

MANEUVERING DIGITAL FRONTIER: TRANSFORMING CONSUMERS PURCHASE INTENTIONS FOR FRESH VEGETABLES THROUGH MOBILE TECHNOLOGY ADOPTION

M. Aslam^{1,2} and Z. Li^{1*}

¹School of Management Jiangsu University, Zhenjiang 212002, Jiangsu, P.R. China

²Department of Agribusiness and Entrepreneurship Development, Muhammad Nawaz Shareef University of Agriculture, Multan 60000, Pakistan

*Corresponding Author's E-mail: zhiwenli@ujs.edu.cn

ABSTRACT

This research investigates the drivers influencing consumers' intentions to purchase fresh vegetables through mobile technology, with a focus on information and communication technologies (ICTs) adoption, particularly smartphones. The integration of mobile technology into digital agribusiness practices may reduce the reliance on intermediaries in the fresh vegetable supply chain, benefiting consumers, farmers, and agribusinesses. By providing access to real-time agricultural market information, such as prices and market trends, mobile technology empowers consumers to make informed purchasing decisions. The research, based on a sample of 300 respondents from Lahore and Multan (Punjab, Pakistan), uses the well-known theories of technology adoption to identify key drivers of consumer behavior. Findings indicate that consumer income, education level, distance to fresh vegetable markets, perceived relative advantage, compatibility, complexity, observability of technology, data security concerns, and social influence all significantly impact purchase intentions. The study highlights the need for policymakers, technology providers, and agribusinesses to promote mobile technology adoption in the fresh vegetable sector to enhance consumer satisfaction and subjective well-being, while also contributing to supply chain modernization.

Keywords: ICTs; digital agribusiness; consumer behavior; data security; supply chain modernization.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Published first online March 10, 2025

Published final April 28, 2025

INTRODUCTION

Agriculture stands as one of the foremost sectors as well as supposed as cornerstone of the country's economy. Despite the structural shifts in the agrarian landscape, this sector contribution to Gross Domestic Product (GDP) is declining but still intact as the leading industry and holding about 22.9% to GDP. Additionally, this sector provides employment opportunities for 37.4% of the workforce (Aslam and Li, 2024). The prime responsibilities of this sector revolve around marketing and production. Fresh vegetables serve as the major source of fibers and nutrition, play an essential role in fostering the health and wellness of the nation's population (Ranjbarshamsi *et al.*, 2016; Jin *et al.*, 2017; Raut *et al.*, 2019). Food security is top agenda for nations worldwide and an important concern mainly for developing nations (Johnson *et al.*, 2019; Aslam *et al.*, 2023). There is noticeable change in vogue as consumers increasingly highlighted concerns related about food safety and food quality, as well as these expressions have also seen in Pakistan. The markets of fresh produce have been emerging and evolving with rapid pace (Hoang *et*

al., 2020; Kabir *et al.*, 2023; Kumar and Agrawal, 2023). Nevertheless, maneuvering advanced information and communication technologies to develop mobile marketing or m-commerce along with other online digital marketing platforms has the potential to evolve traditional agricultural marketing system to be upgraded and modernized agricultural system (Valarezo *et al.*, 2018; Stoleru *et al.*, 2019; Aslam *et al.*, 2023; Sarkar *et al.*, 2022).

Consumers have accessibility of a plethora of technological applications developed to assist them in exploring and procuring the prime quality fresh and organic vegetables. The markets of fresh produce have been emerging and evolving with rapid pace (Hoang *et al.*, 2020; Yoon *et al.*, 2020). The usage of ICTs also streamlines supply chains by reducing reliance on intermediaries, improving traceability, and optimizing logistics (Wang and Somogyi, 2018; Garin- Munoz *et al.*, 2019; Lavanya *et al.*, 2022). As international markets face increasing demands for quality, sustainable, and healthy food options, ICTs-based inventions offer a pathway to satisfy these requirements, particularly in localities where traditional methods of agricultural and

