# B-B E-COMMERCE PLATFORM ADOPTION: A STUDY OF ONLINE AGRICULTURE TRADING PLATFORM IN INDIA

## THESIS

**Submitted to the**

**Delhi Technological University**

**for award of the Degree of**

## DOCTOR OF PHILOSOPHY


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**2023**

# CANDIDATE'S DECLARATION

I hereby certify that the thesis titled **'B-B E-Commerce Platform Adoption: A Study of Online Agriculture Trading Platform in India'**, submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (PhD) is an authentic record of my research work conducted under the guidance of Dr. P. K. Suri. Any material borrowed or referred to is duly acknowledged.

The matter presented in this thesis has not been submitted elsewhere in part or entirely to any other University or Institute for awarding any degree.

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# CERTIFICATE

This is to certify that the thesis titled '**B-B E-Commerce Platform Adoption: A Study of Online Agriculture Trading Platform in India**', being submitted by Mr Sanjay Chaudhary to the Delhi Technological University for the award of the degree of Doctor of Philosophy (PhD), is a record of bonafide research work carried out by him. He has worked under my guidance and supervision and fulfilled the requirements for the submission of the thesis, which has attained the standard required for a PhD degree at the University. The matter presented in this thesis has not been submitted elsewhere for the award of any degree or diploma.

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# ACKNOWLEDGMENTS

I want to express my deepest gratitude to my guide and mentor, Professor P. K. Suri, for his support and patience for the duration of my research work. This research would not have been in its present form without his active interest and constant guidance. I thank him for making me a better researcher and making me a better person.

Special thanks to Dr O. P. Wali (Professor, Indian Institute of Foreign Trade), Prof. M.P. Gupta (Head of Department, Department of Management Studies, Indian Institute of Technology, Delhi), Dr Rajan Yadav (Professor, Delhi School of Management, Delhi Technological University), and Prof. Sushil (Department of Management Studies, Institute of Technology, Delhi) for their guidance and valuable inputs, which has led to the enrichment of this study. I also thank the Head of Department, Delhi School of Management, Ms Archana Singh, for her encouragement.

I would also like to thank the Delhi School of Management (DSM) faculty members who mentored me well during my coursework. Also, I thank Prof. I. M. Pandey, fellow research scholars in DSM, and management at Delhi School of Business, Vivekananda Institute of Professional Studies. They are a constant source of support and learning during the length of this research. Finally, I am also grateful to the library and administration staff at DSM for their undying support. The National Agriculture Market staff and Agriculture Produce Market Committees' management are also special mentions.

Most importantly, I would like to thank my family: my father late Sh. Ved Singh, mother Ms Snehlata, wife Deepali, daughter Saavi and son Yash for their continuous support, patience, help, and encouragement in completing this task.

I dedicate this research work to my parents.

**Sanjay Chaudhary**

2K16/PHDDSM/01

# ABSTRACT

The digitalization revolution is evident in many areas of the economy, for example, manufacturing, service, healthcare, and education. The same is true in agriculture, especially in adopting new digital marketing techniques.

The varied agricultural ecosystem is filled with huge disparities. Therefore, the proper analysis of emerging issues among stakeholders must be done. For accurate analysis, academic research is needed and promoted.

The digitalization and adoption of innovative marketing techniques in agriculture for better profit and value chain efficiency can be partly attributed to B-B e-commerce platforms. However, due to the system's complexity and many variables, the B-B e-commerce implementation efforts face many challenges. These challenges can be tackled with proper measures suggested by research studies. There is a dearth of such academic research in India, particularly in the agricultural marketing context.

A B-B e-commerce initiative is expected to first focus on building a critical number of users and quality. The high number of users (farmer/trader/corporate) and transactions are necessary for creating value at a large scale. As the number of users/transactions on the B-B e-commerce platform grows, the platform becomes more valuable to other stakeholders, e.g., application developers, exporters, transporters, logistics and value-add service providers. Thus, a practitioner must develop a holistic framework for B-B e-commerce adoption and use. The framework that takes care of the problems and challenges involved.

This study proposes and validates the research-based framework to improve B-B e-commerce adoption in the agricultural sector in India from the perspective of farmers. In this research work, the significant variables identified to establish a holistic adoption framework are as follows: Cost, Facilitating Conditions, Perceived Ease of Use, Perceived Usefulness, Social Influence, and Trust.

The research framework's latent variables (constructs) are linked together in a structure using the Total Interpretive Structural Modeling (TISM) method. The case study of the National Agricultural Market (eNAM), a field survey of five hundred farmers

using eNAM, and interviews of seventeen B-B e-commerce start-up chief executive officers and experts provide a practical study context where variables and issues involved in the framework are analyzed comprehensively. The proposed adoption framework is validated. The framework validation is based on the analysis of field survey data using the Partial Least Square – Structural Equation Modeling (PLS-SEM) method.

The construct's manifestation in the respondent sample group of farmers differs from other Industry groups. The adoption framework developed in a B-B e-commerce context is distinct due to its applicability in the agriculture sector, characterized by a developing ecosystem.

The framework is simple to understand. The variance (for the dependent variable ‘Adoption’) explained is better than most competing models. The variance explained for the dependent variable in the competing models are, Theory of Reasoned Action (TRA) - 36 per cent, Technology Acceptance Model (TAM) - 53 per cent, Theory of Planned Behaviour (TPB) - 36 per cent, and Innovation Diffusion Theory (IDT) - 40 per cent. In this study, the survey respondents are working farmers. The nearest competitor model, Unified Theory of Acceptance and Use of Technology (UTAUT), explains about 70 per cent of the variance (adjusted $R^2$) in usage intention with four direct determinants latent construct, that is, two less determinant latent constructs used in this study.

Further, the constructs of the adoption framework are to be ranked so that ranking helps prioritize scarce resources and management attention. Therefore, the constructs in the adoption framework are sequenced for their importance in influencing post-adoption usage of the B-B e-commerce system (eNAM). The ranking is derived using the Interpretive ranking process (IRP) method. The constructs are prioritized as Trust, Cost, Perceived Ease of Use, Facilitating Conditions, Perceived Usefulness and Social Influence, respectively.

This study's significant research contributions are identifying the influence of behavioural and non-behavioural variables on the adoption of B-B e-commerce. The study addresses the ongoing academic debate and knowledge gap in the scholarly

literature about the agricultural B-B e-commerce adoption in India. The Unified Theory of Adoption and Use of Technology is extended by defining and adding two new constructs. ‘Cost’ and ‘Trust’. The study extends the applicability of UTAUT in agricultural marketing and uses the mixed method approach to achieve research objectives. It is expected to pave the way for researchers to conduct further studies in the agricultural e-commerce adoption domain.

The benefits associated with B-B e-commerce increase with growing familiarity and liquidity. Higher adoption is a prerequisite to higher liquidity, which is essential for the initiative's success. Thus, the root cause of adoption is successfully addressed in the study. Hopefully, the research-based recommendations will help realize better adoption of digital B-B eCommerce projects, e.g., eNAM. Similarly, the study's recommendations are expected to help practitioners effectively plan and deliver intended benefits, such as administrative ease, low transaction cost, quick cycle time, and better price realization.

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# List of Abbreviations

| | |
|---|---|
| API: | Application Programming Interface |
| APMC: | Agriculture Produce Market Committee |
| ANN: | Artificial Neural Network |
| ASV: | Average Shared Variance |
| AVE: | Average Variance Extracted |
| CFA: | Confirmatory Factor Analysis |
| CFI: | Comparative Fit Index |
| CR: | Composite Reliability |
| DACFW: | Department of Agriculture, Cooperation and Farmers Welfare |
| eNAM: | National Agricultural Market |
| ESI: | Economic Survey of India |
| GFI: | Goodness of Fit Index |
| GSMA: | Global System for Mobile Communications Association |
| HTDCS: | Hindustan Times Digital Content Services |
| HTMT: | Heterotrait-Monotrait Ratio of Correlations |
| IBEF: | India Brand Equity Foundation |
| ICT: | Information and Communications Technology |
| IRP: | Interpretive Ranking Process |
| KPMG: | Klynveld Peat Marwick Goerdeler |
| MOAFW: | Ministry of Agriculture and Farmers' Welfare |
| MSP: | Minimum Support Price |
| MSV: | Maximum Shared Variance |
| NABARD: | National Bank for Agriculture and Rural Development |

| | |
|---|---|
| NAM: | National Agriculture Market |
| NASSCOM: | National Association of Software and Service Companies |
| NIAM: | National Institute of Agricultural Marketing |
| NITI: | National Institute for Transforming India |
| OECD: | Organisation for Economic Co-operation and Development |
| PIB: | Press Information Bureau |
| PLS-SEM: | Partial Least Squares-Structural Equation Modelling |
| R-Square: | Coefficient of Determination |
| RMSEA: | Root Mean Square Error of Approximation |
| SPSS: | Statistical Package for Social Sciences |
| SEM: | Structural Equation Modelling |
| SRMR: | Standardized Root Mean Square Residual |
| TAM: | Technology Adoption Model |
| TISM: | Total Interpretive Structural Modeling |
| UTAUT: | Unified Theory of Acceptance and Use of Technology |
| UTAUT2: | Unified Theory of Acceptance and Use of Technology 2 |
| VIF: | Variance Inflation Factor |
| WPI: | Wholesale Price Index |

# Chapter 1
# Introduction to the Study

## 1.1 Research Background

The agricultural sector is economically and socially significant in the Indian context. It is the primary source of income for about fifty-eight per cent of Indians (BEF, 2017). Historically, the Indian agricultural supply chain is fragmented and has many non-value-add intermediaries. Because of many go-betweens, the end consumer price escalation in the supply chain is more than sixty per cent. Depending on the nature of the produce, the original producer receives between twenty-eight and seventy-eight per cent of the end consumer price. Thus, a high number of intermediaries end up adding more costs than value (Patnaik, 2011; DAC, 2013; Kaur, 2015).

A digitalized supply chain with integration and quick processing can significantly enhance the overall effectiveness of the agriculture and food sectors. The constituent B-B (business to business) e-commerce platform reduces operational costs, expedites the process, and improves informational quality. It enhances the performance of purchasing rights, as it helps them delivered with all rights, e.g., price, quality, amount, source, and time (Smart and Harrison, 2003; Auramo et al., 2005; White et al., 2005; Shirzad and Bell, 2013; Mor et al., 2015; Tripathy et al., 2016; IBEF, 2019).

In the last five years, along with the economy, the agricultural sector is also witnessing a digital transformation intended to improve the efficiency of the marketing system. One key component of the agricultural marketing system is the wholesale markets. The agricultural commodities sales are progressively shifting from oral auction to B-B e-commerce mode in wholesale markets of India.

The digital solutions in the wholesale B-B procurement/sourcing stage are vital to improving the supply chain. Digitalization helps the buyer (trader/corporate/exporter) get transparency, easy operations monitoring, and efficient transactions. Likewise, the farmer benefits from better access to markets and real-time information. It also gives them amenities that make farmers adopt the recommended agricultural practices and get transparent trading (GSMA, 2020).

B-B e-commerce platforms are more open and transparent than physical markets, resulting in high demand for produce. B-B e-commerce platforms enhance the viability and genuineness of the procurement process. It is also expected to increase the seller's bargaining capability by accessing a broader range of buyers. Consequently, primary sellers (farmers) are expected to make a high profit whenever they sell the produce on the e-commerce platform. It is a better alternative to selling at the farm-gate through a limited number of regional agents (Chaudhuri and Verma, 2008; Banker et al., 2011; Srinivasan, 2018).

The wholesale B-B e-commerce across markets is a recent activity for the agricultural sector in India. It affects this sector's strategy, marketing, processes, distribution, customer relationship, economics, and business culture. The agriculture sector's B-B e-commerce platform must still deal with the ground realities. e.g., low digital literacy, interactions between semi-literate farmers and traders, the importance of tacit know-how, the involvement of social contacts, and poor infrastructure in India (Kaur, 2015; Shalendra and Jairath, 2016).

The need for a pan-India integrated wholesale B-B e-commerce platform, information exchange, and enabling infrastructure is strongly felt as the need of the hour (Chahal et al., 2012; Mor et al., 2015; NABARD, 2018). The National Agriculture Market (eNAM) meets this downstream need of the agriculture supply chain. Launched in April 2016, eNAM has become the de-facto unified wholesale B-B e-commerce platform for agricultural commodities in India.

Research studies are scarce in B-B e-commerce and agricultural B-B e-commerce adoption in the Indian context. There is hardly any theory or framework related to adopting B-B e-commerce in the context of agriculture in India.

The online e-commerce platform focuses first on building a critical number of users and quality. The critical number of users (farmers) and transactions is necessary for creating value at a large scale. As the number of users/transactions on the e-commerce platform grows, the platform becomes more valuable to the farming community besides other stakeholders, which include buyers/traders, application developers, exporters, transporters, and value-add service providers (Alstyne and Parker, 2017).

At this stage, the wholesale B-B e-commerce adoption in the Indian agriculture sector (including eNAM) is still low. Low adoption asks for a better understanding of the adoption of online B-B e-commerce platforms in Indian agricultural markets.

This study attempts to answer the question as to how the adoption of B-B e-commerce in India will be improved. The improvement is viewed in terms of the number of users and transactions.

Consequently, the successful B-B e-commerce platform may deliver the intended benefits to the farmers. Research in the area can help bring out meaningful and actionable recommendations for researchers, policymakers, and managers.

## 1.2 Research Gaps

The research gaps revealed from a review of literature are as follows:

- Research on agricultural B-B e-commerce adoption is scarce.
- The case studies on the agricultural B-B e-commerce marketplace are few, particularly in the Indian context.
- The India-specific studies are limited in number.
- There is little research in India on agricultural B-B e-commerce benefits for farmers.

The research gaps are identified based on the learning from the scholarly articles. The research gap led us to ask research questions. It also led to the need for a systematic investigation of the variables in the B-B agricultural e-commerce adoption framework that would apply to an agricultural context.

## 1.3 Research Questions

The research gaps have led to the following research questions:

- What are the determinants of B-B e-commerce adoption in the Indian agriculture sector?
- How can the adoption of agricultural B-B e-commerce be promoted?
- What are the valuable lessons learnt from current and past initiatives?

## 1.4 Research Objectives

In order to address the above research questions, this study has the following objectives:

- To propose an adoption framework for B-B e-commerce in the context of agricultural marketing.
- To validate the adoption framework for agricultural B-B e-commerce in the context of the National Agriculture Market.
- To suggest ways for improving agricultural B-B e-commerce adoption based on a study of the National Agriculture Market and other similar initiatives.

## 1.5 Significance of the Research

### 1.5.1 For Practitioners

B-B e-commerce in agricultural commodities is a relatively recent activity in India with low adoption (Chaudhri and Verma, 2008). Low adoption asks for a better understanding of the adoption of wholesale B-B e-commerce in Indian agricultural markets. Research in the area can help bring out meaningful and actionable recommendations for policymakers, market managers, and participants.

The research attempts to answer the question as to how the adoption of wholesale B-B e-commerce trading in India will be improved. The improvement is observed in views of the number of users and transactions. The research-based suggestions target

an enhancement in the adoption by improving the enabler constructs of the adoption framework.

The findings may also aid policymakers and implementers achieve the intended benefits of the National Agriculture Market (eNAM). These benefits include farmers getting more options for selling produce. Farmers get a competitive price, and traders get access to secondary trading with a broader market. Companies/buyers/exporters get reduced intermediation costs through direct participation in the local trade.

### 1.5.2 For Researcher

Research studies are scarce in wholesale agricultural B-B e-commerce adoption in India. There is hardly any theory or framework related to adopting B-B e-commerce in India.

The proposed adoption framework is generated using the total interpretive structural modelling (TISM) methodology. The framework is validated with the help of the Partial Least Square – Structural Equation Modelling (PLS-SEM). It intends to fill the gap related to a theoretical framework required for agricultural B-B e-commerce adoption in the Indian wholesale market context.

The research intends to extend the Unified Theory of Acceptance and Use of Technology (UTAUT) in a new context (B-B e-commerce, wholesale e-trading, agriculture marketing, India). The existing UTAUT framework scope is extended by adding new constructs (latent variables and their exogenous predictors) to understand one of the crucial phenomena concerning Agriculture marketing.

The research provides a detailed description of the eNAM case and the constructs of the adoption framework to enable researchers to assess the appropriateness of findings in their context. Abstracting the findings may transfer the themes to more general cases.

## 1.6 Scope of the Study

The study is designed within the following scope:

- The agricultural business to business (B-B) e-commerce refers to the sale/purchase of agricultural produce between farmers and businesses through the Internet-enabled website.
- The adoption is described as using a B-B e-commerce platform to buy/sell agricultural commodities using the Internet.
- The study is based on a survey of eNAM users in five Agricultural Produce Market Committee (APMC) markets in two Indian states.
- Five APMC markets are chosen based on their large size (number of commodities, users, and turnover), high trade transactions, and the B-B e-commerce platform (eNAM) has been functional for at least one year in the APMC market. The survey and the data collection are limited to the farmers registered in these five APMC markets (Aligarh, Meerut, Nadbai, Nagar, and Pilibhit). However, analysis based on expert opinion is not limited to these five markets.

## 1.7 Overall Methodology of the Research

The research philosophy adopted is Pragmatism where concepts are associated with an action (Kelemen and Rumens, 2008). For the research objectives addressing the research gaps, practitioner-oriented solutions are suggested. Multiple and mixed methods are possible with this philosophy. The abductive approach (Suddaby, 2006) to theory development is adopted, where the study uses an expert opinion survey for theoretical framework development, and later theoretical framework is validated using farmers' opinion survey data analysis. The research study time horizon is cross-sectional.

