UNRAVELING THE ROLE OF MOBILE PHONES IN TRANSFORMING AGRICULTURAL SUPPLY CHAINS USING TECHNOLOGY ACCEPTANCE MODEL

Abstract

The integration of mobile phones into agricultural supply chains has become a pivotal force in reshaping traditional practices and processes. This study aims to unravel the role of mobile phones in transforming agricultural supply chains using the Technology Acceptance Model (TAM) as a theoretical framework. By analyzing the adoption patterns and impact of mobile phones on various stakeholders, including farmers, traders, suppliers and consumers, this study explores the transformative potential of mobile technology. Real-world case studies and empirical data are employed to provide a nuanced understanding of how mobile phone adoption improves efficiency, decision-making and coordination throughout agricultural supply chains. The findings contribute valuable insights for policymakers, researchers, and stakeholders seeking to harness the full potential of mobile phones to drive sustainable development and inclusive growth within agricultural supply chains.

Keywords: Mobile phones, Agricultural supply chains, Technology Acceptance Model (TAM).

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I. INTRODUCTION

In recent years, the agricultural sector has undergone a transformative shift, with mobile phones emerging as a powerful tool reshaping traditional practices and supply chain dynamics. As mobile phone penetration continues to rise globally, integrating these devices into agriculture opens new avenues for enhancing productivity, transparency, and sustainability throughout the supply chain (Burrell, 2017; Kosinski & Siciliano, 2018). This study aims to highlight the pivotal role of mobile phones in agricultural supply chains through a comprehensive examination, utilizing the Technology Acceptance Model (TAM) framework to appreciate implementation patterns and assess the impact on stakeholders and processes.

The rapid espousal of mobile phones in the agricultural sector, particularly among farmers, traders, suppliers and other supply chain intermediaries has been observed. Farmers are leveraging mobile technology to access instantaneous information on weather forecasts, market prices, and best farming practices that helps in decision-making and optimization of farming activities (Labrique et al., 2013; Zehir et al., 2020). Additionally, mobile phones facilitate seamless communication, enhancing collaboration and efficiency in the exchange of goods and services among supply chain participants (Reardon et al., 2017; Birhanu et al., 2021). Mobile phones empower smallholder farmers by providing access to financial services like mobile banking and digital payment platforms, promoting financial inclusion and smoother transactions (Duclos & Duhaney, 2015; Fawzi et al., 2021). Moreover, mobile phones have opened doors to e-commerce platforms, connecting farmers directly to consumers, eliminating intermediaries, and promoting fairer prices and better market access for small-scale producers (Bellemare et al., 2017; Kaushal & Chahal, 2019).

Despite these opportunities, the study acknowledges challenges associated with mobile phone adoption in rural and agricultural settings. Limited digital literacy, network coverage and affordability are potential barriers that may hinder widespread uptake among members in the agricultural supply chain (Qureshi et al., 2016; Chipeta et al., 2020). Addressing these challenges is vital to fully unlock the transformative potential of mobile technology in agriculture. Introducing the TAM framework, this study aims to evaluate perceived usefulness (PU) and perceived ease of use (PEOU) of mobile phones in agricultural activities. PU reflects users' belief in mobile phones' ability to enhance performance and productivity, while PEOU gauges users' perception of ease in incorporating mobile phones into daily farming operations. By applying TAM, this study seeks to identify key drivers influencing farmers' intentions to adopt and integrate mobile phones in their supply chain activities.

Conducting a comprehensive study across diverse agricultural contexts, the study aims to provide valuable insights for policymakers, researchers, and stakeholders. Utilizing real-world case studies, surveys and empirical data analysis, the study seeks to harness the full potential of mobile technology to foster sustainable agricultural development and promote inclusive growth within supply chains.

II. LITERATURE REVIEW

Since Independence, Agriculture has served as the foundation of India's economy and its agricultural prowess has been noteworthy even prior to that time. At present, India commands around 12 percent of the global arable land, positioning it as a major player as the third-largest food grain producer, second-largest fruits and vegetables producer, and the largest milk producer worldwide. Furthermore, India boasts the highest number of livestock and enjoys the advantages of diverse agro-climatic regions that facilitate a wide array of agricultural produce (Sazzad, 2014). The emphasis on economic reforms and liberalization within the agricultural sector has highlighted the crucial need to revolutionize Indian agriculture. This transformation entails establishing a holistic supply chain model that integrates innovative practices at the farming level, empowering farmers to attain sustainable profitability even amid evolving circumstances. Simultaneously, it involves establishing suitable market arrangements and providing necessary support to ensure the success of these endeavors (Sazzad Parwez, 2014).