distribution may be less efficient (Valarezo *et al.*, 2018; Stoleru *et al.*, 2019; Xie *et al.*, 2022). The literature indicated that consumers with greater educational level are more comfortable with technology adoption and may comprehend the benefits of digital apps for commodity availability, prices and sales discounts (Aslam *et al.*, 2022; Lu *et al.*, 2024). Perceived relative advantage of innovation describes to the degree to which customers suppose that mobile technology adoption will give more benefits as compared to conventional methods of buying fresh vegetables (Rogers, 2003; Zhang *et al.*, 2018; Akram *et al.*, 2020). The perceived complexity of adopting technological solution is a hindrance to its usage. If these technologies are difficult to use then the consumers might be less inclined to implement these technologies (Chandio *et al.*, 2023). Observability is as a strong predictor in the adoption of technological innovations. The more visible the advantages of implementing a mobile phone technology, then the consumers are more inclined to adopt the technologies (Rogers, 2003). The research also highlights the data security concerns also influence consumer intentions to buy using online platforms (Mohammed and Tejay, 2017; Shang *et al.*, 2021). It is also observed that social influence is a key determinant of mobile technology adoption, specifically when consumers give importance to the opinions of individuals in their social circles (Venkatesh *et al.*, 2003; Yang *et al.*, 2024).

Albeit this study focuses on Pakistan, its findings have broader implications for global markets, where mobile technology and ICTs are increasingly shaping consumer behavior in agribusiness. The insights gained from this research can be applied to similar markets globally, particularly in developing regions where mobile technology adoption is rapidly increasing. The adoption of the new technology in agribusiness is relatively low. Mainly work has been done in climate smart technology, irrigation technology, water conservation technology, farm mechanization, and seed technology. Previous work revealed determinants influencing the decision to adopt a new technology but mainly work was done on socio economic, institutional, and situational factors mainly in developing nations (Kimbi *et al.*, 2021; Shah *et al.*, 2023). While these studies provide valuable insights, they often lack a critical assessment of the interplay between behavioral and cognitive determinants that could shape the adoption process. This gap in the literature limits the ability to position the current research as a novel contribution. Furthermore, existing research tends to overlook a structured comparison between findings from both developed and developing economies. The novel aspect of this research is its comprehensive approach to studying ICT adoption among different consumer categories (early, later, and late adopters) within a specific time frame. This study explores determinants influencing consumer

intentions for purchasing fresh vegetables online, with a focus on sustainability and advancements in smart technology solutions within agribusiness supply chain management. Structuring this manuscript with sections followed as the second section describes the materials and methods, third section illustrates the research findings, fourth exhibits the discussion, while last section concludes the research outcomes and suggests policy implications.

MATERIALS AND METHODS

Theoretical framework: The diffusion of innovations theory (DOI) and unified theory of acceptance and use of technology UTAUT model as a foundation for developing an understanding regarding the adoption of new technologies, mainly in context to shifting agribusiness. These theories assess how novel practices utilized by the individuals and diffuse among the clusters with time. The DOI theory and UTAUT model figures out the drivers influencing consumers' adoption of innovative technologies for consumption by the utilization of ICTs According to Rogers (2003) and Venkatesh *et al.*, (2003) the acceptance and diffusion mechanism refers to the transmission of novel technologies gradually among the consumers who are interested to use and purchase agricultural products, typically demonstrated by the S-shaped graphical representation.

Though, despite rigorous efforts to accelerate the diffusion process, issues prevail, mainly regarding the late adoption of these technologies by the household head. The late adoption of these innovative technologies may exist due to various reasons like lack of information regarding the attributes of technological innovation and the significance of technological innovation in an agribusiness, as well as limited information regarding the technology infrastructure and data security concerns of the consumers by the technology or service provider in the relevant capacity building programs.

Empirical framework: In addition, the study in the given discipline holds promise for offering valuable insights to policy makers and agribusiness industrialists seeking to promote sustainable solutions while marketing agricultural products for the developing economies. The study proceeded mainly to figure out the factors affecting consumers purchase intentions for the fresh vegetables by using mobile commerce. The quantitative research technique was opted for better understanding consumers' adoption to purchase fresh vegetables via ecommerce in the selected regions through in person surveys. The strata in this study refer to the two metropolitan cities of Punjab, Lahore and Multan. The proportional random sampling technique was used to ensure that the sample is representative of every metropolises. Specifically, 150

consumers were selected from each city, allowing for a balanced comparison between the two metropolises in terms of their consumer behaviors and adoption of mobile technologies. The strata thus are based on geographic position (the metropolises of Lahore and Multan). The sample size estimations throughout this analysis were conducted victimization Yamane's (1967) approach, a widely employed approach among the studies (Aslam and Li, 2024; Aslam *et al.*, 2024). A confidence interval of 10% was applied for the adjustments throughout this specific study.

Yamane's formula is:

Where:

$$n = N/1+N(e)^2 \quad (1)$$

n is the sample size,

N is the total population size,

e is the margin of error (in this case, 0.10 or 10%).