The data collected through the survey, and expert opinions have been analyzed to make recommendations in the study context.

This study is mainly divided into three phases. In the first phase, a case study of the National Agriculture Market (eNAM) project was conducted to get better insights into wholesale B-B e-commerce.

Research variables and constructs related to the adoption framework are identified in the second phase. An end-user (farmer) opinion survey is conducted. The data analysis is conducted to identify the relationship between the constructs.

The last phase consists of ranking the constructs influencing the dependent variable 'adoption'. Lastly, a few suggestions are proposed for improving the adoption of the B-B e-commerce platform based on interviews and expert opinions.

During distinct phases of the study, different research techniques have been used. A snapshot of these phases, along with their objectives, methodologies, and technique, is presented in Table 1.1.

Table 1.1 Research Methodologies and Techniques

| **Phase** | **Research Objective** | **Research Method and Technique** |
|---|---|---|
| 1 | Propose an adoption framework for B-B e-commerce in the Indian Agriculture sector. | • Systematic Literature Review<br>• The case study of the National Agriculture Market (eNAM) and other initiatives<br>• Univariate Statistical Analysis<br>• Total Interpretive Structural Modeling (TISM) methodology (Qualitative) |
| 2 | Validate the adoption framework for wholesale agricultural B-B e-commerce in the context of the National Agriculture Market (eNAM). | • Partial Least Squares - Structural Equation Modeling (PLS-SEM) method (Quantitative)<br>• Hypothesis Testing<br>• Interpretation of data analysis result |
| 3 | Recommend ways for improving agricultural B-B e-commerce adoption based on a study of the National Agriculture Market and other similar initiatives. | • Literature Review<br>• Recommendations are based on expert panel interviews and end-user Interviews.<br>• Interpretive Ranking Process (IRP) Method (Qualitative) |

## 1.8 Structure of Thesis

The research study is organized into eight chapters.

**The first chapter**, 'Introduction', describes the background of research, research questions, research objectives, and the scope and relevance of the research. It also brings out an outline of the research methodology used in the research.

**The second chapter**, ‘Literature Review’, presents a detailed literature review about the concept of wholesale B-B e-commerce, various technology adoption models, including the UTAUT adoption model, wholesale agricultural marketing and supply chain in India, eNAM project, and eNAM adoption in India. It further identifies research gaps based on a review of the literature.

**The third chapter**, ‘National Agriculture Market and other Projects’, probes deeper into large eNAM projects and nine relatively small projects.

**The fourth chapter**, ‘Research Design’, explains the TISM methodology used to arrange constructs into relationships within the framework and the Partial Least Squares - Structural Equation Modeling (PLS-SEM) methodology used to validate the framework. It also proposes the research hypotheses to be tested, pilot testing of the questionnaire, sample selection, mechanism of data collection, and tools used for analysis. The Interpretive Ranking Process (IRP) is also explained in brief.

**The fifth chapter**, 'Validation of the Conceptual Research Framework', reflects data analysis. It starts with the theoretical framework based on the literature review. Further, the adoption framework is proposed based on the TISM analysis. Subsequently, it analyzes end-user (farmer) survey data. It presents the results validating the adoption framework based on the PLS-SEM analysis.

**The sixth chapter**, 'Ranking of Constructs for the Continued use of B-B e-commerce', presents an analysis using the Interpretive Ranking Process (IRP) Method. The expert opinion survey and review are conducted to rank the constructs (variables) in the adoption framework for the continued use of the B-B e-commerce platform eNAM.

**The seventh chapter**, ‘Empirically Validated Framework’, depicts an empirically validated framework. Suggestions based on expert opinions and semi-structured interviews with market participants in the study context are discussed in this chapter.

**The eighth and concluding chapter** is 'Recommendations and Conclusion'. In this chapter, research objectives are revisited to check the level of accomplishment in the research. Further, an overview of the research findings and recommendations for researchers, citizens, and practitioners are discussed. Research limitations and a few suggestions for further research in this area are also explained.

## 1.9 Concluding Remarks

This chapter presented an overview of the study.

The study is intended to analyze agricultural B-B e-commerce adoption in India by studying an important national-level project and other initiatives. The effort results in an adoption framework and suggestions to improve the adoption.

The next chapter reviews the literature on the critical areas related to the study.

# Chapter 2
# Literature Review

## 2.1 An Overview of B-B E-Commerce

The market is experiencing a considerable rise in the e-commerce industry. E-commerce is changing the traditional transaction methods and causing significant changes. It has been generally accepted that e-commerce adoption is an important indicator of economic growth in developing countries. However, many enterprises in India still do not use e-commerce. The low e-commerce adoption situation is not specific to India; it is true for many developed and developing countries, resulting in the broadening of the digital divide (Vaithianathan, 2010; Zhu and Thatcher, 2010; Karami, 2014).

Within e-commerce, business-to-business (B-B) e-commerce refers to the sale and purchase of products and services between businesses through an Internet-enabled website. In India, the B-B e-commerce market is among the top growth industry segments as it is expected to reach USD 60 billion by 2025 (Statista, 2022).

The B-B e-commerce adoption is a business engagement for the sale/purchase of goods and services and money exchange through the eNAM. The challenge in the era of digitalization is to ensure that the opportunities and benefits of B-B e-commerce reach all types of businesses via high adoption.

To reap the benefits of B-B e-commerce, Indian firms must understand its potential in their businesses and the businesses of trading partners (Gunasekarana et al., 2002).

Studying the general factors influencing B-B e-commerce in developing countries (Upadhyaya and Mohanan, 2009) is vital. A better understanding of factors determining the adoption of B-B e-commerce platforms shall help companies and policymakers devise a suitable strategy and lead to a structured approach to their management. Doing it early in the life cycle will probably result in the success and desired benefits reaching participants. A better understanding of factors to be

managed by platform operators may ensure the requisite liquidity necessary for the very survival of the B-B e-commerce marketplace.

## 2.2 Traditional Agricultural Wholesale Marketing and Supply Chain

India's agricultural supply chain components are highly dispersed, less coordinated, offline in nature, and involve trader cartels, resulting in information asymmetry. The price dispersion measured as the ratio between the lowest to the highest price at the farm-gate for the same crop in the country ranges from 1.6 (tur pulse) to 5.5 (groundnut). The price wedge between farm-gate and wholesale prices ranges from 5 to 35 per cent in staple grains and 5 to 50 per cent in main vegetables (ESI, 2016).

The fragmented supply chain and an inefficient marketing system also led to a high loss of food in the value chain of approximately US$ 10 billion per annum (McKinsey-CII, 2013).

The high price dispersion and wastage show a clear need for an integrated and efficient supply chain. However, India's agriculture supply chain (Figure 2.1) is full of non-value-add intermediaries, who unnecessarily mark up the total margin in the supply chain to approximately 75 per cent (Patnaik, 2011; Kaur, 2015).

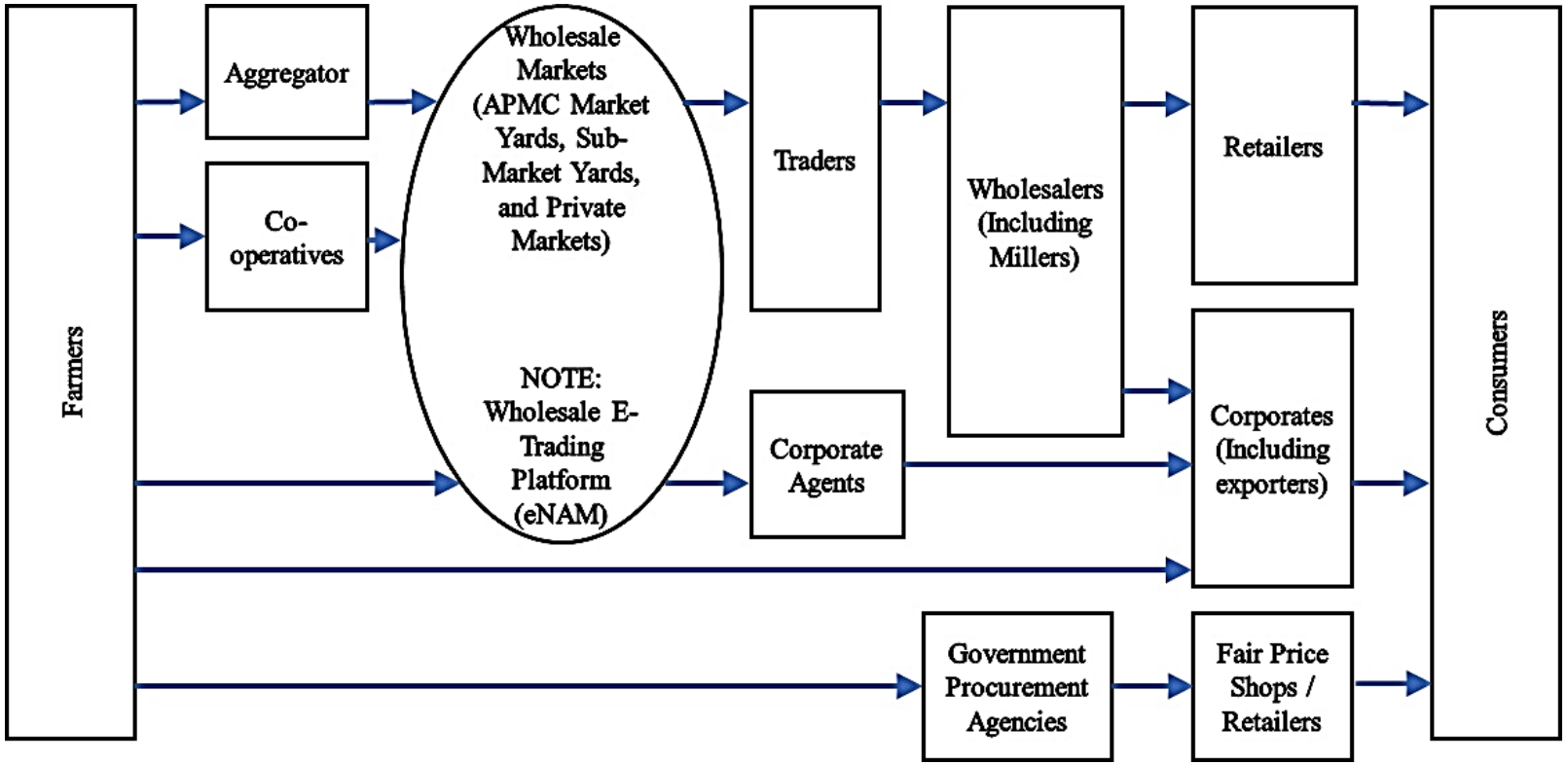


Figure 2.1 Typical Agri Supply Chain

(Source: Adapted from DACFW, 2021).

As an example, the typical supply chain of the wheat and paddy are shown in the following two paragraphs:

- For wheat, the typical supply chain in the private sector consists of Farmer → Wholesaler → Miller (optional) → Retailer → Consumer. The public sector supply chain consists of Farmer → Procurement Agency (Food Corporation of India (FCI), State Government, and Co-operative Marketing Society) → Private Trader/Fair Price Shop/Retailer → Export/Consumer.
- For Paddy (Rice), the primary supply chain in the private sector is Producer → Wholesaler (Paddy) → Miller → Wholesaler (Rice) → Retailer → Consumer. The public sector supply chain consists of Producer → Procurement Agency (Food Corporation of India/State Government/Cooperatives) → Miller (Food Corporation of India/Cooperatives/Private) → Distributing Agency (State Govt.) → Fair price/Ration shop → Consumer.

The channel margins are similar for private and public sector procurement agencies. From the policy perspective, the floor price for 24 mandated crops (including Wheat and Paddy) and sugarcane is under the minimum support price procurement mechanism (MSP) only through the public sector of the Indian Government. The policy initiatives are also meant to minimize market price and quantity volatility (Subramanian, 2016).

Currently, the total marketing margin is high and varies across state APMC markets, channels utilized, and time. For example, in Uttar Pradesh State APMC markets, the market fee is 2 per cent plus a development cess of 0.5 per cent, the trader/retailer/small rice mill license fee is INR 250/100/150 per annum, and market charges in INR per unit (Weighing – 0.50/Qtl., Unloading – 0.50/Qtl., Hamal - 1.0/Qtl., Cleaning – 1.00/Qtl., brokerage – 0.50 per cent), Commission charges are 1.5 per cent, Octroi is Nil, and the sales tax is 4 per cent (Acharya, 2006).

The variation in market fees across APMC markets in states is also noted. The market fee in Punjab state (6 per cent), Haryana state (4 per cent), Andhra Pradesh

state (2.7 per cent), Uttar Pradesh (2.5 per cent), Chhattisgarh state (2.2 per cent), Madhya Pradesh state (1.7 per cent), and Rajasthan (1.6 per cent) as July 2022. The commission and other charges are additional. Such dissimilarity causes hindrance in the unified national B-B e-commerce platform-based e-trading.

The short marketing channel with minimum marketing cost, reasonable returns to the farmer, and affordable price to the consumer is considered a cost-effective channel (Jha, 2010). An IT-based cost-effective channel, without marketing distortion, shall deliver improved overall welfare (Landes et al., 2009; Boffa and Vaerla, 2019).

For wholesale marketing, as per the State APMC Act, the first sale of the notified agricultural commodities in a particular market area (such as wheat, maize, pulses, oilseed, vegetables, and other food grains) must be made in the APMC-controlled market through a licensed agent or a trader, after paying off due fees and tax.

Traditionally, offline transactions in wholesale agricultural markets are in the form of an open auction, closed auction, or mutual agreement. Only the registered farmers, registered agents, and licensed traders participate in wholesale trade.

A farmer brings his produce to the commission agent (CA) shop in the Agricultural Produce Market Committee (APMC) area, which grades produce quality. At open auctions (generally used for perishable produce), traders gather at the CA shop and announce their bid for the lot as per the quality of the produce. The highest bidder gets the produce. In closed auctions (the most popular auction, generally used for grains), all bidders (buyers) write their bids on slips during the permitted time (2 hours to 1 day) — for each lot, the APMC officials confidentially select the highest bid. The APMC official announces the highest bidder (buyer), who collects the produce lot from the CA shop after making the payment. Under mutual negotiation (generally used when there are very few or a single buyer or the produce is bought by a processor/mill), the lot price is mutually decided between the farmer and the trader/agent. Subsequently, it is reported to the APMC market office (Aggarwal et al., 2016; Suri, 2018).

The offline trade transaction in the agricultural wholesale markets is gradually getting replaced by the digital B-B e-commerce platform. However, the digital online B-B platform-based e-marketplaces in the agriculture sector still must deal with on-

the-ground realities, e.g., low digital literacy, interactions between the semi-literate farmers and traders, the importance of tacit know-how, the involvement of social contacts, and poor infrastructure in India (Kaur, 2015; Shalendra and Jairath, 2016).

## 2.3 B-B e-commerce and wholesale marketing in India

Several digitalization efforts are attempted across the agricultural pre and post-harvest supply chain (Figure 2.2). The agricultural sector is witnessing a digital revolution to increase productivity, improve farm practices, make marketing efficient, generate more income for farmers, lower costs, and reduce environmental hazards. The Covid-19 pandemic has further forced the economies to improve their agriculture supply chains' resilience and security.

Before 2015, B-B e-commerce implementation at a large scale was rarely attempted on agricultural-related websites in India. The Indian agriculture websites were limited only to information exchange. Most of the initiatives lacked B-B e-commerce of agricultural produce or service provision. Even today, most successful private B-B e-commerce (ITC e-Choupal, eKutir, Agribazaar) are concentrated in a small area of the country or meet enterprise partners' needs.

The B-B e-commerce system (eNAM) is comparatively better than other prevailing systems, e.g., open auction, manual tender, and direct sale (Chengappa et al., 2012; Mishra and Mishra, 2017; Nirmal, 2017; Pavithra et al., 2018).

Open auction may have a trader collusion scope, whereas; manual tendering is prone to alteration of quotes and entry errors. The direct sale system reduces the bargaining power of a farmer due to a lack of competition. The B-B e-commerce process is transparent and fast. The farmer and the trader know the prices in real-time. These are disseminated quickly using electronic means, e.g., messages and mobile. Thus, a farmer may get a higher price than selling their produce at the farm gate (Banker et al., 2011; Chand, 2016; Dey, 2016).

