; EDS= Enterprise-level digital supply chain software; PAF= Productivity of agro-farms; PRA= Profitability of agro-farms; MEA= Market expansion of agro-farms

**Table 2. Validity and Reliability of Instrument**

| Indicator Variable | Loading | AVE | CR | Chron (α) |
|---|---|---|---|---|
| ION1 | 0.979 | 0.836 | 0.914 | 0.978 |
| ION2 | 0.913 | | | |
| ION3 | 0.868 | | | |
| ION4 | 0.935 | | | |
| ION5 | 0.872 | | | |
| DMS1 | 0.980 | 0.840 | 0.916 | 0.976 |
| DMS2 | 0.926 | | | |
| DMS3 | 0.930 | | | |
| DMS4 | 0.890 | | | |
| DMS5 | 0.851 | | | |
| MST1 | 0.921 | 0.775 | 0.881 | 0.962 |
| MST2 | 0.903 | | | |
| MST3 | 0.884 | | | |
| MST4 | 0.891 | | | |
| MST5 | 0.799 | | | |
| CFS1 | 0.971 | 0.784 | 0.886 | 0.962 |

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| | | | | |
|---|---|---|---|---|
| CFS2 | 0.917 | | | |
| CFS3 | 0.909 | | | |
| CFS4 | 0.743 | | | |
| CFS5 | 0.872 | | | |
| BQR1 | 0.986 | 0.888 | 0.942 | 0.983 |
| BQR2 | 0.887 | | | |
| BQR3 | 0.898 | | | |
| BQR4 | 0.977 | | | |
| BQR5 | 0.960 | | | |
| WIP1 | 0.916 | 0.729 | 0.854 | 0.973 |
| WIP2 | 0.769 | | | |
| WIP3 | 0.812 | | | |
| WIP4 | 0.880 | | | |
| WIP5 | 0.883 | | | |
| EDS1 | 0.947 | 0.696 | 0.834 | 0.944 |
| EDS2 | 0.569 | | | |
| EDS3 | 0.874 | | | |
| EDS4 | 0.899 | | | |
| EDS5 | 0.828 | | | |
| PAF1 | 0.664 | 0.606 | 0.779 | 0.888 |
| PAF2 | 0.844 | | | |
| PAF3 | 0.896 | | | |

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| | | | | |
|---|---|---|---|---|
| PAF4 | 0.852 | | | |
| PAF5 | 0.592 | | | |
| PRA1 | 0.840 | 0.528 | 0.726 | 0.883 |
| PRA2 | 0.769 | | | |
| PRA3 | 0.524 | | | |
| PRA4 | 0.836 | | | |
| PRA5 | 0.606 | | | |
| MEA1 | 0.794 | 0.506 | 0.711 | 0.919 |
| MEA2 | 0.794 | | | |
| MEA3 | 0.575 | | | |
| MEA4 | 0.568 | | | |
| MEA5 | 0.729 | | | |

Source: Pilot survey (2025)

The results in table 2 shows that composite reliability ranges from 0.711 to 0.942. The AVE also ranges from 0.506 to 0.888. The AVE values are greater than 0.50, and the CR is greater than 0.70. These simply mean that the measured items have profound explanation for the constructs. The Cronbach's alpha values for the constructs are greater than 0.70; meaning that the instrument is reliable.

**Table 3. Discriminant Validity**

| | Mean | Std. Deviation | ION | DMS | MST | CFS | BQR | WIP | EDS | PAF | PRA | MEA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ION | 16.41 | 5.83 | .978 | .097 | .056 | .088 | .171 | .088 | .110 | .393 | .032 | .002 |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DMS | 17.86 | 4.80 | .097 | .976 | .005 | .174 | .112 | .060 | .016 | .101 | .199 | .036 |
| MST | 17.12 | 4.99 | .056 | .005 | .962 | .117 | .085 | .020 | .026 | .079 | .320 | .044 |
| CFS | 17.16 | 4.83 | .088 | .174 | .117 | .962 | .042 | .088 | .112 | .018 | .368 | .051 |
| BQR | 17.22 | 4.77 | .171 | .112 | .085 | .042 | .983 | .010 | .027 | .136 | .046 | .025 |
| WIP | 17.63 | 4.97 | .088 | .060 | .020 | .088 | .010 | .973 | .060 | .037 | .082 | .753 |
| EDS | 17.76 | 4.57 | .110 | .016 | .026 | .112 | .027 | .060 | .944 | .131 | .031 | .279 |
| PAF | 17.76 | 4.57 | .393 | .101 | .079 | .018 | .136 | .037 | .131 | .888 | .077 | .007 |
| PRA | 17.31 | 4.53 | .032 | .199 | .320 | .368 | .046 | .082 | .031 | .077 | .883 | .047 |
| MEA | 17.62 | 4.39 | .002 | .036 | -.044 | .051 | .025 | .753 | .279 | .007 | .047 | .919 |