This formula is utilized to estimate a sample size of 300 respondents across the two metropolises (one hundred fifty from each city). This ensures a statistically significant representation of the target population while accounting for the required confidence level and margin of error.

The multinomial logit techniques opted, grouping the purchasers into three categories: early adopters of mobile technologies, later adopters of mobile technologies and additionally the late adopters of mobile technologies. This technique was mainly utilized to examine the main variables affecting the early adoption of mobile technologies in Pakistan's economy. The groups throughout this study were defined based on the timing of adoption of adoption of mobile technologies. Specifically, the early adopters are the consumer who quickly embrace the new technologies and inventions when they are first introduced to the market whereas the once adopters are the consumers who adopt technologies

once they have been established and wide used but are still relatively early in the adoption curve and late adopters are the consumers who adopt new technologies sluggishly and usually keep until the technology is well-established and widely accepted before making the transition. These groups were defined to assess how different stages of adoption consumer behavior and obtain intentions in digital agricultural commerce.

The equation (1) represents the probability of a consumer using innovative technological tools within a specific time-frame, (as 'j' denoting the years of mobile technology adoption). The equation represents the distinct drivers affecting the early adoption of technologies.

The multinomial logit regression equation is expressed as:

$$A = P(Y = j | X) = e^{(\beta_j * X)} / \sum(e^{(\beta_k * X)}) \text{ for } j = 1, 2, \dots, J - 1 \dots \dots \dots (1)$$

Where:

P(Y = j | X) is the likelihood that the outcome is in category j.

β_j is the slope coefficients for category j.

X is a vector of explanatory drivers.

j is the total number of segments.

j=3 if the consumer has implemented the mobile technology from previous five years or above; j=2, if the consumer has implemented the mobile technology from last one year or more while j=1 if the consumer has implemented the mobile technology from less than one year. The similar type of respondents' segmentation was exhibited in the research work of Aslam and Li (2024) and Shah *et al.* (2023). It elaborates the likelihood of an observation being grouped into each segment, supposing the regression determinants X and the slope coefficients β for each segment.

Table 1: Questionnaire Items and Measurement Scale

Acronym	Factor Description	Questions	Measurement Scale
Adoption	Adoption of mobile technology	Have you adopted the innovative mobile technologies for buying of agricultural products mainly fresh vegetables? From how many years you are using these mobile based technologies for purchasing the fresh agricultural commodities?	Categorical
Age	Age of the consumer	What is the age of the consumer?	Continuous
Education	Education of the consumer	What is the education of the consumer?	Continuous
Income Level	Income level of the consumer	What is the income level of the consumer?	Continuous
Distance to market	The distance from consumers' home to buying origin	What is the distance from consumer's home to buying location?	Continuous
Relative Advantage	Relative advantage of mobile based technology for consumer	Is the mobile based technological innovation relatively more beneficial with the previous methods or practices? Is the mobile based technological innovation relatively	Categorical

Observability	Observability of mobile based technology for consumer	cheaper with the previous methods or practices?	Categorical
		Is the mobile based technological innovation relatively more useful with the previous technology?	
Compatibility	Compatibility of mobile based technology for consumer	Is the mobile based technological innovation observed by your fellows, peer groups and social circle?	Categorical
		Is your fellows, peer groups and social circle shows interest to adopt the mobile based technological innovation used by you?	
Complexity	Complexity of mobile based technology for consumer	Is the mobile based technological innovation compatible with your existing conditions?	Categorical
		Is the mobile based technological innovation compatible with your existing requirements?	
Data security	Data security by mobile phone technology provider	Is the mobile based technological innovation relatively easier to use with the previous technology?	Categorical
		Do you have any privacy concerns over the personal data accessibility to mobile based technological services provider?	
Social Influences	Influence of social circles on consumer purchase intentions	Do you think that mobile based technological services provider are credible ones to whom we may share our information?	Categorical
		Have your purchase intentions been influenced by your social circles?	Categorical

Authors' own illustration

RESULTS

Summary statistics of regression determinants used in this multinomial technique are given in Table 2. The relationship between dependent variables (Consumer purchase intentions for fresh vegetables using ecommerce) and independent variables (age of the consumer, education of the consumer, income of the consumer, distance to vegetable mart, relative advantage of mobile application, compatibility, complexity,

observability, data security by mobile service providers and social influence) was estimated by employing a regression technique.