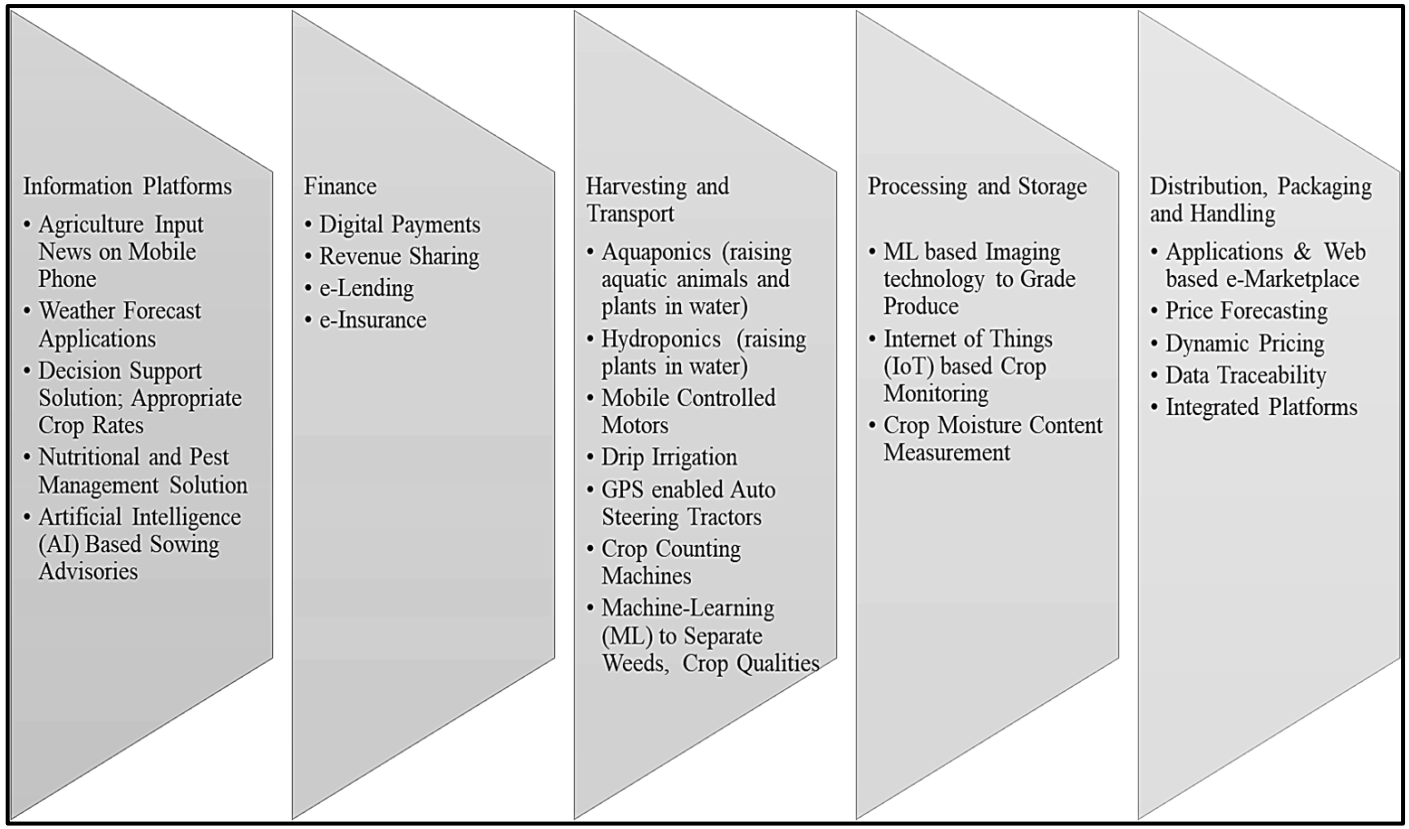


Figure 2.2 Digital Interventions in Agricultural Supply Chain

(Source: Adapted from FICCI, 2018; NASSCOM, 2019)

The critics of electronically held inter-market trade quote the inability to verify quality and lack of physical interaction. In addition, it results in low confidence while transacting (Pavlou and Gefen, 2004).

Over the years, the Indian Government has taken several steps to improve the agricultural marketing system, as shown in Figure 2.3. The efforts are as per the national policy on Information and Communication Technology (ICT) in agricultural extension. The consistent efforts have culminated in forming the new Model Agricultural Produce and Livestock Marketing (APLM) Act, 2017, by the Central Department of Agriculture Cooperation and Farmers Welfare for its customized adoption by the State Governments.

As per the Act, the intended vital improvements in agricultural marketing include setting up private or specialized market yards, a public-private partnership for agricultural market management, direct purchase from the farmer, recognition of farmers' producer organization, one-point market fee payment, contract farming, and unified licensing. However, only eighteen states and three Union Territories have amended their state APMC laws in line with the model Act as of June 2022. It reflects India's slow progress in agricultural marketing and supply chain-related reforms.

The significant outcome of the Model APMC Act is a national B-B e-commerce platform [National Agriculture Market (eNAM)]. eNAM is implemented in one thousand wholesale agricultural produce market committee (APMC) markets as of June 2022. The Government has announced the launch of eNAM in all 2,479 APMC market yards and 4,843 APMC-regulated sub-market yards by 2022 (MOAFW, 2022).

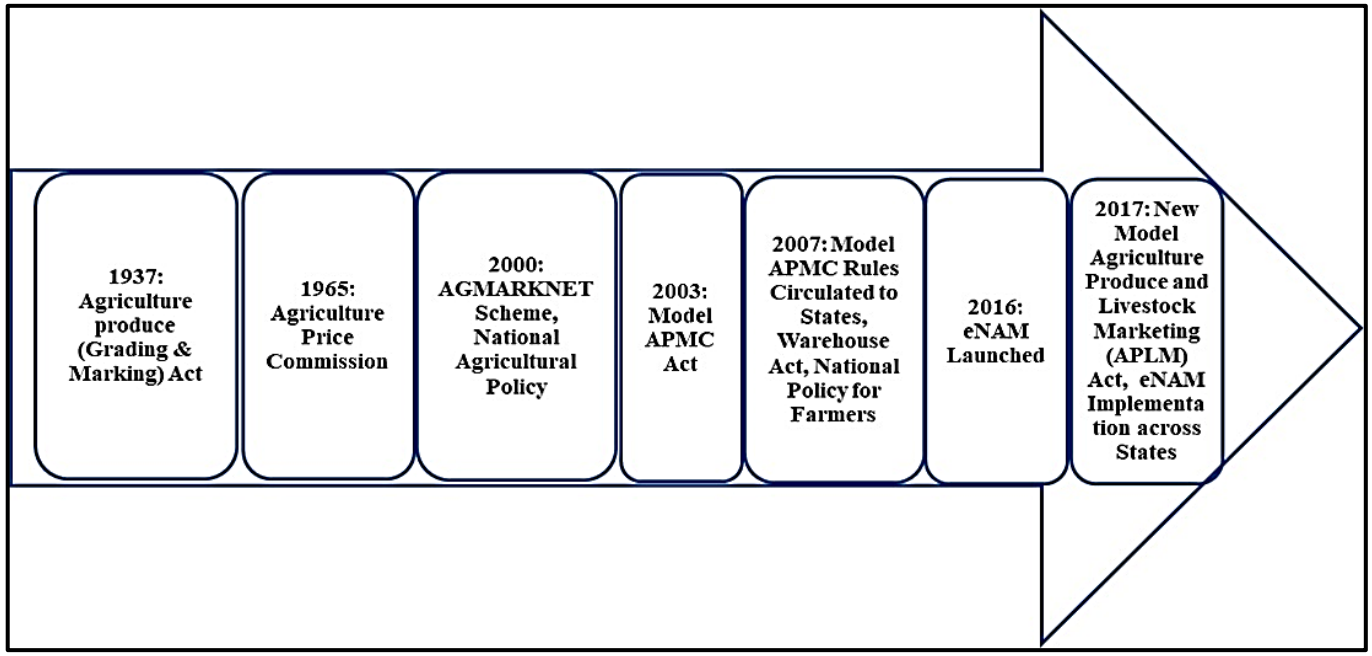


Figure 2.3 Major Regulatory Steps in Agriculture Marketing
(Source: Adapted from MOAFW, 2018)

The synergetic linkage between APMC and eNAM is well reasoned. eNAM provides forward e-integration with buyers and corporations in the agricultural supply chain. At the same time, the APMC provides a backward integration with farmers. According to the Government, the eNAM platform empowers farmers in terms of price information, selling directly to buyers across India, getting better prices for quality, and reducing marketing costs (DAC, 2013).

eNAM B-B e-commerce-based trading is unique because it is an impartial fee-based model. It offers a neutral B-B e-commerce platform by providing equal trading opportunities to all the participants. The eNAM is a flagship government scheme of immense significance since it reaches out to a significant part of India's population. It is listed as a critical instrument of better market price realization in India's government report on doubling farmers' income by 2022 (ICFA, 2016).

In the private sector, during 2013-17, only 126 private marketing licences were issued. The corresponding turnover was also low — the reason cited is the low return on investment (NABARD, 2018). Under the Model Agriculture Produce and Livestock Marketing Act (APLM Act) 2017, the Government has allowed private entities to extend and operate anywhere within the state. In comparison, APMC has its power restricted to the market yards in their respective market areas. Also, the coherence among organizational culture, structure, and strategy besides integration between organization-customer-supplier may help these private sector efforts improve their Wholesale B-B e-commerce efforts (Kumar et al., 2017).

## 2.4 Adoption and Benefits of Agricultural B-B E-Commerce

The earlier studies focused mainly on defining the concept of e-marketing and its use in agriculture markets, including a price gain (Henderson, 1984; Sporleder, 1984).

A study of MarketMaker (a USA government-sponsored electronic trade website for agriculture) estimated that participants had received an average of 2.6 new leads and 1.5 new customers. In addition, registered farmers increased their annual average revenue by USD121 (Zapata et al., 2013).

One critical insight from the case study of MarketMaker, relevant from India's point of view, is that the B-B e-commerce forerunners should encourage other users to become more frequent to achieve the desired benefits. The reason is that the benefits associated with B-B e-commerce increase with increasing familiarity with the website functions (Zapata et al., 2013). Of course, liquidity is a prerequisite for success, necessitating the increasing number of farmers registering and using the website. Given this, peer persuasion and media advertisement are desirable features of B-B e-commerce.

An analysis of the international website www.agriculture.com, with several hits per day as a success criterion, revealed that low transaction costs, national and local language content, number of product categories, trading in agricultural machinery, and age of the e-marketplace are all positively significantly correlated with success (Clasen and Mueller, 2006).

Studies in the Indian context quote the main reason for the agricultural B-B e-commerce platform-based marketplace's success is local community involvement (farmers/traders), practical implementation, trust, and good IT network availability (Chahal, 2012; Jain, 2016). In addition, the participants may pay a premium for high trust provided by a neutral, third-party host provider (Vassalos, 2014). Given this, roping in a third party for implementation, support, and technical operations by eNAM is a logical step.

In the Indian context, a successful e-platform is expected to provide farmers with instructions about getting the best possible benefits from B-B e-commerce. In addition, B-B e-commerce platforms and B-B e-commerce websites shall also provide information related to marketing, best practices, weather forecast, and rural development programmes (Rahane and Waghmare, 2011).

Along with success factors come the barriers to success. The three significant barriers are: change in the value chain, multiple quality levels, and the high-volume trading nature of transactions in agriculture (Leroux et al., 2001).

A combination of strategies can lower the adoption barriers; altering the structure of the value chain (including third-party service providers, alliances with ancillary

service providers/ niche players, and operating virtual supply channels), using expertise (market know-how, commodity knowledge, risk profile), and improving organizational readiness (training, customer care, and knowledge sharing) (Leroux et al., 2001).

The B-B e-commerce platform is expected to reduce operational costs, expedite the process, and improve informational quality. It enhances the performance of purchasing rights, as it helps them delivered with all rights, e.g., price, quality, amount, source, and time (Smart and Harrison, 2003; Auramo et al., 2005; White et al., 2005; Shirzad and Bell, 2013; Mor et al., 2015; Tripathy et al., 2016; IBEF, 2019).

Several studies have detailed the beneficial effect of ICT on India's agricultural marketing and supply chain efficiency (Banerji and Meenakshi, 2004; Chaudhuri and Verma, 2008; Durga, 2012; Modekurti, 2016). For example, B-B e-commerce wholesale prices are 3.3 per cent higher for raw coffee grades and 2 per cent higher for non-premium coffee grades than farm-gate prices. Further, the farmers and primary traders have more chances to get better rates in B-B e-commerce. For example, it has been observed that introducing information kiosks in several markets in the State of Madhya Pradesh in India resulted in the increased price of soybean by 1 to 3 per cent. Thus, it reduced price dispersion across markets (Goyal, 2010; Banker et al., 2011).

The government-sponsored pan-India B-B e-commerce portal, eNAM, works in one thousand regulated APMC markets across India. The eNAM is built on the success stories of several smaller initiatives in the public sector and the private sector. Two such efforts are Unified Marketing Platform (UMP) and the Indian Tobacco Company's (ITC) e-Choupal. Between 2000 and 2005, ITC set up seventeen hundred web kiosks and forty-five procurement hubs in the major soybean-producing areas of Madhya Pradesh. The e-Choupal intervention resulted in a substantial increase in the monthly average wholesale price realized by the soybean farmers in APMCs between 2000 and 2005. This market price increase of soybean was between 1 to 3 per cent, the price dispersion across APMCs got reduced, and the area under soybean cultivation increased significantly. The Unified Market Platform (UMP) in Karnataka has helped farmers see an average price realization increase by thirteen per cent (in real terms, after deflation by WPI) in 2015-16 over the year 2013-14. Lessons on

technology adoption and usage to benefit all stakeholders, including farmers, may also be learnt from Pepsi and Suguna cases (Goyal, 2010; ICFA, 2016; Jain, 2016; The Financial Express, 2017).

Compared to eNAM, most successful private e-marketplaces (ITC e-Choupal, eKutir, Agribazaar) are concentrated in a small area of the country or meet enterprise partners' needs. It is interesting to note that the investment in the agriculture sector is 15 per cent of the Government and the remaining 85 per cent from the private sector. Though the Government may initially take the lead, it needs to incentivize the private sector to act faster and better (NITI, 2017).

## 2.5 Prospective Development of B-B E-commerce Platforms

Compared to the non-platform business, platform companies achieved the same sales with half the number of employees. The platform businesses are twice as profitable, growing twice as fast, and more than twice as valuable, probably because they leveraged employees and assets outside the firm (Cusumano, Gawer and Yoffie, 2019).

However, the above comparison is specific to large publicly traded companies in the United States of America and Europe, e.g., Cargill, Corteva, Syngenta, Bayer, and BASF. Achieving such a scenario in the Indian agricultural sector may require new strategies and leadership styles. The skills required to control internal resources tightly are not enough. The new skills are required to nurture the external ecosystems. For example, despite its small size, the agricultural B-B platform 'Talcot' succeeded due to proactive management, flexibility in technology upgrades, user participation, and a responsive team (Linsey et al., 1990; Alstyne et al., 2016).

The B-B e-commerce platform provider eNAM has started to affiliate with partners (logistics companies, information providers, payment, and finance companies) to reduce internal limitations and garner extra resources. It may further strategically align the partners with extended networks and get the growth network effect due to the direct and indirect positive feedback loop (Parker and Van Astylne, 2018; Snihur et al., 2018; Schmidt et al., 2021).

The service provider (eNAM) uses the latest technologies, such as mobile devices, cloud computing, big data analytics and web 3.0. Now, these technologies may be used to create a service-oriented architecture. The service-oriented architecture has helped international companies increase their coverage by sharing the platform with complementors and developers (Hein et al., 2019).

The most valuable platform-based global companies (Cargill, Corteva, Syngenta, Bayer, and BASF) have innovation and transaction platforms to connect different partners. Currently, on eNAM, vertical integration or closed subcontracts are preferred. However, once the threshold (users, developer base) is reached, the B-B e-commerce platform provider (eNAM) may offer an open default contract to any developer. It allows the complementing partners to build upon the platform. This approach may help attract many resources from third parties and increase the profitability of the platform provider eNAM (Parker et al., 2017; Cusumano, 2020).

## 2.6 Future Roadmap to Agriculture 4.0

According to the Food and Agriculture Organization (FAO), food production is expected to increase by seventy per cent by the year 2050, and it needs to be marketed efficiently to feed 9 Billion humans. The key enablers of this shall be e-commerce and agriculture 4.0 technologies. The market size of agriculture 4.0 technologies is expected to be USD 21 Billion in the year 2026 (Variant Market Research, 2022).

The study has discussed B-B e-commerce. Further, the broader area of Agriculture 4.0 is detailed below.

The agriculture ecosystem in the most developed countries is evolving to agriculture 4.0 (digital agriculture, e-agriculture). Though developing countries like India are in the pilot testing or early deployment stage as far as agriculture 4.0 is concerned.

Agriculture 4.0 uses industry 4.0 technologies to generate knowledge and support decision-making to improve agriculture’s sustainability (economic, environmental, and

social). It uses a resource-efficient approach of streamlined agricultural product system using precision agriculture farming solutions (involving Internet of Things, mobile phones, smart tractors, smart equipment, robot, and drone) and smart farming (farm management, big data, analytics, artificial intelligence, cloud) solutions (Scuderi et al., 2022). The advent of technologies in industry 4.0 and agriculture 4.0 is shown in Table 2.1.

Table 2.1 Illustrative Timeline of Technology Progress

| **Year** | **Industry Version** | **Theme** | **Technologies** | **Agriculture Version** | **Technologies** |
|---|---|---|---|---|---|
| Before 1784 | | | | Agriculture 1.0 | Manual work, indigenous tools, animal power |
| 1784-1870 | Industry 1.0 | Mechanization | Steam engine, waterpower | Agriculture 2.0 | Tractor, fertilizer, pesticide |
| 1871-1969 | Industry 2.0 | Electricity | Mass production, electrical energy | | |
| 1969-2010 | Industry 3.0 | Computers and electronics | Automation, information technology | Agriculture 3.0 | Yield monitoring, guidance system, variable rate application |
| 2011 onwards | Industry 4.0 | Intelligence | Artificial intelligence, Internet of things, big data | Agriculture 4.0 | Autonomous farming, reliable food supply, ubiquitous sensors |

(Source: Adapted from Liu et al., 2021)

Beyond the farm, agriculture 4.0 can contribute to Indian agriculture in the following areas:

- Early warning system (for disaster management)
- E-marketing
- Farmer capacity development
- Fintech for financial services and crop insurance
- Food safety using blockchain and image recognition
- Innovative systems for agriculture

- Rural empowerment
- Support compliance
- Sustainable agriculture
- Traceability using blockchain

Agriculture 4.0 solutions with information and communications technology (ICT) at their core may improve access to assets, markets, and services across the agricultural value chain (Figure 2.4).