In developing regions, the role of smallholder farmers in agriculture is crucial, underscoring the need to empower them with knowledge, information and essential services to enhance their farming practices (Anderson & Feder, 2004). However, farmers in remote villages face challenges due to limited infrastructure, which hampers their access to these vital resources (Fu & Akter, 2016). To bridge this knowledge gap, agricultural extension services serve as a vital tool by facilitating the transfer of valuable insights, advice and education on new farming technologies and best practices (Jack, 2011). Regrettably, due to limited access to information, knowledge and necessary inputs, many farmers still resort to sub-optimal practices. In India, a significant majority of resource-poor farmers lack access to state-funded services, with nearly sixty percent unable to benefit from them (Ferroni & Zhou, 2012). Ensuring equitable access to knowledge and agricultural services for smallholder farmers, particularly those in remote areas, becomes crucial for promoting sustainable and effective farming practices and driving positive change in the agricultural sector (Fu & Akter, 2016). Extension workers play a critical role in efficiently gathering and disseminating diverse information to support small producers (Ogutu, Okello, & Otieno, 2014). Farmers demand access to market updates, farm management insights, and knowledge about handling pests, diseases and pesticides (Cole & Fernando, 2012). Mobile phones have the potential to play a pivotal role in this context (Aker, 2011). However, their integration into agriculture remains limited, leaving marginalized farmers, women and those in remote areas excluded from their benefits (Fu & Akter, 2016). The emergence of mobile phones equipped with audio and video capabilities holds the promise of resolving this problem by facilitating two-way communication between farmers and service providers. This empowering technology allows farmers to directly share their issues and receive effective assistance (Aker, 2011).

Today, smart phones equipped with internet connectivity and touch screens have achieved extensive usage and integration into modern societies worldwide. It is estimated that approximately two billion people own smart phones, and projections suggest that by the year 2020, around 80% of the global population will be smart phone users (Dehnen-Schmutz et al., 2016). A vast number of apps are accessible to support farmers; however, only a limited few make use of the built-in sensors in smart phones to offer agricultural solutions (Pongnumkul et al. 2015). Supply chain management in agriculture is a relatively novel concept in the field of agribusiness. Although the supply chain has been a longstanding

aspect of the agricultural industry, recent developments have led to new methodologies for analyzing the organization and dynamics of agri-food networks (Espolov et al., 2020).

The Agricultural Supply Chain (ASC) encompasses a flow starting from suppliers providing inbound materials and services for farm-level operations, ultimately leading to customer satisfaction through various distribution channels. Researchers have proposed diverse supply chain models for different agricultural products, such as dairy, grains, vegetables, meat/fish, flowers, and fruits. Literature reviews have identified enablers, barriers, and performance indicators related to ASC and have suggested various methodologies to manage these factors and improve ASC performance (Routroy & Behera, 2017). A study by Rais and Sheoran (2015) found that certain factors affect the performance of ASC, including the absence of cold storage facilities, inadequate government policies, poor connectivity, lack of sorting and grading technology, subpar handling and packaging practices, unskilled labor, and weaknesses in marketing channel linkages and facilities. The literature also reveals that a significant portion of 30-35 per cent, of all produced food goes to waste due to inefficiencies in infrastructure and the food processing industry (Parwez, 2014).
The transformative impact of mobile phones in transforming agricultural supply chains is evident from research exploring the opportunities, challenges, and impact of mobile technology adoption in agriculture (Kaushal & Chahal, 2019; Birhanu et al., 2021). Mobile phones empower smallholder farmers, streamline supply chain operations, and promote sustainability in agriculture. They facilitate streamlined communication and coordination among supply chain actors, leading to reduced transaction costs and minimized post-harvest losses.

Additionally, mobile phones play a crucial role in promoting sustainable farming techniques, providing financial inclusion, and disseminating market opportunities (Bellemare et al., 2017; Fawzi et al., 2021). Despite the promising potential, researchers have also identified several challenges in the widespread adoption of mobile technology in agriculture (Labrique et al., 2013; Chipeta et al., 2020). The digital divide, limited connectivity in rural areas, affordability concerns and data privacy and security issues pose obstacles to effective mobile phone usage. Addressing these challenges requires targeted efforts such as providing digital literacy training and ensuring affordable access to mobile technology and data services.

In conclusion, the literature review highlights the transformative impact of mobile phones in agricultural supply chains. Future research should continue to explore innovative solutions and policy interventions to optimize the benefits of mobile technology for sustainable agricultural development.

III. METHODOLOGY

1. **Conceptual Framework:** TAM is a well-established theoretical framework used to understand and predict users' acceptance and adoption of technology. In this context, the focus is on examining the role of mobile phones in transforming agricultural supply chains.