Variance inflation factor (VIF) is a technique to evaluate the situation of multicollinearity in regression drivers. The digits for our chosen explanatory determinants were observed between 1.27 and 3.79, which explores that all the digits exist below the threshold level of 10. Thus, we found no issue of multicollinearity in our regression determinants (Table 3).

Table 2: Summary Statistics of Selected Variables.

Drivers	Description of Drivers	Means±SD
Age	Age of a landholder (years)	37.33±9.95
Education	Qualification level of landholder (number of years in schooling)	7.22±5.79
Income Level	Total income of a household head (rupees per month)	35000±9.99
Distance to market	Distance to output/commodity market (kilometers)	7±8.21
Relative Advantage	=1 if a landholder's adoption has been impacted by relative advantage of technology, 0 otherwise	0.45±0.37
Observability	=1 if a landholder's adoption has been affected by observability of technology, 0 otherwise	0.60±0.43
Compatibility	=1 if a landholder's adoption has been impacted by compatibility of technology, 0 otherwise	0.47±0.38
Complexity	=1 if a landholder's technology adoption has been impacted by complexity trait of technology, 0 otherwise	0.44±0.36
Data security	=1 if a landholder's technology adoption has been affected by data security by service providers, 0 otherwise	0.38±0.33
Social Influences	=1 if a landholder's technology adoption has been influenced by social influences, 0 otherwise	0.59±0.42

Author's own calculations

Table 3: Multicollinearity Statistics of Explanatory Factors.

Explanatory Factors	Tolerance	VIF
Age	0.25	3.79
Education	0.28	2.94
Income Level	0.36	2.99
Distance to market	0.24	3.45
Relative Advantage	0.39	1.39
Observability	0.88	2.33
Compatibility	0.13	1.79
Complexity	0.96	1.28
Data Security	0.56	1.27
Social Influences	0.39	2.84

Author's own calculations

The Pseudo R² value in our study is 0.61, which elaborated that all explanatory drivers contributed to 61% change collectively in the given dependent factor, i.e. consumer purchase intentions for fresh vegetables by using mobile technology. It was also observed that some other drivers also caused variations in the regressand variable i.e. 39% change in the regressand variable, the influence of these factors could not be exhibited by our predicted model.

The age of the respondent represented that there was a profound but negative association with the early adoption of mobile phone technologies for buying fresh vegetables. It was also assumed that usually the youngsters were more inclined to adopt technological gadgets as compared to the older folks. This outcome inculcated that the consumers having less age were more likely to adopt mobile phone technologies than those having higher age in the study area. The educational level of the consumer showed there was a significant as well as positive relationship with the adoption of mobile phone technologies for buying of agricultural commodities.

The research findings revealed that the consumers' income also contributed to purchase intentions via adopting mobile based technology. It suggested that the consumers who had high levels of income were more inclined to adopt mobile based technological tools for buying of fresh vegetables, as outlined in Table 4.

The findings described that consumers' decisions to timely adopt mobile based technology for purchasing fresh vegetables were influenced by distance of consumer for consumption origin to mart or store. It implied that if the distance were high, the consumption through the use of these digital technologies would rise. The outcome showed that consumers' decision to adopt mobile based technologies during the initial time frame are influenced by the relative advantage of the mobile based technology. It suggested that consumers who saw the new technology as relatively more advantageous in terms of cost and function were more likely to adopt mobile based

technologies for purchasing agricultural commodities (Table 4).

The findings identified that consumers' decisions to adopt mobile based technologies during the initial phases of mobile oriented technological revolution were influenced by the observability of mobile based technology by the fellow consumers' relatives, friends and social circle. It implied that the consumers who observed fellow consumers who adopted the mobile based technologies for purchasing were more inclined to adopt these technological instruments for buying of the agricultural products (Table 4).

The finding showed that consumers' decision to adopt mobile based technologies during the initial time frame were influenced by the compatibility of the mobile based technology. It suggested that consumers who saw the new technology as compatible with the current circumstances and requirements of users were more likely to adopt mobile based technologies for purchasing agricultural commodities, as shown in Table 4. The outcome portrayed that consumers' decision to adopt mobile based technologies during the initial time frame were affected by the complexity of the mobile oriented technology. It suggested that the consumers who understood the new technology as simple and easier to operate with compared to previous technologies were more inclined to adopt mobile based technologies for buying of agricultural products (Table 4).

Table 4: Econometric Outcomes for Consumers' Purchase Intentions for Fresh Vegetables through Mobile Technology Adoption.