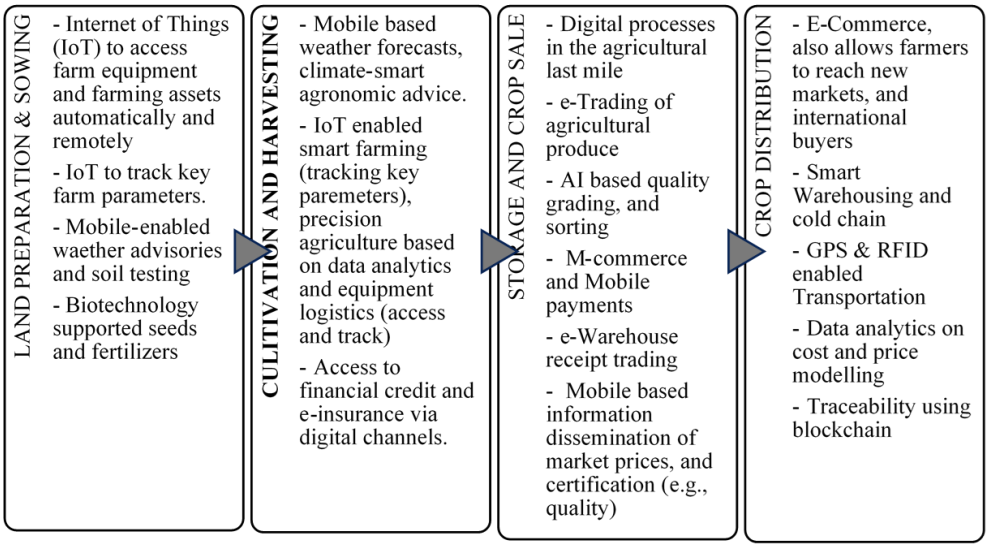


Figure 2.4 Digital Solutions in Agricultural Value Chain

(Source: Adapted from GSMA, 2020)

Artificial intelligence-based analyses determine seed type, seed quality detection, pest identification, crop disease identification, and customizing small-scale solutions. Internet of Things (IoT) and big data (BD) analytics help adjust the lighting for indoor farming. It is also helpful for the health monitoring of livestock. Drones and a three-dimensional (3D) mapping system help gather information about geography, crop conditions, pest infections and soil structures in smart agriculture. Even drip farming uses IoT sensors to water the farm's deficient area to the required level. Robotics help in seed plantations, spraying pesticides, and producing harvesting. It, along with self-driven tractors, promotes better efficiency.

Blockchains have shown the potential to improve food security, safety, integrity, support for small farmers, waste reduction, and better supply chain management (Hooijdonk, 2019).

The data analytics solution involves farm mapping, farm management (soil and crop health diagnostics), drones or tractor-based data on weather/crop to forecast or assess risk using artificial intelligence, customer relationship management, blockchain traceability, and compliance.

The infrastructure enablers include drone-enabled vertical farming monitoring solutions, aquaponics, IoT-enabled smart farming, high-precision crop control, data collection/analysis, automated farming techniques, hydroponics, and drip irrigation.

Farming as a service (FAAS) solution involves on-demand harvesting, digital payments, market pricing and agricultural machinery platforms (renting and crop care practices). The agri-finance solutions cater to fees, revenue sharing, insurance, and lending features (FICCI, 2018).

The market is already witnessing start-ups and large companies (Bayer, Cargill, Syngenta) initiatives in the above domains. The shared and B-B e-commerce platforms tend to help these initiatives as they share the platform with such partners and developers (Hein et al., 2020).

For example, the B-B e-commerce company, Agribazaar (www.agribazaar.com) used blockchain to tag proof of origin and authenticity. The blockchain-based traceability reduced the electronic-trade commissions from two or three per cent to half per cent. The e-wallet helped quick and hassle-free digital payment of more than USD 1 Billion between 2017-2021. The internet of things solutions help track vehicle transportation for on-time delivery and commodity distribution. Artificial intelligence-based image recognition is used to gauge the quality of the produce. The artificial intelligence algorithms enable users to get a customized credit-on-a-click, and crop advisory.

The combination of agriculture 4.0 solutions and B-B e-commerce technologies is poised to make progressive changes in agricultural production and marketing in India.

## 2.7 Trends in Scholarly Research

The empirical research on the study topic is limited. A few statistics are detailed below-concerning research articles published in scholarly journals only during the last decade (2013-2022).

The academic databases of ProQuest (http://www.proquest.com) are searched for the term 'E-commerce' or 'Electronic commerce in the article's title only. The search result is 1827 articles in the scholarly journal during the last decade.

When the above search was further restricted to 'B-B E-commerce' across the sectors, the search results were surprisingly restricted to only 36 articles in the scholarly journal during the last decade. Among the B-B e-commerce articles, all were published in English. Among geographies, China is most prolific with four articles tagged, whereas the United States, India, and Canada came second with two geography-tagged articles each. Among the top five journals are the Sustainability, Academy of Marketing Studies Journal, Electronic Commerce Research, International Journal of Production Research and IOP Conference Series. Materials Science and Engineering, respectively.

The list of articles in the scholarly journals of business and management domain during the last decade was only 51 that also include 'Agriculture e-commerce' or 'Agriculture electronic commerce' in the title of the articles. Again English is the dominant language, and among countries geo-tagged to articles, China is followed by India, Jilin China, Taiwan, and Bangladesh in descending order. The search result for 'Agriculture B-B e-commerce' or 'agriculture B-B electronic commerce' in the document title did not yield any results. Thus, searching for such articles is completed using the Scopus (http://www.scopus.com) database.

The search results of the database 'Scopus' provides the required indicators of the number of published articles in scholarly journals. The search is widened for the term 'Agricultural B-B E-commerce' in the title, abstract or keywords during the last decade. The result list includes 55 articles. However, the trend is upward, with the number increasing from 1 published article in 2004 to 7 published articles in 2021 (Figure 2.5).

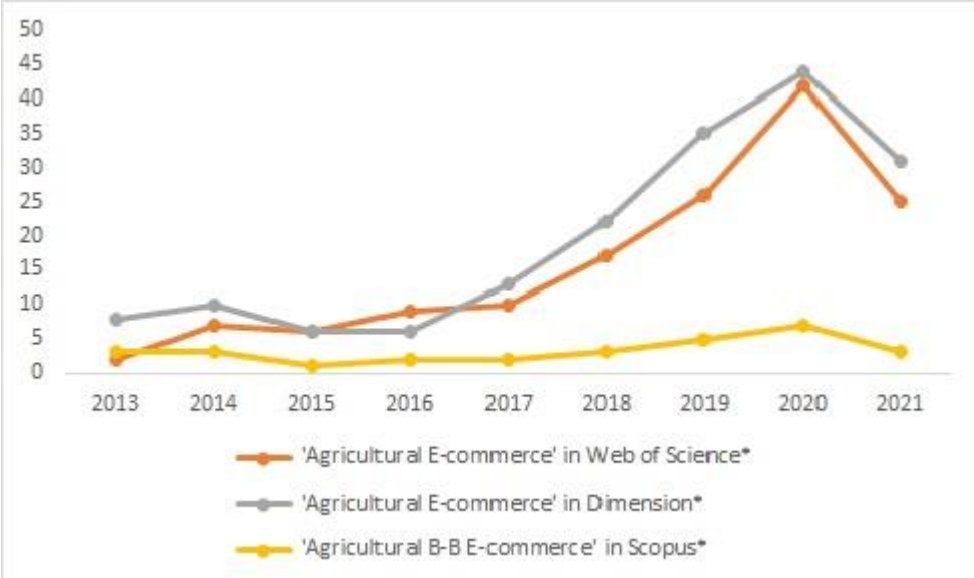


Figure 2.5 Number of Articles in the Scholarly Journals

(Source: Adapted from http://www.dimensions.ai, http://www.scopus.com, and https://www.webofscience.com)

**Decade till August 2022*

*Note: Scopus and Web of Science search are in the text of the article title, abstract and keywords. The Dimension database search is in the title and abstract only.*

The upward trend in 'Agricultural B-B E-commerce' is backed by the increasing academic research interest in the larger domain of 'Agricultural E-commerce'. The search results from another popular scholarly database, Dimensions (http://www.dimensions.ai), show that the academic research in 'Agricultural E-commerce' is increasing in the business and management domain. For example, the search for the term 'Agricultural E-commerce' in the Title and Abstract of a published article resulted in a list of 178 articles during the last decade till 2022. However, the trend of published articles is steadily increasing as three such articles were published in 2013, which increased to 31 in 2022 till date (Figure 2.5). Similarly, the trend of open

access publishing is upward as only two articles were open access in the list, as mentioned earlier, which increased to 18 in 2018, 29 in 2020, and 36 in 2021.

On the Web of Science core databases (https://www.webofscience.com), the search is further widened by searching for the terms ‘Agriculture E-commerce’ anywhere in the title, abstract, or keywords leading to 159 articles in scholarly journals over the last ten years. Most of these articles were in the domain of business and management (51), followed by computer science and information science (49), and agriculture or food science (35). Again the trend of publishing in the area is upward, with the top five journals as Journal of theoretical and applied electronic commerce research, electronic commerce research, electronic commerce research and application, Institute of Electrical and Electronics Engineers (IEEE) Access, and Sustainability.

The above statistics highlighted the limited academic literature in the ‘Agricultural B-B E-commerce' area with the business and management domain. However, the academic community's interest has been increasing over the years, as evident from the increase in published articles in scholarly journals. The increased number of published articles may be attributed to renewed interest in the topic during the pandemic period, an increase in open-access publishing, and demand for academic literature from the research community in the post-pandemic environment.

## 2.8 Review of Adoption Models and Theories

There are popular technology adoption theories in the literature that directly or indirectly explain e-commerce adoption (Hong and Zhu, 2006). Most of these theories (Table 2.2) have their origin in systems, psychology, and sociology.

Table 2.2 Popular Technology Adoption Theories

| Theory | Author | Explanation |
|---|---|---|
| Theory of Reasoned Action (TRA) | Fishbein and Ajzen (1975) | The beliefs influence attitudes, which, in turn, leads to the intention to use and finally to the actual performance of the behaviour. The stronger the intention, the more likely it will lead to the actual behaviour. Its primary constructs are Attitude, Subjective Norm, Behavioural Intention and Behaviour. |
| Diffusion of Innovation Theory (DOI) | Rogers. E. M. (1983) | The individual receiver's perceptions of the five attributes of innovations (relative advantage, compatibility, complexity, trialability and observability) predict an innovation's adoption rate. In addition, other variables affecting the innovation rate of adoption include the type of innovation decision, the nature of communication channels, the nature of the social system, and the extent of change agents' efforts in diffusing the innovation. |
| Theory of Planned Behaviour (TPB) | Ajzen (1985) | TPB is an expansion of TRA. The construct behaviour is expanded to perceived behavioural control (Perceived ease of performing the behaviour and reflects experience and anticipated impediments and obstacles). |
| The Technology Acceptance Model (TAM) | Davis et al. (1989) | The TAM is to predict the consumer's acceptance of technology. Its primary constructs are Behavioural Intention, Attitude, Perceived Usefulness and Perceived Ease of Use. |
| Technology - Organization - Environment Framework (TOE) | Tornatzky, L. G., and Fleischer, M. (1990) | It identifies three types of factors that affect technology innovation adoption: the technological context (e.g., availability, characteristics), organizational context (e.g., size, the complexity of organizational structures, communication processes, availability of slack resources), and environmental context (e.g., industry characteristics and market structure, IT infrastructure, government regulation). |
| Unified Theory of Acceptance and Use of Technology (UTAUT) | Venkatesh et al. (2003) | The theory has three direct determinants of intention to use (performance expectancy, effort expectancy, and social influence) and two direct determinants of usage behaviour (intention and facilitating conditions). |
| Unified Theory of Acceptance and Use of | Venkatesh et al. (2012) | An extended model of UTAUT. The original model is extended in the consumer context. It adds three new constructs: hedonic motivation, price value, and habit. |

| | | |
|---|---|---|
| Technology (UTAUT2) | | |
| Other not too prominent theories: | | |
| Resource-Based View (RBV) | Wernerfelt, B. (1984) | Firms have heterogeneous resources (valuable, rare, imperfectly imitable, and non-substitutable), which enable them to achieve competitive advantage and superior long-term performance. |
| Expectation-Confirmation Theory (ECT | Oliver (1980) | This model embodies the concept that expectations with perceived performance lead to post-purchase satisfaction. Its main constructs are Expectation, Perceived Performance, Confirmation, Satisfaction and Repurchase Intention. |

The three broad types of theory extensions are possible. First, examine the theory in a new context (recent technology, new user demographics, and new cultural setup). Second is the addition of new constructs to expand the scope of the theory. The third is the inclusion of new observed (exogenous) predictors of the variables.

The Diffusion of Innovation Theory (DOI) draws on the perceived characteristics of specific technology or system to explain the behaviour of the users to adopt that technology, while the Theory of Reasoned Action (TRA) looks at the beliefs of an individual to explain adoption behaviour (Morris and Dillon, 1997). According to the TRA, if the suggested behaviour is evaluated as positive (attitude), and if they think its performance is want of significant others (subjective norm), this leads to a higher intention (motivation) and subsequent behaviour. A high correlation of attitudes and subjective norms to behavioural intention and subsequent behaviour has been confirmed via many studies (Sheppard et al., 1988).

The Theory of Planned Behaviour (TPB) is essentially an extension of TRA with an additional belief, perceived behavioural control to explain the behavioural intention. The perceived behavioural control refers to the degree to which a person believes that they control any given behaviour. It consists of two dimensions: self-efficacy and controllability. Self-efficacy refers to the level of difficulty that is required to perform the behaviour, and controllability refers to the outside factors (Ajzen and Fishbein, 2005).

B-B e-commerce adoption decisions incorporate both transactional and non-transactional dimensions, which means that users' intentions to perform should be regarded as multi-dimensional behavioural intentions (Pavlou, 2002). Subjective norm is defined as an individual's perception regarding approval or disapproval of his behaviour by significant others. Purchase intention refers to the possibility of a user's willingness to buy a product (Zeithaml, 1988). The subjective norm has a positive but not significant impact on intention. Further, the intention is found to be significantly and positively related to behaviour (Mishra, 2014).

Evolving from TRA, the Technology Acceptance Model (TAM) (Davis, 1989) gained a reputation as a model that addresses individuals' behaviours and attitudes towards technology. Several researchers have replicated Davis's original study to provide empirical evidence on the relationships that exist between usefulness, ease of use and system use (Adams, Nelson, and Todd, 1992; Segars and Grover, 1993; Subramanian, 1994). For the instrument usage for different populations and products, the researchers found good test-retest reliability with predictive validity (Hendrickson, Massey and Cronan, 1993; Szajna, 1994). The importance of the perceived usefulness to Information System (IS) adoption has been documented in some earlier studies (Pikkarainen et al., 2004; Cheong and Park, 2005). The perceived ease of use has a significant positive effect on behavioural intention; and is noted as significantly related to usage intentions in the context of mobile banking (Amin et al., 2008)

Several studies extended TAM by adding variables in it to explore their effects on users' attitudes, behavioural intention, and actual use of technology. Some of these factors are perceived self-efficacy, facilitating conditions, systems quality, trust, experience, risk, cost, reputation, reliability, and functionality (Chircu and Kauffman, 2000; Fathema, Shannon, and Ross, 2015). One such modification, TAM 2 (Venkatesh and David, 2000,) includes the following variables: usage, intention to use, perceived usefulness, experience, social influence processes (subjective norms, voluntariness, and image), and cognitive instrumental processes (job relevance, output quality, result demonstrability and perceived ease of use).

The TAM 2 later resulted in the Unified Theory of Acceptance and Use of Technology (UTAUT). It integrates the eight models of TRA, TPB, decomposed TPB,

TAM, Innovation Diffusion Theory (IDT), Social Cognitive Theory (SCT), the Motivational Model and the Model of Personal Computer Utilization (MPCU). The UTAUT (Venkatesh et al., 2003) integrates the technology acceptance domain into one theory with ‘behavioural intention’ and ‘actual usage behaviour’ as the main dependent variables.

In the online research database "PROQUEST" on April 25, 2017, the Unified Theory of Acceptance and Use of Technology (UTAUT) is prominently among the search results. The UTAUT (Venkatesh et al., 2003) theory has 'behavioural intention' and 'actual usage behaviour' as the primary dependent variables.

The UTAUT has received numerous citations since 2003. The model is also confirmed in a cross-cultural study applicable across countries (Oshlyansky et al., 2007).

The UTAUT is a better choice based on the variance analysis done by several researchers. The competing frameworks explained between 17 per cent and 53 per cent of the variance in the usage intentions, compared with UTAUT, which explains about 70 per cent of the variance (adjusted $R^2$) in usage intention (Venkatesh et al., 2003).

The UTAUT is preferred over the UTAUT2 since UTAUT is suitable at both organizational and individual levels. In contrast, UTAUT 2 is mainly used for Individual-level studies. In many research studies, UTAUT explains the acceptance and use of a technology (Baron et al., 2006; Venkatesh and Zhang, 2010; Chen and Chang, 2011).