Source: Pilot survey (2025)

Table 3 shows the discriminant validity using the Fornell-Larcker criterion. It can be seen from the results that the values on the diagonal in the constructs, which represent the square root of the average variance extracted, are higher than the correlation between the constructs. It proves that each construct is independent. This means that discriminant validity exists in the study. This is because each construct measures different constructs with respect to the items.

**Table 4. Demographics of Respondents**

| **Demography** | **Frequency** | **Percent** |
|---|---|---|
| **Age** | | |
| < 20 | 29 | 19.0 |

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| | | |
|---|---|---|
| 21–30 | 89 | 32.5 |
| 31–40 | 146 | 33.0 |
| > 41 | 100 | 15.5 |
| **Educational Level** | | |
| Secondary school cert. | 10 | 8.5 |
| NCE/ND | 97 | 36.0 |
| First Degree | 151 | 29.5 |
| Postgraduate | 106 | 26.0 |
| **Work Experience** | | |
| < 5 years | 27 | 23.0 |
| 6–8 years | 94 | 37.5 |
| 9–12 years | 143 | 28.5 |
| > 12 years | 100 | 11.0 |
| **Agro-farm operators** | | |
| Crop production | 115 | 52.5 |
| Livestock farming | 110 | 47.5 |
| Mixed farming activities | 139 | |

**Source:** Field survey, 2025

Table 4 shows that the largest proportion of respondents were between 31 and 40 years (33.0%), followed closely by those aged 21–30 years (32.5%), suggesting that most agro-farm operators are within the economically active and productive age bracket. The majority possessed NCE/ND qualifications (36.0%), while a substantial number held first degrees (29.5%) and postgraduate qualifications (26.0%). This implies that most respondents had sufficient educational exposure to understand and potentially adopt digital management systems in their farming operations. Most respondents had between 6 and 8 years of experience (37.5%), followed by those with 9–12 years

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of experience (28.5%), indicating that the respondents possessed practical knowledge of agro-farm management and inventory-related activities. The distribution of farming activities further shows that respondents were involved in crop production (52.5%), livestock farming (47.5%), and mixed farming activities, providing perspectives from different agricultural sectors. This diversity strengthens the study because it captures the views of agro-farm operators with varying backgrounds and experiences.

**Table 5. Digital tools for inventory control and productivity of agro-farms**

| **PAF** | **ION** | | **DMS** | |
|---|---|---|---|---|
| | **Direct Effect** | **Indirect Effect** | **Direct Effect** | **Indirect Effect** |
| Coefficient | 0.531 | 0.533 | 0.536 | 0.540 |
| Std. Error | 0.041 | 0.034 | 0.057 | 0.044 |
| t-Statistic | 13.108 | 15.603 | 9.378 | 12.186 |
| P-value | <0.001 | <0.001 | <0.001 | <0.001 |

R2= 0.520; F-statistic= 195.162; Durbin-Watson stat= 1.847; P-value = 0.001

Note: Inventory accuracy serves as mediating variable.

Table 5 shows that digital tools for inventory control have a meaningful effect on the productivity of agro-farms. The $R^2$ (0.520) shows that about 52% of the variation in agro-farm productivity is explained by the use of digital inventory tools, while the remaining 48% is due to other factors not captured in the model. The F-statistic (195.162) with a p-value of 0.001 confirms that the overall model is statistically significant, meaning the relationship observed is unlikely to have occurred by chance. The Durbin–Watson statistic (1.847) suggests that there is no serious problem of autocorrelation in the residuals, indicating that the model estimates are reliable.