Drivers	Coefficient	Standard Error
Age	-0.18	-0.867*
Education	2.95	1.793*
Income level	0.67	0.551*
Distance to market	0.11	0.649*
Relative advantage of mobile technology	2.79	0.833*
Observability of mobile technology	2.25	1.315*
Compatibility of mobile technology	3.43	1.647*
Complexity of mobile technology	1.49	1.918*
Data Security	3.89	2.023*
Social Influences	7.66	5.479*
Value of Pseudo R²		0.61
Value of LLog-likelihood		391.3
Value of LR Chi- Square		127.86
Chi square significant		0.000

Author's own calculations: *Indicates the significance level at 0.01 whereas **represents the significance level at 0.10. Later and late adopters categories are as the reference groups.

Another key driver of consumer' mobile based technology adoption was the data security. In our research findings, this regressor driver significantly and

positively influenced the consumers' mobile based technology adoption decision for buying of the agricultural commodities. Based on empirical findings of our study, the social influences also had a positive influence on the consumers' mobile based technology adoption decision purchasing fresh vegetables, as outlined in Table 4.

DISCUSSION

This study aims to investigate the key determinants influencing consumer purchase intentions regarding the adoption of mobile phone technology for purchasing agricultural commodities, specifically fresh vegetables. Therefore, the previous research works pinpointed the significance of innovative technologies in agricultural marketing, not only for improving the adoption but also for accelerating the adoption mechanism among the masses. While the investigation of DOI and UTAUT in context to consumers' acceptance of technological innovations is an emerging domain in Pakistan's economy, it draws upon from existing literature from Pakistan as well as from the developed nations, highlighting the complex drivers of technology adoption for marketing of agricultural commodities (Aslam *et al.*, 2024; Shah *et al.*, 2023; Nickkar *et al.*, 2024).

Based on the insights derived from the Diffusion of Innovation (DOI) theory and the Unified Theory of Acceptance and Use of Technology (UTAUT), several independent variables were identified that influence consumer behavior in this context: age, education, income level, distance to the market, relative advantage, observability, compatibility, complexity, data security, and social influences. The findings provide valuable insights into the factors that shape consumers' purchase behavior for agricultural products through mobile technologies.

Age emerged as a significant determinant impacting adoption behavior, with a negative association between age and early adoption of mobile technologies for buying fresh vegetables. This means that younger consumers are more adept at navigating technological inventions and are therefore quicker to adopt mobile based solutions for agricultural purchases. It figures out the comfort and familiarity of young individuals with the novel digital platforms (Aslam and Li, 2024; Yang *et al.*, 2024). Our findings indicate that education level has a positive influence on the decision to adopt mobile technology. Consumers with higher levels of education are more likely to use mobile technologies to purchase fresh vegetables instantly, compared to those with lower education levels (Razzaq, 2011; Lavanya *et al.*, 2022; Kabir *et al.*, 2023). This suggests that highly educated consumers are better equipped to understand and utilize mobile technologies. Furthermore, educated consumers

tend to possess stronger cognitive abilities, allowing them to more effectively assess and integrate fresh vegetables into their food choices, thus facilitating a more timely and rational adoption decision.

According to our analysis, income level was identified as a significant factor influencing the adoption of mobile technology for agricultural consumption activities. Consumers with higher income levels are more likely to adopt mobile oriented solutions for purchasing fresh produce (Wang and Somogyi, 2018; Lavanya *et al.*, 2022; Aslam *et al.*, 2022). This suggests that individuals with higher incomes are not only more inclined to invest in digital technologies but also possess the financial capacity to facilitate the early adoption of mobile platforms for purchasing agricultural produce. Based on our research findings, distance to the market emerged as another key factor influencing mobile adoption decisions. A positive correlation was observed between distance to the market and the likelihood of adopting mobile technology for purchasing fresh vegetables. This suggests that consumers living farther from retail outlets are more likely to embrace digital alternatives, as these solutions offer a more convenient and time-efficient way to access goods (Razzaq, 2011; Aslam *et al.*, 2022; Lavanya *et al.*, 2022). The consumers in remote or less accessible areas are more motivated to adopt mobile technologies for shopping purposes (Mollick *et al.*, 2023).