The UTAUT applies to both individual and organization subjects. For example, the UTAUT use-case includes a study of perceptions of 243 individuals in Finland toward mobile services (Koivumäki et al., 2008), a study of social influence on intention to adopt technology in 152 German companies (Eckhardt et al., 2009), and the social media adoption by 409 United States non-profit companies (Curtis et al., 2010). The theory is also used to explain m-technologies (Park et al., 2007), m-learning (Wang et al., 2009), m-shopping (Yang, 2010), m-banking (Yu, 2012), m-trading of stocks (Ku and Tai, 2013) and location-based mobile services (Zhou, 2012). The extended

UTAUT is also used in several studies, e.g., the physicians' adoption of robotic-assisted surgery (BenMessaoud, Kharrazi, and MacDorman, 2011), mobile learning in Taiwan (Wang and Wu, 2009) and m-banking adoption in India (David and Deb, 2014).

Several studies found new constructs and extended UTAUT, for example, two new constructs added in a study (attitude toward using technology, leadership) on the physicians' adoption of robotic-assisted surgery (BenMessaoud et al., 2011) and two new constructs (perceived playfulness, self-management) in the study of the acceptance of mobile learning in Taiwan (Wang et al., 2009). For e-commerce, a positive relationship is found for three variables (usefulness, ease, and social influence) to the intention to adopt m-banking (Deb and David, 2014). In the negative opinion, the presence of a high number of independent variables is highlighted by critics (Bagozzi, 2007).

The Unified Theory of Acceptance and Use of Technology (UTAUT) is considered the base framework for expansion and further improvement.

## 2.9 Research Gap and Research Questions

Based on the literature review, the research gaps are identified as follows:

- Research on agricultural B-B e-commerce adoption is scarce. The research focus in agriculture is still technology and science-oriented with many articles, but there is a dearth of academic literature on the management side. The extension of adoption theories in the new context (B-B e-commerce technology, Indian geography, and agricultural market) with new or modified constructs shall add to the academic literature.
- The case studies on the agricultural B-B e-commerce marketplace are few, particularly in the Indian context. Before eNAM, India's corporate or government initiative was restricted to a limited geographic area and dealt in a small number of commodities. The spread and number of start-ups were limited by the low internet and mobile penetration in rural areas. Detailed proprietary data about users and adoption is not available from the companies. The farmers do not freely share the information due to limited information technology literacy and

non-clarity on initiatives. Thus, the case studies' in-depth analyzing the phenomenon of agricultural e-commerce and marketplaces in the natural, real-life context are limited.

- The India-specific studies are limited in number. The agricultural B-B e-commerce is a relatively new phenomenon in India, and there is a lack of credible data and published scholarly articles. The analyzed data in public space is still limited. Only during the last five years is limited data made available through the institutes, government portals, industry associations and venture capitalists. However, a reasonable number of academic studies in the management domain are still a requirement, especially on the lesson learnt from the current and past initiatives.
- There is little research in India on agricultural B-B e-commerce benefits for farmers. Only select academic articles were published during the last ten year, mainly focusing on the information sharing and process automation aspects of information technology. The comprehensive and in-depth detailing of activities linked to promoting agricultural B-B e-commerce is still an open area.

The above leads us to the following research questions:

- What are the determinants of B-B e-commerce adoption in the Indian agriculture sector?
- How can the adoption of agricultural B-B e-commerce be promoted?
- What are the valuable lessons learnt from current and past initiatives?

If the determinants are identified, defined, measured, and related to adoption, then the model of a framework contributing to the adoption theory may be proposed. Also, the recommendations on the activities from the different stakeholders that may positively or negatively influence the adoption shall be helpful for policymakers and practitioners. Besides the users and experts, it may be helpful to consider the management viewpoint of agricultural B-B e-commerce Start-ups’ chief executive officers. The lessons from the venture's success, failure, growth, and issues shall be valuable real-life learning.

## 2.10 Research Objectives

The research questions have led to the following research objectives:

- To propose an adoption framework for B-B e-commerce in the context of agricultural marketing.
- To validate the adoption framework for agricultural B-B e-commerce in the context of the National Agriculture Market.
- To suggest ways for improving agricultural B-B e-commerce adoption based on a study of the National Agriculture Market and other similar initiatives.

## 2.11 Concluding Remarks

An attempt has been made to understand B-B e-commerce, B-B e-commerce in agricultural marketing, the evolution of B-B e-commerce in agricultural wholesale marketing in India, existing theories and frameworks for technology adoption, and empirical evidence.

This chapter aims to identify research gaps and generate research questions based on the learning from the literature review. Based on the literature review, the shortcomings of the existing framework from the point of view of the B-B e-commerce system and agricultural marketing in India were learned.

Several issues pertinent to agricultural marketing, agricultural supply chain, rural India, B-B e-commerce project (eNAM), and user demographics led to the proposed conceptual adoption framework. As a result, the need arises to develop a revised and validated adoption framework based on the existing literature review.

It is crucial to analyze the B-B e-commerce system of both public and private sectors for better understanding.

The eNAM and several other private sector initiatives are discussed in the next chapter.

# Chapter 3

# National Agriculture Market and other Projects

## 3.1 Introduction

A pan-India integrated wholesale online B-B e-commerce platform, information exchange and enabling infrastructure are the need of the hour (Chahal et al., 2012; Mor et al., 2015; NABARD, 2018). The National Agriculture Market (eNAM) is a step in the direction of meeting this requirement. eNAM has become the de-facto unified national B-B e-commerce platform for agricultural commodities in India. The eNAM initiative is expected to enhance previous market information dissemination initiatives, e.g., AGMARKNET and mKrishi (Suri, 2005; Agmarknet, 2019). It helps meet the need for harmonization and consistency across Indian states regarding plans, regulations, and implementation (OECD, 2019).

Compared to eNAM, other initiatives are either smaller in size or scope in terms of geographical spread and commodities covered.

The study focuses on the eNAM project. Besides eNAM, Agribazaar and a few other agricultural B-B e-commerce projects were analyzed through the literature review and by interviewing executives. It helps to know the issues being faced by the smaller start-ups in the private sector.

## 3.2 National Agriculture Market Project

To meet the need of the hour, the Government of India approved a scheme for deploying a unified B-B e-commerce platform, eNAM (Figure 3.1).


Figure 3.1 National Agriculture Marketing Portal

(Source: MOAFW, 2022)

The eNAM is implemented in one thousand wholesale agriculture produce market committees (APMCs). It is expected to reach all 2,477 APMC market yards and subsequently 4,843 APMC-regulated sub-market yards. In stages, it envisions networking all APMCs (PIB, 2021; MOAFW, 2022).

The Small Farmers' Agribusiness Consortium (SFAC) manages the project. With regular investment and continued operational support, eNAM aims to fill the infrastructure gaps built over six decades. The eNAM initiative is expected to take India's agricultural marketing system to the next higher level. The effort is a significant shift in India's APMC markets (Chand, 2016; Shalendra and Jairath, 2016; Subramanian, 2016).

The entire initial costs of the ICT platform, including maintenance, are borne by the Ministry of Agriculture and Farmers Welfare. However, the local operations costs, including local software, quality checks, and human resource costs, are met by the

per-transaction fee (about 2 per cent) charged by APMC. The bifurcation makes high usage of the B-B e-commerce ICT platform attractive for the local APMC market.

### 3.2.1 eNAM Trading and Transaction Process

In eNAM, most trade process activities are in the online form. The eNAM platform has a virtual electronic trading portal in the front with a physical market ('Mandi') infrastructure at the back end. The end-to-end B-B e-commerce process activities (Figure 3.2), e.g., registration of farmers/traders/buyers/agents, lot entry at the gate, quantity and quality check, trading, and payments, are digital. At the same time, the actual material movement happens in the physical market. In any market, the selected agricultural commodities are mandatorily traded online on e-NAM.

For quality grading, standard tradable parameters are developed for 175 agricultural commodities. Market-specific products out of the expanding list of 175 permissible commodities are bought-sold-paid through online transactions.

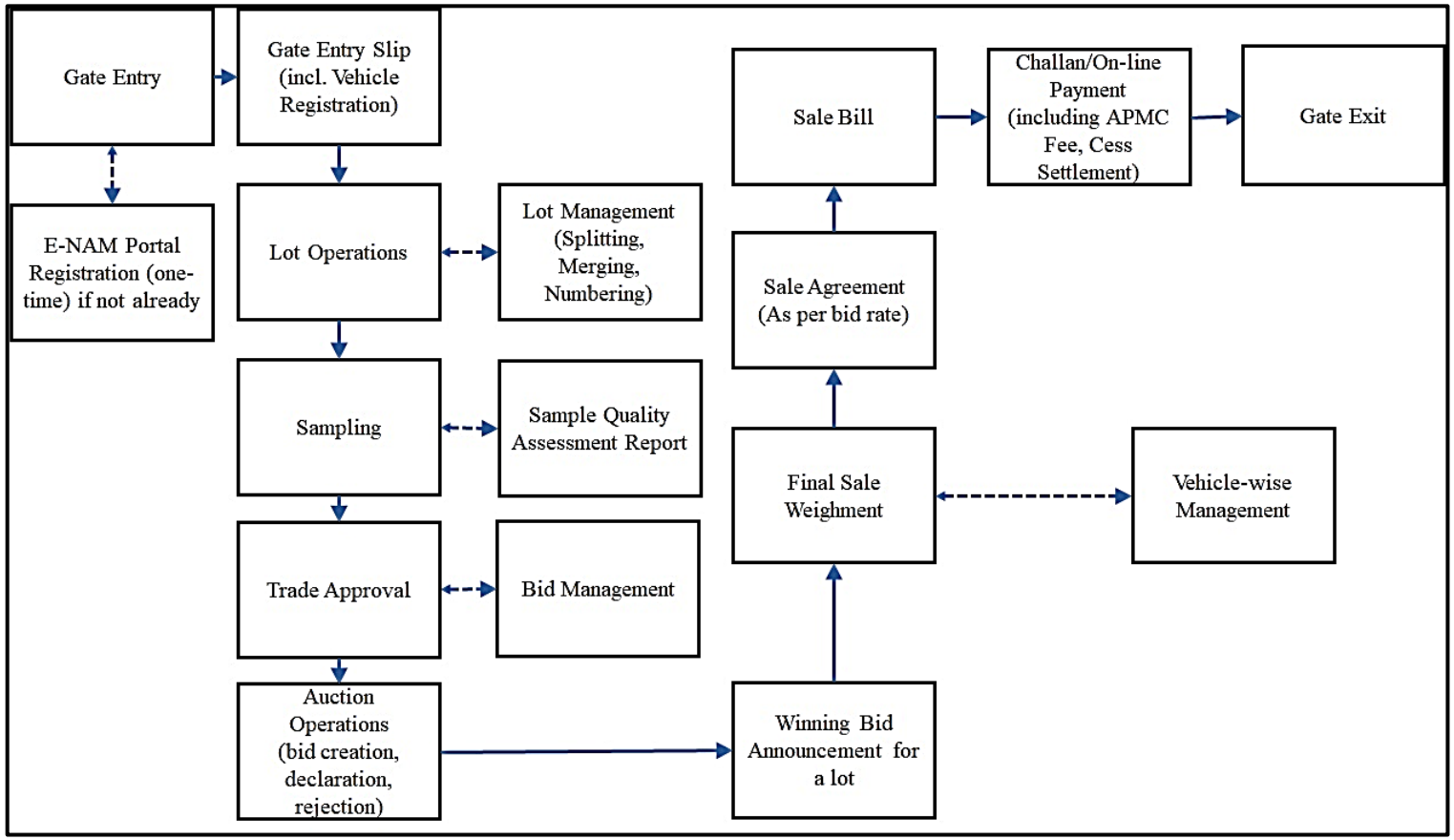


Figure 3.2 Complete E-Trading Process

(Source: MOAFW, 2022)

The B-B e-commerce system (eNAM) is comparatively better than other prevailing systems, e.g., open auction, manual tender, and direct sale (Chengappa et al., 2012; Mishra and Mishra, 2017; Nirmal, 2017; Pavithra et al., 2018).

Open auctions may have possibilities of trader collusion scope, whereas manual tendering is prone to alteration of quotes and entry errors. The direct sale system reduces the bargaining power of a farmer due to a lack of competition. The e-trading process in B-B e-commerce is transparent and fast. The farmer and the trader know the prices in real-time. These are disseminated quickly using electronic means, e.g., messages and mobile. Thus, a farmer may get a higher price than selling their produce at the farm gate (Banker et al., 2011; Chand, 2016; Dey, 2016).

The e-trading transaction flow (Figure 3.3) is outlined below:

- Online bidding is held on the portal.
- An initial invoice is generated automatically on intra-market or inter-market trade confirmation (by e-NAM software) and shown to traders. The winning bidder also gets an email / SMS.
- The winning bidder deposits the amount online (RTGS/NEFT or online payment gateway provided)/offline as per the sale deed, including market charges, agent's charges, and labour/packaging charges.
- In eNAM, the system sends a confirmation message to the farmer/trader/agent on receiving the fund.
- The delivery happens as per terms and conditions. It is either on the spot market or through a logistics service provider (arranged by the supplier/buyer) listed on the portal.
- As soon as the buyer or representative accepts the delivery, payment is made to the farmer/trader/agent online through registration. The timing is T+1 business day routed through the e-NAM bank account.

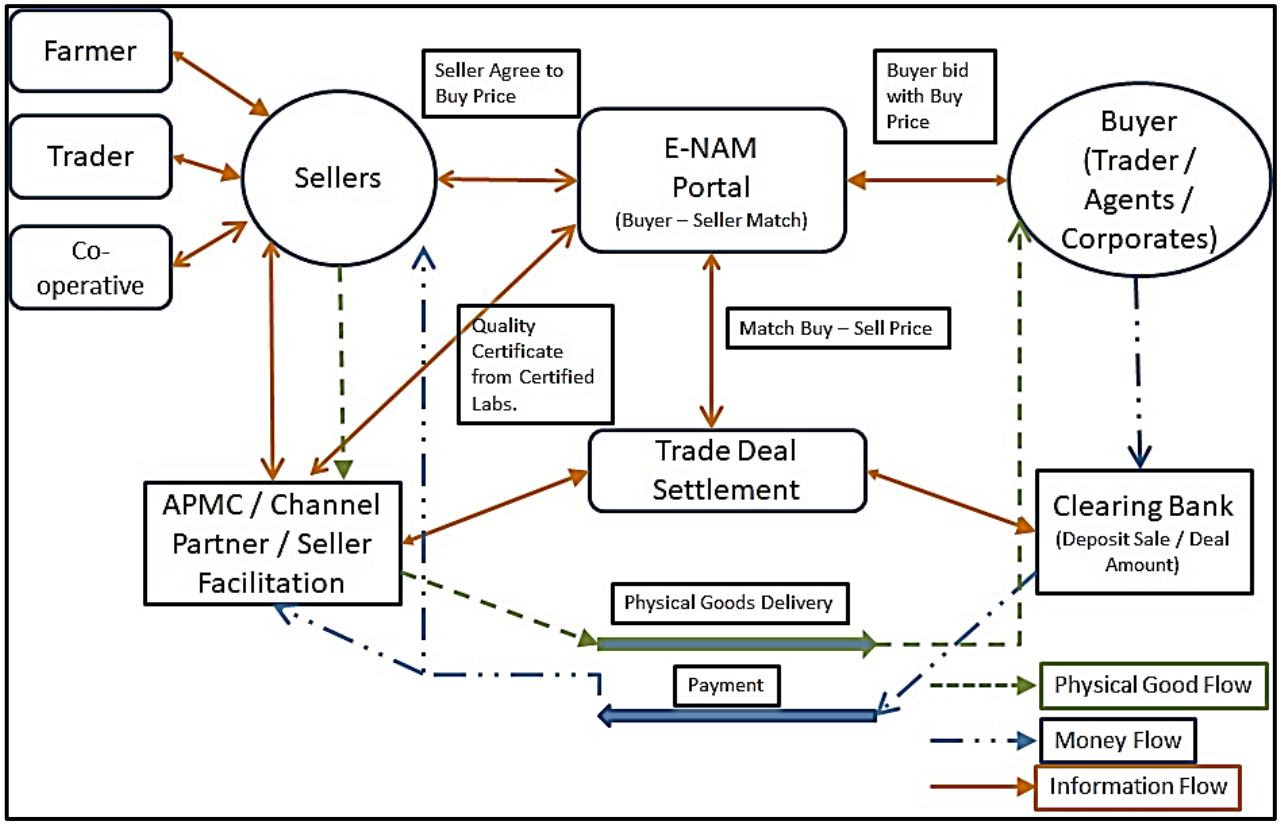


Figure 3.3 eNAM Transaction Flow

(Source: MOAFW, 2022)

In the past, with the introduction of the Unified Market Platform (UMP) in Karnataka before the national level eNAM initiative, farmers got an average 38 per cent higher average sale price in FY16 compared to FY 2014. An impact assessment of the e-marketplace of agricultural commodities in Karnataka found that eighty-three per cent of parties affected felt that the operations had become more transparent. The process was found to be time-efficient (Shailendra, 2013; Chand, 2016).

After eNAM implementation, some early results indicate that farmers are now more quality conscious. Online transactions, electronic fund transfers and online banking literacy have increased. Now that the Mandi records are computerized, better transparency of transaction flow is achieved. Farmers get a clear sale bill of transparent online e-trading, experience less trade collusion, and a quick payment cycle. The payment cycle is one day compared to the earlier 1 to 2 weeks (NABARD, 2018; Nirmal, 2019).