    - **Perceived Usefulness (PU):** This component of TAM refers to the extent to which individuals believe that using mobile phones in agricultural supply chains will

enhance their efficiency, productivity, and decision-making capabilities (Davis, 1989).

- **Perceived Ease of Use (PEOU):** PEOU represents the degree to which individuals perceive that using mobile phones in agricultural supply chains is effortless and user-friendly (Davis, 1989).

- **Behavioral Intention to Use (BI):** Behavioral intention to use mobile phones in agricultural supply chains is the likelihood that individuals will adopt the technology based on their perceptions of usefulness and ease of use (Davis, 1989).

- **Actual Use (AU):** Actual use refers to the real-world implementation and adoption of mobile phones in agricultural supply chains by farmers, suppliers, and other stakeholders (Davis, 1989).

- **External Variables:** These may include factors external to TAM that influence the acceptance and adoption of mobile phones in agricultural supply chains. Examples include individual characteristics, organizational factors, and environmental factors (Venkatesh & Davis, 2000).

- **Transformation of Agricultural Supply Chains:** This represents the impact of mobile phone adoption on agricultural supply chains, including improvements in communication, access to market information, coordination, and efficiency (Ghobakhloo, 2011; Mandal et al., 2015).

2. Conceptual Pathways and Hypotheses

- **Perceived Usefulness (PU) → Behavioral Intention to Use (BI):** It is hypothesized that if farmers and other stakeholders perceive mobile phones as useful tools for improving their supply chain operations, they will be more inclined to adopt and use them.

- **Perceived Ease of Use (PEOU) → Behavioral Intention to Use (BI):** It is hypothesized that a user-friendly and easy-to-use mobile phone system will positively influence individuals' intention to use it in agricultural supply chains.

- **Behavioral Intention to Use (BI) → Actual Use (AU):** The behavioral intention to use mobile phones is expected to be a strong predictor of their actual adoption and usage in agricultural supply chains.

- **Perceived Usefulness (PU) → Transformation of Agricultural Supply Chains:** The extent to which mobile phones are perceived as useful will directly impact the transformation of agricultural supply chains, leading to improvements in various aspects like information flow, decision-making, and efficiency.

- **Perceived Ease of Use (PEOU) → Transformation of Agricultural Supply Chains:** If mobile phones are perceived as easy to use, it will facilitate their integration into agricultural supply chains and contribute to their transformation.

By applying the Technology Acceptance Model in the context of agricultural supply chains, this conceptual framework aims to provide valuable insights into the factors that influence the adoption and transformational impact of mobile phones in this sector.

- **Data Sources:** This study adopts a conceptual approach, drawing upon data from diverse secondary sources, including Academic Journals, Conference Proceedings, Books and E-books, Government Reports, Industry Reports, Databases, Institutional Repositories, Official Websites, and Publications.

3. **Theoretical Contributions:** Discuss the original contributions of the research by identifying new insights, perspectives, or connections among existing theories. Emphasize how the paper extends or challenges current theoretical paradigms.

- **Mobile Phone Adoption in Agricultural Supply Chains:** Mobile phone adoption in agricultural supply chains has emerged as a transformative and promising phenomenon, revolutionizing the way farmers and stakeholders engage in agricultural practices. Through the utilization of mobile phone technologies, farmers can access real-time information on market prices, weather forecasts, and agricultural best practices. This empowers them to make well-informed decisions and optimize their production processes (Kang & Chou, 2020). Mobile phone adoption facilitates seamless communication and coordination along the supply chain, connecting farmers with suppliers, traders, and consumers, thus reducing information asymmetries and enhancing market linkages (Babatunde & Qaim, 2019). Additionally, mobile applications and platforms have enabled efficient data collection and monitoring, leading to improved traceability, quality control, and sustainable agricultural practices (Murendo & Wollni, 2019). As mobile phone ownership continues to increase in rural areas, this technology has the potential to foster inclusive growth, poverty reduction, and sustainable agricultural development, positively impacting the livelihoods of millions of farmers worldwide (Kumar & Maity, 2017).

- **Impact on Supply Chain Efficiency and Effectiveness:** The adoption of mobile phones in supply chains has had a significant impact on both efficiency and effectiveness. Mobile technologies have streamlined communication and information exchange between different nodes in the supply chain, enabling faster decision-making and response times (Ramanathan & Gunasekaran, 2014). Real-time data access and sharing have improved inventory management, reduced stockouts, and minimized excess inventory, leading to more efficient operations and cost savings (Ngai et al., 2008). Additionally, mobile-enabled tracking and monitoring systems have enhanced supply chain visibility, allowing for better coordination and optimization of logistics and transportation processes (Akkucuk & Esnaf, 2019). These improvements in efficiency and effectiveness have resulted in enhanced customer satisfaction, reduced lead times, and increased overall supply chain

performance (Lambert & Cooper, 2000). Overall, the integration of mobile technology in supply chains has proven to be a crucial enabler for achieving higher levels of operational excellence and competitiveness in today's dynamic business environment.