As per our research analysis, the relative advantage of mobile based technology was found positive determinant of adoption behavior. The selected consumers perceive mobile technologies as profitable, easy to manage, a lot of accessible, and presumptuously effective access to agricultural transactions. The perceived relative advantage is a powerful motive for early adoption of technological inventions. As mobile technologies increasingly offer comparative advantages over traditional ways, consumers are more likely to adopt them them (Kante *et al.*, 2019, Shang *et al.*, 2021, Aslam and Li, 2024). Similarly, the observability of mobile technology was also associated with consumer adoption intentions. When mobile technologies are visibly used and promoted throughout a consumer's environment the likelihood of adoption increases. The visibility of technology plays a significant role in its diffusion. Consumer are typically influenced by the experiences of others in their social circle or community, which can turn out a snowball effect encouraging adoption (Wang and Somogyi, 2018; Kante *et al.*, 2019; Shang *et al.*, 2021).

According to our research outcomes, the complexity of mobile technology was found to have a positive influence on adoption intentions. When mobile technologies align with consumers' existing routines, values, and expectations, they are more likely to adopt these innovations. Compatibility plays a crucial role in shaping consumers' willingness to implement new technologies into their routine purchasing behaviors,

especially when these technologies provide a seamless and user-friendly experience (Kante *et al.*, 2019; Shang *et al.*, 2021; Lavanya *et al.*, 2022; Aslam and Li, 2024). Based on our research outcomes, there is a significant and positive association between data security and mobile technology adoption underscores the importance of trust in digital platforms. Consumers need assurance that their personal and financial information is protected when using mobile apps for agricultural purchases (Kante *et al.*, 2019; Shang *et al.*, 2021; Kabir *et al.*, 2023). Finally, as per our research analysis, social influences were found significant and impacting positively to consumers' decisions to adopt mobile based technology for purchasing fresh vegetables. It implies that consumer are influenced by their social networks, including family, friends, and peers, when making technology adoption decisions. So, social influences are often considered as significant driver of technology adoption especially in community oriented societies (Kante *et al.*, 2019; Shang *et al.*, 2021; Aslam and Li, 2024). In summary, this study identifies several major determinants that influence consumers' mobile technology adoption intentions for purchasing fresh vegetables. Factors as age, education level, income, distance to the market, relative advantage, observability, compatibility, complexity, data security, and social influences all play significant roles in shaping consumer behavior. Understanding these factors is crucial for the design and marketing of mobile based agricultural solutions, as they can inform agricultural marketers/service providers to foster adoption among different consumer segments. These insights will contribute for expanding body of literature on technology adoption, particularly in the context of mobile based platforms for purchasing agricultural commodities.

Conclusions: The sustainable diffusion of mobile-based technologies among consumers is pivotal for the success of the digital agribusiness supply chain. Our analysis identifies several crucial drivers impacting consumers' purchase intentions through the adoption of mobile technologies, including age, educational level, income, distance to vegetable stores, relative advantage, compatibility, complexity, observability, data privacy concerns, and social influence. The outcomes suggest that the agribusinesses, particularly mobile service providers, must also play a critical part in this transition. They should prioritize transparent data privacy policies and address security concerns to make consumer trust, therefore encouraging advanced adoption rates. also, understanding income level diversities and the complexity of technology adoption is important for developing tailored marketing strategies and products offerings.

REFERENCES

- Akram, U., A.R. Ansari, G. Fu and M. Junaid (2020). Feeling hungry? let's order through mobile! Examining the fast-food mobile commerce in China. *J. Retail. Consum. Serv.* 56: 102142. <https://doi.org/10.1016/j.jretconser.2020.102142>
- Aslam, M. and Z. Li (2024). A multinomial approach for organic agricultural production practices adoption vis-à-vis socio-economic and ICT determinants. *J. Anim. Plant Sci.*, 34(3): 672-670. <https://doi.org/10.36899/JAPS.2024.3.0752>.
- Aslam, M., Z. Li and M.A. Ali (2024). Navigating sustainability in agribusiness: analyzing organizational performance vis-à-vis organizational climate from multinational food provider companies. *Custos e @gronegocio on line*, 20(1): 72-80. <http://www.custoseagronegocioonline.com.br/numero1v20/OK%20%20climate.pdf>.
- Aslam, M., Z. Li and S. Naeem (2023). Improving agricultural productivity in Pakistan's agriculture through ICTs: determinants and impact. *Custos e @gronegocio on line*, 19(4): 94-115. <http://www.custoseagronegocioonline.com.br/eng/seventy%20three.html>.
- Aslam, M., M. Ansar, I.A. Baig, S. Nasir, M.A. Imran and S. Ullah (2022). Drivers influencing consumers' buying intentions towards frozen chicken products: A case of South Punjab, Pakistan. *J. Econ. Impact* 4(2): 105-109. <https://doi.org/10.52223/jei4022212>.
- Chandio, A.A., K.K. Gokmenoglu, I. Khan, F. Ahmad and Y. Jiang (2023). Does internet technology usage improve food production? Recent evidence from major rice-producing provinces of China. *Comp. Electron. Agric.* 211: 108053. <https://doi.org/10.1016/j.compag.2023.108053>.
- Garin-Munoz, T., R. Lopez, T. Perez-Amaral, I. Herguera and A. Valarezo (2019). Models for individual adoption of ecommerce, ebanking and government in Spain. *Telecomm. Policy* 43(1): 100-111. <https://doi.org/10.1016/j.telpol.2018.01.002>.
- Hoang, H.G. (2020). Determinants of the adoption of mobile phones for fruit marketing by Vietnamese farmers. *World Develop. Perspec.* 17: 100178. <https://doi.org/10.1016/j.wdp.2020.100178>.
- Jin, S.S., H.Y. Li and Y. Li (2017). Preferences of Chinese consumers for the attributes of fresh produce portfolios in an e-commerce environment. *British Food J.* 119(4): 817-829. <https://doi.org/10.1108/BFJ-09-2016-0424>.