The eNAM project progress is not at par with the adoption targets set in its vision document. There is an urgent need to remove the constraints in implementing and adopting eNAM through active participation in the national agricultural market by local and state-level stakeholders (Hindu, 2019; Krishnamurthy, 2019).

If implemented correctly, the eNAM initiative may prove to be a game-changer for India's farmers and agriculture value chain (Chand, 2016). As of now, eNAM is pushed by the government as a mandatory activity.

### 3.2.3 Benefits of eNAM

After eNAM implementation, early results indicate that farmers are increasingly becoming quality conscious. Online transactions, electronic fund transfers and online banking literacy have increased. Now, the Mandi records are computerized, and better transparency of transaction flow is achieved. It allows buyers and traders to bid virtually in real-time. At the same time, the seller keeps track of his bid through a mobile application. APMCs' market fee revenues have increased due to increased online tendering. Farmers also gain price improvements due to competition, accurate

electronic scale weighment, and reduced inter-market marketing costs. Now, farmers get a clear sale bill, experience less trader collusion, and a quick payment cycle of 1 day compared to the earlier duration of 1 to 2 weeks (NABARD, 2018).

Evidence suggests that the eNAM-enabled markets have helped farmers realize higher prices than non-eNAM-enabled markets. For example, using eNAM copra and onion, farmers got INR 292 and INR 113 more per quintal prices, respectively, compared to prices in select non-eNAM enabled APMC markets of Karnataka in the year 2017. A study in Karnataka has found that the eNAM has helped farmers in realizing up to 9 per cent better prices in 2016 over 2015 and 13 per cent better prices over the previous year, 2014 (The Financial Express, 2017; Gowda et al., 2018).

The eNAM, if implemented effectively, may prove to be a significant shift in the conventional mode of agricultural marketing in India.

### 3.2.4 Current Situation of eNAM

As of 30 April 2022, the eNAM has registered seventeen Million and three hundred thousand farmers, 0.22 Million traders, and 2140 farmer producer organizations (FPOs) in 21 States and UTs. As of January 2022, the platform has recorded overall transactions of agricultural produce worth INR 1720 billion (MOAFW, 2022).

The eNAM has standard tradable parameters for 175 agricultural commodities for quality grading.

During the last four years (2018-2021), the following noteworthy features have been introduced to this B-B e-commerce platform (PIB, 2021; DACFW, 2021):

- Website content in six vernacular languages.
- Multiple competitive online bidding on a real-time basis.
- Warehouse receipt acceptance.
- Unified Payment Interface (UPI) through BHIM in regional languages in addition to existing payment channels of RTGS/NEFT, debit card, and Internet banking.

- Multilingual mobile application with features such as gated entry, e-payment, a progress update on lot trading, real-time bid-price updates, and payment receipt short message service (SMS) messages and viewing of the assaying quality certificates.
- Updated website with e-learning module, live commodity prices, information on events, dynamic training calendar and grievance redress feature.
- Integration of central farmer database in eNAM.
- List of quality parameters updated for 175 commodities.
- MIS dashboard for better decision support.
- Two-factor authentication and push SMS notifications.
- Training Videos are uploaded on the website.
- Farmer Producer Organization and Logistics portal integration.
- Inter-state trading is operationalized with a unified trading license.
- Web links to other B-B e-commerce platforms.

The review of recent Agricultural reports suggested providing an open and unified digital ecosystem platform for Agriculture 4.0 in the future. The large-scale public platform shall help interoperability and continuity of the multiple technology solutions and smaller e-commerce platform initiatives by the private players in India.

### 3.2.5 Future Developments

Post the national roll-out networking of all 2,477 APMC market yards and 4,843 APMC-regulated sub-market yards, the scope of eNAM may become wider and deeper. The review of reports and literature provides few details of expected development in the future.

From a deployment and practical perspective, most information and communication technology solutions have recently been anchored around shared platforms. The platform anchoring tends to make information and communication technology solution-based businesses twice as profitable, growing twice as fast, and

more than twice as valuable, probably because they leveraged employees and assets outside the firm (Cusumano et al., 2019).

Though the shared platforms have an upside on the cost and asset turnover, they require new skills to nurture the external ecosystems in such platform-anchored businesses. For example, despite its small size, the agricultural B-B platform 'Talcot' got success due to proactive management, flexibility in technology upgrades, user participation, and a responsive team (Parker and Alstyne, 2016).

Agriculture 4.0 is gradually increasing its use in agriculture practices. The agriculture 4.0 solutions and service providers use the latest technologies, such as mobile devices, cloud computing, big data analytics, and web 3.0. These solution providers are potential partners of B-B e-commerce provider (eNAM), and they share the eNAM platform.

The most valuable platform-based global companies (Amazon, Alphabet-Google, Bayer, Cargill, Tencent, and Facebook) have innovation and transaction platforms and benefit from connecting with different partners (Parker et al., 2017; Cusumano, 2022). A similar approach may help eNAM attract resources from third parties and increase its profitability. The agriculture 4.0-based Indian companies can co-exist on a platform like the National Agriculture Market (eNAM).

The generic open stack acronym LAMP (Linux, Apache, MySQL, PHP) software stack is known to most developers and solution providers in the technology community. However, when it comes to large-scale, country and domain-specific, open to all ecosystem platform stack, the government or the industry body has a definitive leading role. An open agriculture 4.0 platform shall help interoperability and continuity of the multiple solutions and smaller platform initiatives by the private players (InDEA, 2022).

In India, the multiple initiatives around e-trading, B-B e-commerce platform, B2C e-commerce platform, data exchanges, and open development stack shall converge into an open agriculture 4.0 ecosystem platform. The common platform provisioned by

the public agency may be open for data exchange and provisioning of end-user applications by public or private companies. The open platform is intended to be interoperable to serve solution providers, start-ups, agribusiness companies, service providers, technology developers, users (farmers, general users, traders), and other systems.

The reference architecture of one such open agriculture 4.0 ecosystem platform adapted from the multi-domain open ecosystem platform undergoing a multi-stakeholder open consultation process in India is shown in Figure 3.4. The core of the open agriculture 4.0 platform may consist of generic foundational building blocks like Unique Identification (ID), core registries (dynamic list of statutory rights linked registered entities with unique identifiers, e.g. entities, products, or services), core directories (less dynamic administrative lists of entities, locations, products, authorities, offices, and services), master codes (identifiers of locations, products, and uniform classifications), architecture repository (a dynamic portal to keep updated artefacts, building blocks, and code, along with toolkits and a help desk), and a unified Agritech service interface (application programming interfaces (API) to handle multiple types of transactions and data exchange in the digital space).

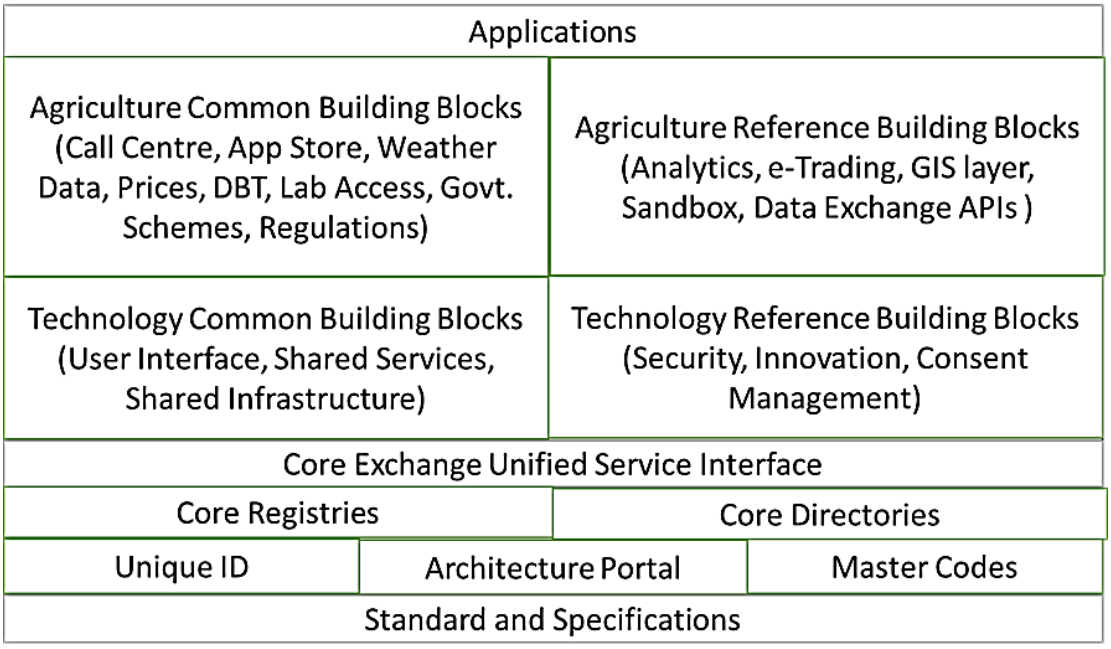


Figure 3.4 Reference Architecture of Ecosystem Platform
(Source: Adapted from IDEA, 2022).

The agriculture 4.0 ecosystem platform may use the standard generic/multi-domain building blocks, including a citizen-facing services portal with a contact centre, productivity tools, and shared digital infrastructures like storage e-marketplace public cloud. It may also use the standard generic/multi-domain reference blocks of helpful software tools (knowledge management system, learning management system, geographical information system, vernacular language support, search, analytics, and other relevant applications (sandbox, e-contracts, payment gateway).

The agriculture 4.0-specific standard blocks complement the generic multi-domain building blocks. The agriculture 4.0 standard building blocks consist of register-and-use, subscribe-and-use, or plug-and-play applications that quickly deploy configurable functionalities. The examples include a graphical user interface, Agri app store, Agri contact centre, and weather data. It also includes links to Agri institutes and universities, real-time pricing information, link to direct benefit transfer schemes, links to government sponsored Agri schemes, and access to common regulatory forms.

The domain reference building blocks are open-source applications with generic functionality available for download and customization. A few examples are analytical tools, e-trading portal, geographical information system (GIS) app and tools, sandbox/idea box to test and validate solutions, and agri data exchange for data exchange between interested parties.

The suggested open agriculture 4.0 ecosystem platform is at the consultation stage in India and has yet to follow the cycle of design, agile development, deployment, and maintenance.

## 3.3 Select other Agricultural B-B E-Commerce Projects in India

Besides the Indian government-backed eNAM platform, several other B-B e-commerce initiatives use Information Technology (IT) to solve the challenges in the procurement/sourcing stage in the agricultural supply chain when the buyers of crops (trader/agent/agribusinesses) interact with the producers of crops (farmers).

The digital solutions in the procurement/sourcing stage (Figure 3.4) are vital to improving the supply chain. Digitalization helps the buyer in terms of transparency, easy monitoring of operations, and making transactions efficient. The farmer benefits from better access to markets, information, and services that help him adopt the recommended agricultural practices and get transparent trading (GSMA, 2020).

Major drivers for the increase in the private sector agricultural B-B e-commerce initiatives include growing rural mobile penetration, increases in the farming community's purchasing capability, the rise of farmer producer organizations, changing food consumption patterns, upgrades in logistics, and improvements in digital infrastructure and regionalization supply chain. The cost of components (mobile devices, data connectivity, sensors, vernacular content technology, and robotics) and provisioning cloud computing technology/ICT-based agricultural services is declining rapidly (Kalaari, 2018; KPMG, 2017; Lele and Goswami, 2017).

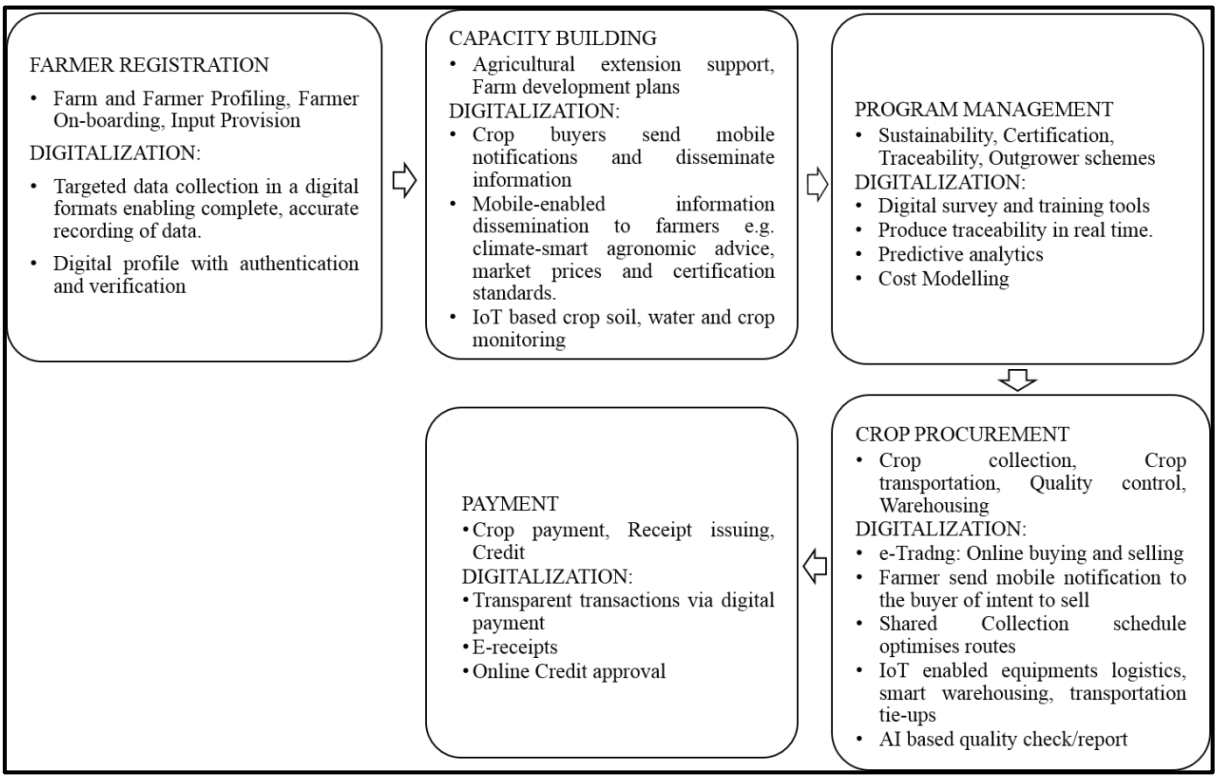


Figure 3.5 Digitalization in Procurement

(Source: GSMA, 2020)

One of the most prominent private sector's agricultural B-B e-commerce start-ups, 'Agribazaar' and several smaller initiatives are reviewed. The review helps to identify the key issues facing the new companies in this domain.

### 3.3.1 Agribazaar

Agribazaar is a full-stack B-B e-commerce company operating an Internet-based e-trading platform (Figure 3.5) for agricultural commodities. Agribazaar started in 2017 with the backing of StarAgri, a leading agricultural solutions company in India. The parent company delivers integrated post-harvest solutions, including warehousing, logistics, collateral financing, and testing services across the commodity supply chain.

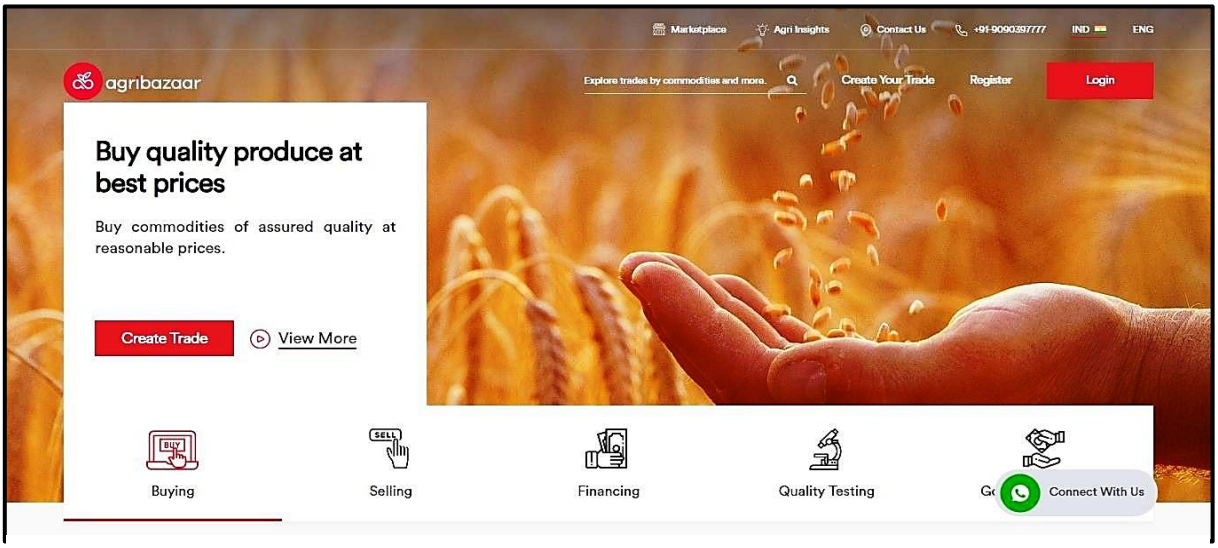


Figure 3.6 Agribazaar Portal

(URL: https://www.agribazaar.com; last accessed on 9 October 2021)

The start-up team consists of four co-founders: Amith Agarwal, Amit Mundawala, Sushan Rungta, and Sarat Mulukutla. From a humble beginning, with four employees - each having approximately 12 years of experience in agribusiness. The company has grown to 1400 employees. The organization also includes an in-house team of more than one hundred professionals with in-depth IT expertise.