- **Empowering Smallholder Farmers:** Empowering smallholder farmers is a crucial aspect of sustainable agricultural development and poverty reduction. Providing smallholder farmers with access to resources, knowledge, and technologies can significantly improve their productivity, livelihoods, and overall well-being. Financial inclusion through microfinance initiatives enables farmers to access credit, invest in improved farming practices and cope with risks and uncertainties (Gine & Yang, 2009). Access to extension services and agricultural training equips farmers with valuable knowledge on modern farming techniques, leading to increased crop yields and income (Asfaw et al., 2012). Additionally, the adoption of information and communication technologies, such as mobile phones and internet-based platforms, offers smallholders real-time market information, weather forecasts and access to agricultural best practices, empowering them to make informed decisions and optimize their farming operations (Kwadwo & Rajasekaran, 2021). By empowering smallholder farmers, societies can foster inclusive economic growth, reduce rural poverty and enhance food security, contributing to a more sustainable and resilient agricultural sector.

IV. CHALLENGES AND LIMITATIONS

While mobile phones have demonstrated their potential to transform agricultural supply chains, there are several challenges and limitations to maximize their impact. These are as following:

1. **Digital Divide and Connectivity:** Limited access to reliable internet connectivity and network coverage can hamper the smooth functioning of mobile-based applications and services (Birhanu et al., 2021). Without adequate connectivity, farmers and other stakeholders may face difficulties in accessing timely information.

2. **Digital Literacy:** Effective utilization of mobile phones and their applications requires a certain level of digital literacy among the users. Smallholder farmers and older generations may encounter challenges in understanding and navigating the functionalities of mobile-based platforms (Labrique et al., 2013).

3. **Affordability and Accessibility:** The investment in smartphones or feature phones, along with the cost of mobile data and application usage, can be a financial burden for small-scale producers (Chipeta et al., 2020). Ensuring affordable access to mobile technology and data services is essential to encourage broader adoption among farmers and other supply chain stakeholders.

4. **Data Privacy and Security:** Ensuring data privacy and security becomes paramount to safeguard against potential misuse and breaches (Zehir et al., 2020). Building trust among users and implementing robust data protection measures are crucial steps to address these concerns.

5. **Reliability and Maintenance:** Mobile technology relies on the proper functioning of hardware and software components. Device malfunctions or software glitches could disrupt communication and information flow within the supply chain (Fawzi et al., 2021).

6. **Resistance to adopt technology:** Resistance to change and unfamiliarity with mobile technology can hinder the widespread adoption of mobile phones in agriculture (Duclos & Duhaney, 2015). Encouraging behavioral change and promoting the benefits of mobile technology through targeted awareness campaigns are essential to overcome adoption resistance.

V. FUTURE PROSPECTS AND RECOMMENDATIONS

The given study offers promising future prospects for the agriculture supply chains in India. As mobile phone penetration continues to grow in rural areas, there is immense potential to further integrate mobile technologies into various stages of the supply chain. To leverage these opportunities effectively, policymakers and stakeholders should focus on increasing digital literacy among farmers, providing affordable access to mobile technologies and developing user-friendly agricultural apps and platforms. Collaborative efforts between governments, technology providers and agricultural organizations can facilitate knowledge-sharing and capacity-building initiatives to maximize the benefits of mobile phone adoption. Additionally, further research should investigate the impact of mobile technology on specific agricultural value chains. By embracing these recommendations, the agricultural sector can harness the transformative power of mobile phones, driving sustainable development, improved livelihoods, and food security in the future.

VI. CONCLUSION

The agricultural sector has undergone a transformative shift with mobile phones emerging as a powerful tool reshaping traditional practices and supply chain dynamics. With the increasing global penetration of mobile phones, their integration into agriculture presents fresh opportunities to boost productivity, transparency, and sustainability across the supply chain. Notably, there has been a rapid adoption of mobile phones in the agricultural sector, especially among smallholder farmers, traders, suppliers, and other actors involved in the supply chain. Mobile phones empower smallholder farmers by providing access to real-time information, enabling informed decision-making and optimization of farming activities. Additionally, they facilitate seamless communication, enhancing collaboration and efficiency among supply chain participants. However, challenges like limited connectivity, affordability and data privacy remain and addressing these is crucial to unlock the transformative potential of mobile technology in agriculture.

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