IoT systems have a positive and significant direct effect on agro-farm productivity ($\beta = 0.531$, $t = 13.108$, $p < 0.001$). This indicates that greater use of IoT-based technologies is associated with higher levels of productivity among agro-farms. The strength of the coefficient suggests a moderate to strong positive relationship, implying that IoT systems may contribute to improved monitoring, tracking, and management of inventory-related activities, which can support more efficient farm operations. The statistical significance of the result provides strong evidence that the observed relationship is unlikely to have occurred by chance. The results also reveal a positive and significant indirect effect ($\beta = 0.533$, $t = 15.603$, $p < 0.001$), which is slightly larger than the direct effect. This suggests that IoT systems may influence productivity not only through their immediate impact on inventory control processes but also through inventory accuracy.

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The results indicate that digital monitoring systems have a positive and statistically significant direct effect on agro-farm productivity (β = 0.536, t = 9.378, p < 0.001). The results suggests that increased use of digital monitoring systems is associated with higher productivity levels among agro-farms. The magnitude of the coefficient indicates a substantial positive relationship, implying that digital monitoring systems may enhance farm productivity by providing timely information on inventory levels, improving oversight of farm resources, and supporting more efficient inventory control practices. The highly significant p-value further confirms that the observed relationship is unlikely to be due to random variation. The results also show a positive and statistically significant indirect effect through inventory accuracy (β = 0.540, SE = 0.044, t = 12.186, p < 0.001). Notably, the indirect effect is slightly stronger than the direct effect, suggesting that inventory accuracy plays an important role in explaining how digital monitoring systems contribute to agro-farm productivity. This implies that digital monitoring systems improve productivity partly because they enhance the accuracy of inventory records, enabling agro-farm operators to make better decisions regarding stock management, input utilization, replenishment planning, and resource allocation.

**Table 6. Mobile applications for inventory control and profitability of agro-farms**

| Variable | Coefficient | Std. Error | t-Statistic | P-value |
|---|---|---|---|---|
| C | -2.046 | 0.853 | -2.397 | 0.017 |
| MST | 0.840 | 0.032 | 26.153 | 0.001 |
| CFS | 0.096 | 0.032 | 3.055 | 0.002 |
| BQR | 0.162 | 0.032 | 5.048 | 0.001 |

R-squared= 0.697; F-statistic= 276.488; Durbin-Watson stat= 1.517; P-value (F-stat) = 0.001

Table 6 shows that mobile applications for inventory control have a strong and significant relationship with the profitability of agro-farms. The $R^2$ (0.697) shows that approximately 69.7% of the variation in agro-farm profitability is explained by the use of mobile inventory applications, while about 30.3% is influenced by other factors not included in the model. The F-statistic (276.488) with a p-value of 0.001 confirms that the overall regression model is statistically significant, indicating that the explanatory variables jointly have a meaningful effect on profitability. The Durbin–Watson statistic (1.517) suggests a mild possibility of positive autocorrelation, though it is not severe enough to invalidate the model's results.

The regression results in Table 6 indicate that mobile applications for inventory control have a statistically significant positive effect on the profitability of agro-farms. The constant term (β = -2.046, p = 0.017) suggests that, in the absence of the listed digital tools, profitability would be

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negative and statistically significant at the 5% level. The use of mobile-based stock tracking applications shows a strong positive and highly significant relationship with profitability (β = 0.840, t = 26.153, p < 0.001). The result shows that 84% change in the use of mobile-based stock tracking applications will result to proportional mean change in profitability. This indicates that mobile-based stock tracking applications is the most influential predictor among the variables considered. Similarly, cloud-based farm inventory systems also exhibit a positive and significant effect on profitability (β = 0.096, t = 3.055, p = 0.002). That is, 9.6% change in cloud-based farm inventory systems will lead to same mean change in profitability. Barcode and QR code scanning inventory applications demonstrate a positive and significant contribution to profitability (β = 0.162, t = 5.048, p < 0.001). This also shows that 16.2% increase in barcode and QR code scanning inventory applications will result to proportional increase in profitability. This further confirms the beneficial role of automated tracking technologies.