During 2017-19, the company invested INR 360 Million, with a current turnover of INR 1600 Million per annum. Another INR 360 Million investment is in the pipeline to improve the supply chain's quality testing and traceability infrastructure. Agribazaar has registered approximately 10,000 traders, processors, and farmer organizations with its network of 200,000 farmers across India. During 2017-19, in 29,222 auctions, it traded 1.91 Million tonnes of produce valued at INR 7,1860 Million on its B-B e-commerce platform. The trade amount makes India's largest private Agri-trading B-B e-commerce platform (Agribazaar, 2019).

On the Agribazaar technology platform, a user gets end-to-end B-B e-commerce services. The user inputs their requirement by creating auctions or classifieds. Buyers view existing bids and make their bids. The trade settlement is also online, and assurance is provided via escrow account-based online payments directly to the seller's bank account.

The business model aligns e-commerce solutions with tangible benefits. Due to competitive bidding among multiple buyers across India for the quality-checked commodity, a transparent price discovery mechanism is used. It increases the chances of getting higher prices for the farmer/seller. In case financing is required, that need is also met through a related company tie-up. All the value-add and low settlement risk earn farmers' trust and confidence which is much needed for customer loyalty.

The company's unique selling proposition is its integration with a complete pan-India ecosystem with market insights. About eight hundred plus warehouses, collateral financing, and brand customers, e.g., Cargill, Britannia, complement the e-commerce (farmer-trader-customer) platform.

According to Sh. Amith Agarwal, CEO, "the platform serves the needs of all stakeholders in the farm-to-fork value-chain".

Amit attributes his success to the four principles of "experienced founding team, professional hiring and staffing, transparent corporate governance, and participative marketing". The founders each have a minimum of 12 years of experience in agribusiness. The new staff is hired through a written and personal interview with an annual performance review. Professional auditing firms prepare the annual report (e.g., KPMG), and all financial transactions are through the banking channel. Participative marketing is organized via farmers' participation in information sharing, hand-holding them for warehousing and financing, and increasing awareness of e-commerce. Whereas traders are provided with free consultations on value-add activities, e.g., grading, sorting, packaging, milling, and IT use.

The CEO, Mr Smith, reiterates, "*We are constantly upgrading our business model every three years*". Amith aims for Agribazaar as "*a global platform for the betterment of the farming community along with investors and innovation partners*". It wishes to connect nearly one hundred Million farmers and sixty Million traders into the B-B e-marketplace by 2023, with a USD 1 billion or more traded volume. He adds, "*Technology shall play a key role in future success*". The new B-B pre-harvest solutions are added to its existing post-harvest services dealing with testing, storing,

e-trading and financial. The company introduced a few innovations, including an IoT-based soil moisture detector, application for the physical examination of seeds and grains, artificial imaging-based satellite imaging for crop yield estimations, weather tracking, a digital wallet for online payments, and a warehouse management system.

Based on the values of fairness, transparency, and integrity between users, it further aims to continue contributing to the development of the user communities. In 2018, the B-B e-commerce provider partnered with Rajasthan State Co-operative Marketing Federation Ltd. (RajFed) to help farmers get reasonable prices for their garlic produce using the Agribazaar platform. The Bihar government conducted a similar exercise for maize production. The company continues to deepen its customer base of traders, bulk commodity buyers, commodity exchanges, processors, food, health, and FMCG companies in India and abroad.

### 3.3.2 Other Platforms

Besides eNAM and Agribazaar, eight other B-B e-commerce start-ups reviewed are as shown in Table 3.1.

Table 3.1 Activities of select Agricultural B-B E-commerce Start-ups

| S. No. | Start-Up | Activities |
|---|---|---|
| 1 | Agribazaar (http://www.agribazaar.com) | Agribazaar is an e-commerce site conveying future-prepared answers for the Indian agrarian business. With warehousing, guarantee financing and administrations, Agribazaar services range covers most of the ecosystem, including AI and Data Analytics, based IT solutions. |
| 2 | AgriCx (http://agricx.com) | Provides Artificial Intelligence enabled software as a service solution aimed at the agricultural value chain, e.g., production, trading, storage, logistics, and financing of Agri commodities. |
| 3 | Augentia (http://www.augentia.com) | The company provides marketing and digital marketing services. |

| | | |
|---|---|---|
| 4 | Jeevanksh Eco-Products Pvt. Ltd.<br><br>(http://www.jeevanksh.com) | The solution integrates the backward supply chain for organic produce. It helps increase supply chain efficiency and marketing of organic products. It also provides bio-pesticides and crop nutrition. The company has five employees with a turnover of INR 1 Million in 2018. |
| 5 | Jivabhumi<br><br>(http://jivabhumi.com) | It gives an agricultural community-supported e-commerce solution. The company offers produce procurement, aggregation, food traceability, and e-commerce service. Its flagship solution uses blockchain technology to capture the produce information during production, processing, and distribution in the supply chain. |
| 6 | Krishilok<br><br>(http://www.krishilok.com) | Sourcing, distribution, and marketing solution start-up. It has promoted a network of rural Agro-entrepreneurs and provides processing, packaging-as-a-service, and storage solutions. It also has onboarded several large retail chains in its buyer base. |
| 7 | Padmavati and VARI Agro Services Pvt. Ltd. | Uses information system platform (web and mobile App) to provide updated agricultural market information to farmers and consumers. It also uses its supply chain solution to source millets from farmers and exports them to the USA. The company started in 2014 with 101 employees and a turnover of INR 2 Million in 2018. |
| 8 | Stamp IT Business Solutions<br><br>(http://www.stampit.biz) | It provides a desktop and mobile application to streamline the information flow between farm field-level activities and management. The services are targeted at Value Chain service providers to help in the crop protection and production process. The company started in 2015 and has fifteen employees with a turnover of INR 10 Million in 2018 |

### 3.3.3 Key Issues facing B-B E-Commerce Start-Ups

The critical issues in the further growth of B-B E-commerce start-ups in India are explored using content analysis. The 'Word Map' feature in NVivo software-generated keywords in the shortlisted academic articles, reports, and case reviews. The themes were conceptualized around the high-frequency keywords as the add-on, but a similar

analysis was done for the CEOs and expert Interviews. The revealed themes/issues are listed in Table 3.2.

Note: The definitions of the 'Issues' are different from the definitions of the framework constructs, even though the word may be similar.

Table 3.2 Key Issues in the Growth of Indian E-Commerce Start-ups

| S. No. | Issue | References |
|---|---|---|
| 1 | Infrastructure Availability and Incubation Support (Facilitating Conditions) | (Bose and Kiran, 2014), (Mor et al., 2015), (FAO, 2017), (FICCI, 2018), (IBEF, 2018), (NASSCOM, 2018; 2019), (Anupam and Saravanan, 2019), (Sharma and Mathur, 2019). |
| 2 | Availability of low-interest and creative models of financing (Cost) | (Kalaari, 2018), (MOAFW, 2018), (Agfunder, 2020), (NASSCOM, 2020), (Subramaniam, 2020). |
| 3 | Supportive mindset of Business Customers and Partners (Trust) | (Singh, 2013), (Kundu and Joshi, 2014), (IBEF, 2018), (Sachitanand, 2018), (Anupam and Saravanan, 2019), (NASSCOM, 2019), (Sharma and Mathur, 2019), (Arafat et al., 2020). |
| 4 | Cross-Domain Quality Solutions with Multiple Levels of Features (Perceived Usefulness) | (Subhash et al., 2016), (FICCI, 2018), (MOAFW, 2018), (Sachitanand, 2018), (NASSCOM, 2020), (Sarangi, 2020). |
| 5 | Skill-Building and Training of Farmers (Perceived Ease of Use) | (Singh, 2013), (FAO, 2017), (D'Cunha, 2018), (Sarangi, 2018), (Sharma and Mathur, 2019), (Tohidyan and Rezaei, 2019), (Crawford, 2020). |
| 6 | Lack of Subject Matter Experts/Mentors (Facilitating Conditions) | (Bose and Kiran, 2014), (FICCI, 2018), (Anupam and Saravanan, 2019), (Subramaniam, 2020). |
| 7 | Low level of Digitalization and Information Availability (Facilitating Conditions) | (Ray, 2012), (Seth and Ganguly, 2017), (Ciruela-Lorenzo et al., 2018), (Sarangi, 2018), (EY, 2020). |

Besides the CEOs' and experts' interviews, an additional opinion survey of the convenience sample of 202 respondents was conducted in August 2021. The respondents were e-commerce users (37 per cent), small-scale entrepreneurs (33 per cent), experts (16 per cent) and agriculture-related postgraduate course students having enough subject knowledge to have an opinion (14 per cent).

The critical issues for growth raised by the start-ups engaged in India's agricultural e-commerce space are ranked and summarised in Table 3.3.

Table 3.3 Relative Importance of Issues

| S. No. | Top 5 Issues | User Opinions Rank* | Percentage (Out of a 7-point scale) | CEO Opinions Rank** | Percentage (Out of 17) |
|---|---|---|---|---|---|
| 1 | Availability of low-interest and creative models of financing (Cost) | 1 | 60 | 1 | 53 |
| 2 | Infrastructure Availability and Resource Support (Facilitating Conditions) | 2 | 57 | 2 | 41 |
| 3 | Cross-Domain Quality Solutions with Multiple Levels of Features (Perceived Usefulness) | 3 | 54 | 3 | 41 |
| 4 | A supportive mindset of Business Customers and Partners (Trust) | 4 | 53 | 4 | 35 |
| 5 | Skill-Building and Training of Farmers (Perceived Ease of Use) | 5 | 51 | 5 | 18 |

*Based on the average of 202 opinions in the survey

**Based on Frequency of Note out of seventeen

The ranking by the CXO survey and the opinion survey of users, experts and small-scale entrepreneurs are the same. The additional insight from the user opinion survey is that the agricultural e-commerce users and experts feel that 'Lack of Subject Matter

Experts/Mentors and Talent Retention is as vital as 'Skill-Building and Training of Farmers' as both are ranked five.

The other suggestions from the opinion survey are as follows:

- The ecosystem needs to be developed by spreading awareness at the village level, training farmers on a large scale, and increasing knowledge of its benefits.
- The access to agri-tech solutions may be increased via better internet connectivity via smartphones and making services available at the customers' doorstep via volunteers. The software solution bundling with the leased/rental equipment/hardware may increase the affordability of the new solutions.
- Digitalization can get a big push from the marketing and e-commerce applications as the supply chain infrastructure improves. The entrepreneurs may start looking early at international growth opportunities.

### 3.4 Concluding Remarks

The ease of regulations, government-initiated large projects in B-B e-commerce, artificial intelligence, digital literacy, financial inclusion, and mobility, along with several initiatives by large corporate entities, e.g., ITC, TATA, IFFCO and HUL, have set the stage for a massive transformation of the agricultural value chain, with B-B e-commerce leading the change.

The net effect of the Covid-19 pandemic on agricultural B-B e-commerce is estimated to be positive in the post-pandemic economy. Large companies are now targeting start-ups to improve their offerings for the post-COVID-19 pandemic market (AgFunder, 2020; BCG, 2020; Markets and Markets, 2020).

B-B e-commerce platform start-ups reviewed in the study highlight the potential to improve existing supply chain efficiency and information access. However, they ask for increased and timely support from the government and large corporations to further boost the industry segment in India.

In the current scenario, the e-commerce start-ups are explicitly looking for low-cost financing, Infrastructure support from the government, trust of large corporates,

cooperation among ecosystem partners and user (farmer/trader) skill enhancement through training. The next chapter explains the research design for the study.

# Chapter 4
# Research Design

## 4.1 Introduction

The research design section of the study explains the research methodology to meet the research objectives. Before that, the conceptual research framework is explained in detail.

## 4.2 Conceptual Research Framework

Based on the literature review, the conceptual B-B e-commerce adoption framework for agricultural marketing in India is presented in Figure 4.1.

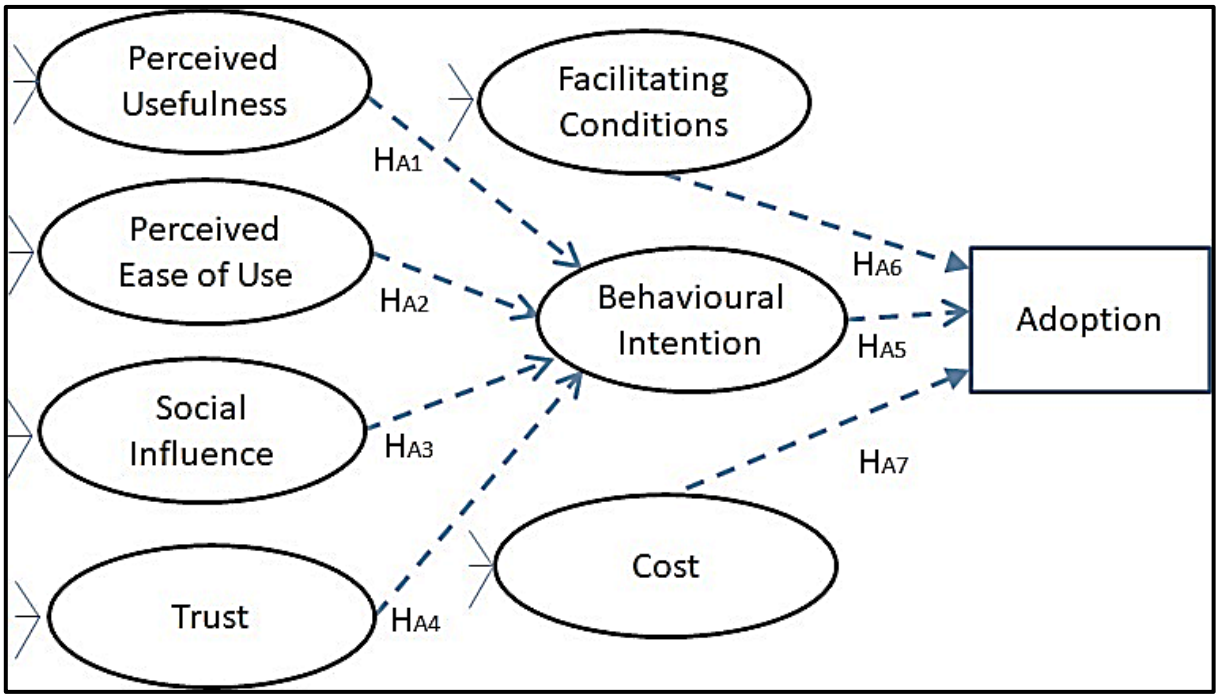


Figure 4.1 Conceptual Research Framework

The seven constructs are conceptualized as significant direct or indirect determinants of B-B e-commerce adoption in Indian agricultural markets in the study context. The framework has six determinant latent variables (Constructs), each derived from three observed independent variables. The 'Behavioral Intention' is the potentially mediating latent variable (Construct). The dependent variable is 'Adoption'.

The constructs in the framework are defined in Table 4.1. The constructs are considered and analyzed in the agricultural sector adoption context (Saghafian, Laumann and Skogstad, 2021).

Table 4.1 Constructs in the Research Framework

| Code | Variable | Explanation In Study Context | References |
|---|---|---|---|
| PU | Perceived Usefulness | eNAM extends benefits to users in terms of better pricing and speed of market transactions. | (Davis, 1989), (Moore and Benbasat, 1991), (Compeau et al., 1999), (Kilpatrick and Factor, 2000), (Venkatesh et al., 2003), (Michels et al., 2019), (Salimi et al., 2020), (Bahn, Yehya and Zurayk, 2021), (Molina-Maturano et a., 2021), (Roy and Joseph, 2021). |
| PEU | Perceived Ease of Use | eNAM is easy to learn and simple to use | (Davis, 1989), (Moore and Benbasat, 1991), (Auramo et al., 2002), (Engotoit et al., 2016), (Michels et al., 2019), (Molina-Maturano et al., 2021), (Saghafian, Laumann and Skogstad, 2021), (Sui and Geng, 2021). |
| SI | Social Influence | A community of close friends, leading farmers, associated traders, and community leaders encourage and promote the eNAM. | (Mathieson, 1991), (Moore and Benbasat, 1991), (Venkatesh et al., 2003), (Engotoit et al., 2016), (Dwivedi et al., 2019), (Roy and Joseph, 2021), (Saghafian, Laumann and Skogstad, 2021), (Zomwe et al., 2021). |
| T | Trust | User confidence in eNAM portal trade and information. It is also a belief that the eNAM is reliable and the management will act in the interest of farmers and other stakeholders. | (Moorman et al., 1992), (Killpatrick and Factor, 2000), (Ridings et al., 2002), (Kuttainen, 2005), (Casalo et al., 2011), (Ramesh et al., 2012), (Bisen and Kumar, 2018), (Jayashanker et al., 2018), (Wiyada et al., 2018), (Samant and Dey, 2021), (Sui and Geng, 2021). |
| C | Cost | Transaction Costs on the eNAM platform | (Dodd et al., 1991), (Garicano and Kaplan, 2001), (Clasen and Mueller, 2006), (Solaymani et al., 2012), |

| | | | |
|---|---|---|---|
| | | | (Mustaqquim, 2017), (Wiyada et al., 2018), (Samant and Dey, 2021). |
| FC | Facilitating Conditions | The infrastructure, including quality testing laboratories, bidding halls, logistics support, IT training, and customer care, complement the use of eNAM. | (Moore and Benbasat, 1991), (Lummus et al., 1998), (Bender, 2000), (Killpatrick and Factor, 2000), (Lalonde, 2000), (Venkatesh et al., 2003), (Russell and Hoag, 2004), (Cigolini et al., 2004), (Tomar et al., 2016), (Dwivedi et al., 2019). |
| BI | Behavioural Intention | The level to which an individual has made a conscious plan to trade on eNAM | (Davis, 1989), (Ajzen, 1991), (Venkatesh et al., 2003; 2010). |
| U | Adoption | Actual usage of eNAM | (Davis, 1989), (Ajzen, 1991), (Venkatesh et al., 2003; 2010). |

The construct's manifestation in the respondent sample group of farmers differs from other Industry groups. The adoption framework is different from traditional ones. Unlike other sectors, the agriculture sector is characterized by a lack of support infrastructure, a low literacy level of farmers, and low ICT awareness among farmers and traders. In a unique wholesale trading context, users' adoption factors are yet to be adequately addressed, and consideration must be done in a broader societal context (Bettencourt, Lusch, and Vargo, 2014).