- Johnson, L.K., J.D. Bloom, R.D. Dunning, C.C. Gunter, M.D. Boyette and N.G. Creamer. (2019). Farmer harvest decisions and vegetable loss in primary production. *Agric. Sys.* 176: 1-11. <https://doi.org/10.1016/j.agsy.2019.102672>.
- Kabir, A.N.M.F., M.J. Alam, I.A. Begum and A.M. McKenzie (2023). Consumers' preference for purchasing vegetables in Bangladesh: what matters? *Soc. Sci. Human. Open* 8(1): 100685. <https://doi.org/10.1016/j.ssaho.2023.100685>.
- Kante, M., R. Oboko and C. Chepken (2019). An ICT model for increased adoption of farm input information in developing countries: a case in Sikasso, Mali. *Inform. Process. Agric.* 6(1): 26-46. <https://doi.org/10.1016/j.inpa.2018.09.002>.
- Kimbi, T.G., E. Akpo, E. Kongola, C.O. Ojiewo, R. Vernooy, G. Muricho, J. Ringo, G.A. Lukurugu, R.Varshney and R.Tabo (2021). A probit analysis of determinants of adoption of improved sorghum technologies among farmers in Tanzania. *J. Agric. Sci.* 3(1): 73-87. <https://doi:10.5539/jas.v13n1p73>.
- Kumar, A. and S. Agrawal (2023). Challenges and opportunities for agri-fresh food supply chain management in India. *Comp. Electron. Agric.* 212: 108161. <https://doi.org/10.1016/j.compag.2023.108161>.
- Lavanya, N., B. Aparna, N. Vani, G.M. Naidu and N. Chamndeswari (2022). Consumer preferences and purchasing pattern towards fruits and vegetables purchased through e-commerce sector. *Int. J. Res. Appl. Sci. Eng. Technol.* 10(VII): 4883-4884. <https://doi.org/10.22214/ijraset.2022.45945>.
- Lu, S., Z. Sun and M. Huang (2024). The impact of digital literacy on farmers' pro-environmental behavior: an analysis with the Theory of Planned Behavior. *Front. Sustain. Food Syst.* 8. <https://doi.org/10.3389/fsufs.2024.1432184>.
- Mohammed, Z.A. and G.P. Tejay (2017). Examining privacy concerns and ecommerce adoption in developing countries: the impact of culture in shaping individuals' perceptions toward technology. *Comp. Security* 67: 254-265. <https://doi.org/10.1016/j.cose.2017.03.001>.
- Mollick, J., R. Cutshall, C. Changchit and L. Pham (2023). Contemporary mobile commerce: Determinants of its adoption. *J. Theor. Appl. Electron. Commer. Res.* 18(1): 501-523. <https://doi.org/10.3390/jtaer18010026>.
- Nickkar, A., S. Pourfalamatoun, E.E. Miller and Y.J. Lee (2024). Applying the heteroskedastic ordered probit model on injury severity for improved age and gender estimation. *Traffic Inj. Prev.* 25(2): 202-209. <https://doi.org/10.1080/15389588.2023.2286429>.
- Ranjbarshamsi, H., O.M. Najafabadi and S.J.F. Hosseini (2016). Factors influencing consumers' attitudes toward organic agricultural products. *J. Agric. Food Inform.* 17(2-3): 110-119. <https://doi.org/10.1080/10496505.2016.1176574>.
- Raut, R.D., B.B. Gardas, V.S. Narwane and B.E. Narkhede (2019). Improvement in the food losses in fruits and vegetable supply chain-a perspective of cold third-party logistics approach. *Ope. Res. Perspec.* 6: 100-117. <https://doi.org/10.1016/j.orp.2019.100117>.
- Razzaq, M. (2011). Market potential and consumer's willingness to pay for selected organic vegetables. Thesis MBA (Marketing and Agribusiness) submitted to Institute of Business Management Sciences, University of Agriculture, Faisalabad.
- Rogers, E.M. (2003). Diffusion of innovations, 5th Edition, Free Press. <https://www.amazon.com/Diffusion-Innovations-5th-Everett-Rogers/dp/0743222091>.
- Sarkar, A., H. Wang, A. Rahman, A. Jony Abdul, W.H. Memon, L. Qian (2022). Structural equation model of young farmers' intention to adopt sustainable agriculture: a case study in Bangladesh. *Renew. Agr. Food Syst.* 37(2):142-154. <https://doi.org/10.1017/S1742170521000429>.
- Shah, Z.A., M.A. Dar, E.A. Dar, C.A. Obianefo, A.H. Bhat, M.T. Ali, H.A. Alatawi, H.I. Ghamry, M. Shukry and S.A. Sayed. (2023). A multinomial approach to sustainable and improved agricultural technologies vis-a-vis socio-personal determinants in apple (*Malus domestica*) cultivation. *J. King Saud Uni.-Sci.* 34(7): 102286. <https://doi.org/10.1016/j.jksus.2022.102286>.
- Shang, L., T. Heckelei, M.K. Gerullis, J. Börner and S. Rasch (2021). Adoption and diffusion of digital farming technologies-integrating farm-level evidence and system interaction. *Agric. Sys.*190(C):1-17. <https://doi:10.1016/j.agsy.2021.103074>.
- Stoleru, V., N. and A. Istrate (2019). Perception towards organic vs. conventional products in Romania. *Sustainability* 11(8): 2394. <https://doi.org/10.3390/su11082394>.
- Valarezo, A., T. Perez-Amaral, T. Garin-Munoz, L.H. Garcia and R. Lopez (2018). Drivers and barriers to cross-border e-commerce: evidence from Spanish individual behavior. *Telecomm. Policy* 42: 464-473. Data retrieved on October