**Table 7. Software for inventory control and market expansion of agro-farms**

| Variable | Coefficient | Std. Error | t-Statistic | P-value |
|---|---|---|---|---|
| C | 0.387 | 0.949 | 0.408 | 0.684 |
| WIP | 0.419 | 0.035 | 11.949 | 0.001 |
| EDS | 0.558 | 0.038 | 14.660 | 0.001 |

R-squared= 0.502; F-statistic= 181.964; Durbin-Watson stat= 1.694; P-value (F-stat)= 0.001

Table 7 shows a significant relationship between the variables in the model. The coefficient of determination ($R^2$ = 0.502) shows that approximately 50.2% of the variation in the dependent variable is explained by the independent variables, while the remaining 49.8% is attributed to factors not captured in the model. The F-statistic (181.964) with a p-value of 0.001 confirms that the overall model is statistically significant, indicating that the explanatory variables jointly have a meaningful effect on the outcome variable. The Durbin–Watson statistic (1.694) suggests that there is no serious autocorrelation problem in the residuals, as the value is close to 2.

The constant term (β = 0.387, p-value = 0.684) is not statistically significant, indicating that baseline market expansion is not different from zero when the explanatory variables are not considered. The use of web-based inventory platforms has a positive and significant effect on market expansion (β = 0.419, t = 11.949, p < 0.001), showing that their use is strongly associated with improved market reach. This means that 41.9% change in the use of web-based inventory platforms will lead to about 41.9% mean change in market expansion. Similarly, the use of enterprise-level digital supply chain software has stronger positive and highly significant effect on market expansion (β = 0.558, t = 14.660, p < 0.001). That is, 55.8% change in the use of enterprise-

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level digital supply chain software will bring about 55.8% mean change in market expansion. The results indicate that the use of enterprise-level digital supply chain software is a stronger factor in expanding agro-farm markets among the variables examined.

### 4.1 Discussion of Findings

H1: Digital tools for inventory control has positive effect on productivity of agro-farms when mediated by inventory accuracy.

The study showed that the use of digital tools for inventory control in agro-farms, including IoT systems, mobile applications, and digital monitoring platforms, both have a positive and significant effect on productivity outcomes in agricultural operations. In Agricultural Innovation Studies, these digital tools are important because they improve real-time tracking of inputs, reduce wastage, and support better decision-making in farm management, which directly contributes to higher productivity levels. This supports the finding by Balachandar et al. (2022) that IoT-based agricultural systems improve monitoring and coordination in farm production processes, leading to better output performance. It is also consistent with Singh et al. (2023) who reported that mobile-based digital advisory and tracking systems improve farming practices and efficiency, which strengthens overall productivity outcomes. Broader evidence from Klerkx et al. (2019) and Ashoka et al. (2023) confirms that digital agriculture technologies consistently enhance productivity by improving information flow, precision farming practices, and resource management efficiency.

Finding indicates that the use of mobile applications for inventory control has a positive and significant effect on the profitability of agro-farms. In Agricultural Economics, these mobile systems are important because they reduce stock losses, improve cost efficiency, and support faster market decisions, which all contribute to higher profit levels. This is supported by Kalimoldayev et al. (2024) who explain that digital inventory management improves stock optimization and reduces operational inefficiencies, leading to better financial outcomes. Similarly, Chen and Zhou (2025) found that digital inventory systems enhance control over supply chains and improve overall business performance. Sharma and Reddy (2025) also show that integrated digital tools improve traceability and operational efficiency, which strengthens income generation. Flores et al. (2025) and Yao and Sun (2020) confirm that improved inventory systems reduce post-harvest losses and improve supply chain performance. Additional support is provided by Mashayekhy et al. (2022), who highlight that IoT and mobile-based systems significantly improve inventory efficiency across sectors, reinforcing the finding that mobile applications are a key driver of profitability in agro-farms through inventory accuracy.

H2: The use of mobile applications for inventory control has a positive effect on profitability of agro-farms.

Findings indicate that the application of mobile technology in inventory management has high positive impacts on the profits of agro-farms. This finding is consistent with that of Singh et al.

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(2023) who found that mobile based advisories made a positive impact on the practice of agriculture in Southern India. This reinforces the assertion that mobile technology is reinforcing farm performance. They also found that mobile stock tracking apps are closely associated with profitability, with a positive correlation. This is in line with the work of Mashayekhy et al. (2022) that real-time tracking can enhance the accuracy of their applications on IoT. It also helps in the reduction of losses. Both are conducive to greater profitability. The study also revealed positive and significant effects of farm inventory systems through the cloud on profitability. This is consistent with Ali et al. (2024) who claimed engineering companies found digital supply chain tools to benefit their inventory management processes. This indicates that it has a lot of applications in many industries. One of them is agriculture. The findings also indicate that scanning apps for the barcode and QR code help to increase profit. This confirms Flores et al. (2025) who pointed out that agricultural supply chain digital inventory tools can help decrease food waste. They are also effective in enhancing the utilization of resources. This results in improved financial performance for farms on both of these aspects.

H3: The use of software for inventory control has positive effect on market expansion of agro-farms.

Findings indicate a significant positive effect of software-based application in the agro-farm market expansion in relation to inventory control. This finding is in line with Yoraeni et al. (2025) who found that an online inventory management system increased operational efficiency. Enhanced efficiency provides a basis for business expansion. This finding further confirms that of Baylosis et al. (2023) who found comparable advantages for businesses in their research of web-based inventory control systems. This is further reinforced by the fact that the findings indicate that the web based inventory platforms have a positive and significant impact on market expansion. It is also similar to Sharma and Reddy (2025) who discovered that the use of digital technologies enhanced transparency in farm operations. This also enhanced general performance. These improvements will enable farms to gain access to new markets. Ali et al. (2024) found the same overall trend that enterprise-level digital supply chain software has a greater impact on market expansion. They found that engineering companies using digital supply chain technologies increased inventory management effectiveness. The better the inventory management, the bigger the operation can be. It may also be used to gain access to new markets. This finding is also in line with Flores et al. (2025) who claimed that advanced inventory tools in agricultural supply chains optimise the use of resources. Increased use of resources can enhance a farm's growth potential. Digital and enterprise-level software tools are important tools for supporting agricultural enterprises to enter new markets.

## 5. Conclusion

This study concludes that digital management systems can contribute to growth of agro-farms. Replacing paper with electronic tools for inventory control helps to increase productivity. This is

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achieved by using inventory accuracy. Having accurate records on hand aids in decision making for farm managers. Such decisions result in increased productivity. The study also confirms that improving profitability is a benefit of inventory control applications on mobile devices. Mobile tools help farmers keep track of stock more efficiently. This efficiency helps to minimize losses and promote positive financial results. Moreover, software for inventory control can aid in market expansion. Digital tools can provide the organization necessary to keep more livestock on the farm. This enables the farmers to enter new markets with assurance. However, this study provides the evidence that digital and mobile based inventory systems are useful for agro-farms.

### 5.1 Recommendations

The study recommends as follows:

i. Digital inventory solutions to enhance accuracy are recommended for agro-farm managers. Training on digital tools for inventory control is important and should be done regularly by the staff. Safe and proper data input should be adhered to throughout the stock handling process. Periodic audits also should be conducted on farms. These audits can verify that digital records are accurate with regard to actual stock. This will help sustain the positive link between inventory accuracy and productivity.

ii. Mobile apps are the solution for agro-farm owners for everyday inventory activities. These tools must be easy to operate. This will help in full adoption by farm workers. It is also recommended that the farms have access to a reliable internet connection in farm locations. This will help mobile apps to run smoothly. Owners should monitor their profits on a frequent basis. This will give them a sense of the direct value of mobile inventory tools.

iii. For agro-farms with ambitions to expand into new markets, it is essential to invest in good inventory management software. This software ought to have a large quantity of stock. It should also be connected with the sales and distribution channels. Before scaling up its operations, farm managers should train their personnel in the software. This will decrease the chances of error during growth. Farms should also regularly check the software systems in place. This will allow the systems to continue to sustain the market's growth.

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