- 27, 2024
<https://doi.org/10.1016/j.telpol.2018.03.006>.
- Venkatesh, V., M.G. Morris, G.B. Davis and F.D. Davis (2003). User acceptance of information technology: toward a unified view. *MIS quarterly*, 425-478.
- Wang, O. and S. Somogyi (2018). Consumer adoption of online food shopping in China. *British Food Journal*, 120(12): 2868-2884. <https://doi.org/10.1108/BFJ-03-2018-0139>.
- Xie, C., X. Tian, X. Feng, X. Zhang and J. Ruan (2022). Preference characteristics on consumers' online consumption of fresh agricultural products under the outbreak of COVID-19: an analysis of online review data based on LDA model. *Pro. Comp. Sci.* 207: 4486-4495. <https://doi.org/10.1016/j.procs.2022.09.512>.
- Yamane, T. (1967). *Elementary sampling theory* (pp. x-405). Englewood Cliffs, New Jersey: Prentice-Hall, Inc., USA.
- Yang, Y., Y. Zhang, B.X. Zhu, J. Zhou, Y. Liu, D. Gao and J. Sauer (2024). ICT promotes smallholder farmers' perceived self-efficacy and adaptive action to climate change: empirical research on China's economically developed rural areas. *Climate Service* 33: 100431. <https://doi.org/10.1016/j.cliser.2023.100431>.
- Yoon, C., D. Lim and C. Park (2020). Factors affecting adoption of smart farms: the case of Korea. *Computers in Human Behavior*, 108. <https://doi.org/10.1016/j.chb.2020.106309>.
- Zhang, B., Z.T. Fu, J. Huang, J.Q. Wang, S.Y. Xu and L.X. Zhang (2018). Consumers' perceptions, purchase intention, and willingness to pay a premium price for safe vegetables: a case study of Beijing, China. *J. Clean. Prod.* 197: 498-1507. <https://doi.org/10.1016/j.jclepro.2018.06.273>.