In the farmer context, unlike the enterprise subscription context, farmers are responsible for costs, and such costs ('transaction costs') can influence farmers' adoption decisions (Coulter and Coulter 2007; Chan et al. 2008). As a new construct, 'Cost' is added; it complements UTAUT's consideration of only time and effort.

The lower Internet service costs or low e-commerce costs can encourage businesses to adopt B-B ecommerce (Zhu et al., 2006; Solaymani et al., 2012). Evidence suggests that transaction costs in e-marketplace should be lower than those of traditional markets to increase liquidity and chances for success (Garcicano and

Kaplan, 2001; Clasen and Mueller, 2006). For this research, the ‘transaction cost’ is considered as the ‘Cost’ variable in the adoption framework.

Similarly, adding the construct 'Trust' to UTAUT results in a direct or indirect effect on the 'Adoption', and alters the relationship between 'Behavioural Intention' and 'Adoption'.

Trust (T) comprises the trusted confidence in the trustee’s actions (Lee et al., 2006). It is also a looking forward to that the trustee’s promise can be relied on and that the trustee will act in benevolence. Trust is of utmost importance in B-B e-commerce as we have limited or partial information about other trading-party (Hawes et al., 1989; Ridings et al., 2002). It reduces the information asymmetry between the parties. It is also the main harbinger of user participation and sustainable communities formation (Casalo et al., 2011). An Indian study discloses that trust has a positive effect on the ‘Behavioural Intention’ to adopt the Internet banking platform (Kesarwani and Bisht, 2012).

By extending and adding to the prior frameworks/models, the key expected contributions are:

- Expand the overall subjective and objective aspects of integrative theoretical frameworks related to technology use by incorporating two new constructs into UTAUT (Bagozzi, 2007)
- Advance the theoretical base by altering existing relationships and extending the adoption framework theory into the agricultural B-B e-commerce domain (Alvesson and Korean, 2007).
- For practitioners, the details of the constructs, adoption framework, and case studies may help practitioners to better design and market B-B e-commerce to farmers during adoption and post-adoption.

## 4.3 Pilot Study

To check the suitability of the constructs, a pilot project was conducted among the farmers in the Meerut APMC market.

The validation of determinant factors in the framework is done via the survey of NAM participants using a Likert scale-based questionnaire (*Appendix B*) response. The Likert scale has options of 1 to 5, where 1 means 'Negligible' and 5 means 'To an extreme extent' on B-B e-commerce adoption.

**NOTE**: The main study survey questionnaire (*Appendix A*) was modified to a 7-point Likert scale.

Out of 50 survey responses, 40 complete responses are used for data analysis. The internal consistency reliability of each construct is tested to be more than 0.65 Cronbach's alpha value and found to be acceptable (Hair et al., 2006; George and Mallery, 2011).

The descriptive statistics are presented in Table 4.2. The standard error value is negligible, and the sample means can be interpreted in general.

The mean value of the 'Social Influence' construct (4.37) is relatively high. Persuasion by the influencer farmers, initiative-taking NAM users and officials at the Meerut APMC market is quoted as the primary reason for adoption in the early stage. The next highest mean value (4.16) is for the 'Perceived Usefulness' construct, given that a quick response and faster e-trade process impress users and increase their expectations to get price benefits. At a mean value of 3.41, the low transaction 'Cost' is also a pull factor besides price.

The mean value (3.62) of the 'Trust' construct is also on the relatively high side, given that website Information is regarded as accurate, and the NAM platform is supported by the government. The construct 'Perceived Ease of Use' and 'Facilitating Conditions' have relatively low mean values (3.28), which was evident by high user dependency on eNAM contract staff, availability of only one lab for sampling and testing, low promotion, and training of users, and continued high user dependency on authorized market facilitators/agents. The traders and farmers are successfully using the NAM mobile applications, which need to be further promoted.

Table 4.2 Univariate Statistical Analysis of Pilot Study Data

| Construct | Mean | Observed Variable (Micro-Variable) | N | Mean | Std. Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| Perceived Usefulness (PU) | 4.16 | Useful in Trade (PU1) | 40 | 4.38 | 0.54 | 0.016 | -0.970 |
| | | Accomplish Task Quickly (PU2) | 40 | 4.15 | 0.70 | -0.215 | -0.871 |
| | | Price Increase (PU3) | 40 | 3.95 | 0.677 | 0.060 | -0.708 |
| Perceived Ease of Use (PEU) | 3.28 | Good User Interface (PEU1) | 40 | 3.43 | 0.939 | 0.139 | -1.16 |
| | | Easy to use (PEU2) | 40 | 3.30 | 0.853 | 0.325 | -0.664 |
| | | Easy to Learn (PEU3) | 40 | 3.13 | 0.986 | 0.012 | -1.088 |
| Social Influence (SI) | 4.37 | Influencers (SI1) | 40 | 4.45 | 0.639 | -0.737 | -0.395 |
| | | Helpful Management (SI2) | 40 | 4.23 | 0.480 | 0.608 | 0.106 |
| | | Organization support (SI3) | 40 | 4.43 | 0.636 | -0.649 | -0.483 |
| Facilitating Condition (FC) | 3.28 | Infrastructure (FC1) | 40 | 3.13 | 0.911 | 0.385 | -0.617 |
| | | Training (FC2) | 40 | 2.95 | 0.986 | 0.611 | -0.782 |
| | | Support (FC3) | 40 | 3.78 | 0.862 | -0.547 | -0.081 |
| Trust (T) | 3.62 | Accurate Information (T1) | 40 | 4.03 | 0.920 | -0.547 | -0.282 |
| | | Trust in Seller (T2) | 40 | 3.58 | 0.781 | -0.432 | -0.108 |
| | | Trust in Buyer (T3) | 40 | 3.25 | 0.670 | 0.202 | -0.176 |
| Cost (C) | 3.41 | Transaction cost (C1) | 40 | 3.58 | 0.813 | -0.255 | -0.291 |
| | | Overall Cost (C3) | 40 | 3.25 | 0.670 | 0.202 | 0.176 |

The univariate statistical analysis of the pilot study data indicates the relationship between adoption and framework constructs. The survey indicates a positive relationship as all the influencing constructs as a mean value between 3.28 and 4.37

on a scale of 1 to 5. The relationship is positive for the explicit variable level as the mean value ranges between 2.9 and 4.45 on a scale of 1 to 5.

The pilot study was conducted at one agriculture produce market committee (APMC) market and among 40 users. The pilot study sets the stage for a more extensive main study to systematically analyze the conceptual adoption framework.

## 4.4 Formulation of Research Hypotheses

The 'perceived usefulness' (PU) is defined in the study context as the eNAM extends benefits to users in terms of better pricing and speed of market transactions. Based on the review of several studies (Table 4.1), we expect that 'perceived usefulness' affects the construct 'behavioural intention'. The conceptualized null hypothesis (H01) and alternate hypotheses (HA1) are as follows:

> *H01: 'Perceived Usefulness' does not affect the 'Behavioural Intention' to adopt the B-B e-commerce platform.*
>
> *HA1: 'Perceived Usefulness' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform.*

The 'perceived ease of use' (PEU) is defined in the study context as the eNAM is easy to learn and simple to use. Based on the review of several studies (Table 4.1), we expect that 'perceived ease of use' affects the construct 'behavioural intention'. The conceptualized alternate hypothesis (HA2) is as follows:

> *HA2: 'Perceived Ease of Use' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform.*

The 'social influence' (SI) is defined in the study context as a community of close friends, leading farmers, associated traders, and community leaders encouraging and promoting the eNAM. Based on the review of Several studies (Table 4.1), we expect that 'social influence' affects the construct 'behavioural intention'. The conceptualized alternate hypothesis (HA3) is as follows:

> *HA3: 'Social Influence' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform.*

The 'trust' (T) is defined in the study context as the user confidence in the eNAM portal trade and information. It is also a belief that the eNAM is reliable and that the management will act in the interest of farmers and other stakeholders. Based on the review of several studies (Table 4.1), we expect that 'trust' affects the construct 'behavioural intention'. The conceptualized alternate hypothesis (HA4) is as follows:

> *HA4: 'Trust' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform.*

The 'behavioural intention' (BI) is defined in the study context as the level to which an individual has made a conscious plan to trade on eNAM. Based on the review of several studies (Table 4.1), we expect that 'behavioural intention' affects construct 'adoption'. The conceptualized alternate hypothesis (HA5) is as follows:

> *HA5: 'Behavioural Intention' affects the 'Adoption' of the B-B e-commerce platform.*

The 'facilitating conditions' (FC) are defined in the study context as the infrastructure, including quality testing laboratories, bidding halls, logistics support, IT training, and customer care, complement the use of eNAM. Based on the review of several studies (Table 4.1), we expect that 'facilitating conditions' affect the construct 'adoption'. The conceptualized alternate hypothesis (HA6) is as follows:

> *HA6: The 'Facilitating Conditions' affect the 'Adoption' of the B-B e-commerce platform.*

The 'cost' (C) is defined in the study context as the transaction costs on the eNAM platform. Based on the review of several studies (Table 4.1), we expect that 'cost' affects the construct 'adoption'. The conceptualized alternate hypothesis (HA7) is as follows:

> *HA7: 'Cost' affects the 'Adoption' of the B-B e-commerce platform.*

## 4.5 Methodology

The methodologies applied are explained in this section. These are mapped to the research objective as presented in Table 4.3.

Table 4.3 Research Objectives and Methodologies Applied

| Phase | Research Objective | Research Method and Technique |
|---|---|---|
| 1 | Propose an adoption framework for B-B e-commerce in the Indian Agriculture sector. | • Systematic Literature Review<br>• The case study of the National Agriculture Market (eNAM) and other initiatives<br>• Univariate Statistical Analysis<br>• Total Interpretive Structural Modeling (TISM) methodology (Qualitative) |
| 2 | Validate the adoption framework for wholesale agricultural B-B e-commerce in the context of the National Agriculture Market (eNAM). | • Partial Least Squares - Structural Equation Modeling (PLS-SEM) method (Quantitative)<br>• Hypothesis Testing<br>• Interpretation of data analysis result |
| 3 | Recommend ways for improving agricultural B-B e-commerce adoption based on a study of the National Agriculture Market and other similar initiatives. | • Literature Review<br>• Recommendations are based on expert panel interviews and end-user Interviews.<br>• Interpretive Ranking Process (IRP) Method (Qualitative) |

### 4.5.1 Total Interpretive Structural Modelling

The observed variables and constructs have been identified using a literature review. Total interpretive structural modelling (TISM) methodology (Sushil, 2009) has been used in the study to determine the relationship between the constructs and propose the adoption framework.

In theory-specific contributions, the building blocks include figuring out the variables ("what") to a particular phenomenon, establishing an inter-relationship

("how") between variables and interpreting the causality ("why") between relevant variables (Whetten, 1989). TISM helps to carve out a structured model, interpreting both the nodes ("what") and links ("how" and "why") as envisaged by both individuals and groups (Sushil, 2017a).

TISM is a better version of interpretive structural modelling (ISM). The TISM method has been used in many management contexts (Sushil, 2017a), e.g. agile manufacturing, construction labour productivity, cloud computing, e-Government, emotional intelligence, enterprise resource planning, green supply chain management, higher technical education, lean implementation in healthcare, lean performance, manufacturing system, marketing and sales, organizational and information systems flexibility, public distribution system, supply chain management, Smartphone manufacturing ecosystem, strategy execution, sustainable integrated logistics, sustainable supply chain management, technology strategy, telecom service sector: throughput accounting, total quality management, and waste management (Bohtan et al., 2017; Dubey et al., 2017; Mohanty and Shankar, 2017; Patri and Suresh, 2017; Sindhwani and Malhotra, 2017).

TISM is used in the study to detail the relationship between the constructs in the conceptual research framework. As the nature of the relationship is not evident during the conceptual research framework developed post literature review, the link between the constructs is depicted through the dotted line (Figure 4.1). Only when the relationship between the constructs and interpretation becomes clear post-TISM will the relationship be shown through the firm line and directions through the arrows. The likely ways to improve eNAM adoption are partly based on an understanding developed through interviews with experts during the TISM procedure.

### 4.5.2 Partial Least Squares - Structural Equation Modeling

The Partial Least Squares - Structural Equation Modeling (PLS-SEM) method, a statistical analysis technique, is used to validate the proposed framework, test the hypotheses, and identify the key driver constructs for the dependent variable 'Adoption'.

The PLS-SEM as a multivariate analysis method has gained popularity in management information systems (MIS) research. For example, in the journal MIS Quarterly, in the 20 years (1992-2011), one hundred and nine structural equation model estimations using PLS-SEM were reported in the sixty-five articles (Gefen et al., 2011; Ringle et al., 2012).

PLS-SEM is a variance-based structural equation Modelling (SEM) approach. PLS-SEM is preferred over covariance-based structural Modelling (CB-SEM) due to its ability to handle small sample size, no condition of data normality, no distribution assumption, and ability to address nominal, ordinal, and interval-scaled factors. The PLS-SEM can take multicollinearity among the independent variables and has been found robust to handle missing data and the presence of data noise (Gotz, Liehr-Gobblers and Krafft, 2010; Hair et al., 2011, 2014; Garson, 2016).

The PLS-SEM is used in the research for the data analysis due to the following two reasons: the exploratory study is aimed at identifying key driver constructs, and data for one nominal dependent variable ('Adoption') is binary (‘Yes’ = ‘1’, ‘No’ = ‘0’) and not normally distributed (Hair et al., 2011, 2016; Rožman et al., 2020).

### 4.5.3 Interpretive Ranking Process

A large part of the decision-making process involves ranking the alternatives or finding the best option. Especially when multiple criteria (which may be conflicting) are present simultaneously, e.g., higher return but the low risk on mutual fund stocks, customer satisfaction versus the cost of service (Madhurika and Hemakumara, 2015), the problems can be solved using multiple-criteria decision-making (MCDM).

The Interpretive Ranking Process (IRP) is a well-known MCDM method. The various competing MCDM methods are the Analytical Hierarchy Process (AHP), the Analytical Network Process (ANP), the Data Envelopment Analysis (DEA), and the Interpretive Ranking Process (IRP) (Govindan et al., 2015).

Initially, within the supply chain domain, the AHP method was preferred. It consists of steps including problem modelling, pair-wise comparisons, scales, consistency indices, sensitivity analysis and group decisions.

However, the IRP method is gaining preference in the last decade. IRP has been preferred for this study. The reason choosing IRP over the AHP is the IRP method's capability to extract the expert knowledge and reasoning used for the rating during its pairwise comparison. Expert reasoning may be lacking in the expert judgements used during AHP and ANP (Sushil, 2009; Ho et al., 2010).

The IRP methodology mixes the analytical logic (rational choice process) with an intuitive process. The IRP is essentially a knowledge-intensive MCDM method. It uses a process of ranking variables (ranking factors) concerning criteria (reference factors).

The IRP's strengths include quickly setting the interaction boundaries; the interaction details help in comparison; and making quick decisions concerning the relative dominance of one interaction with the other. The paired comparison reduces cognitive overload and reliance on the factor or the variable weight. It applies to any assemblage of variables. Different influencers with varied interests can be included in the evaluation to prevent pre-conceived opinions. The efficient IRP process considers the implicit and transitive dominance between variables during comparison, reducing the number of interpretations made by the expert panel.

The IRP is not software or calculation intensive. The knowledge generated can be re-used with added information for future decision-making. The limitations of IRP are that the approach is judgmental and interpretive and is subject to biases; given that all criteria are considered equal, it neglects their relativistic importance; objective validation tests are difficult to be administered, and interpretation of a matrix of size beyond ten by ten is complex given the exponential increase in paired comparison (Warfield, 1974; Sushil, 2009).

IRP has been applied in several research areas, including the public value of e-governance projects, Third-party logistics providers, mapping of IS failure factors, a ranking of flexibility initiatives, energy security and sustainability, lean implementation manufacturing sector, risks in the business analytics practices adoption, integrated supplier selection, world-class manufacturing, flexible supplier selection, and risk management in the supply chain (Gangotra and Shankar, 2016; Soni et al., 2016; Narkhede et al., 2017; Sushil, 2017b; Jain and Suri, 2018).

IRP is used in the study to rank the constructs of the adoption framework concerning their influence on post-adoption usage of the B-B e-commerce platform eNAM. The ranking may prioritize the constructs for management attention or resource allocations.

## 4.6 Flowchart of Research Procedure

The key activities involved in the study are presented in Figure 4.2.

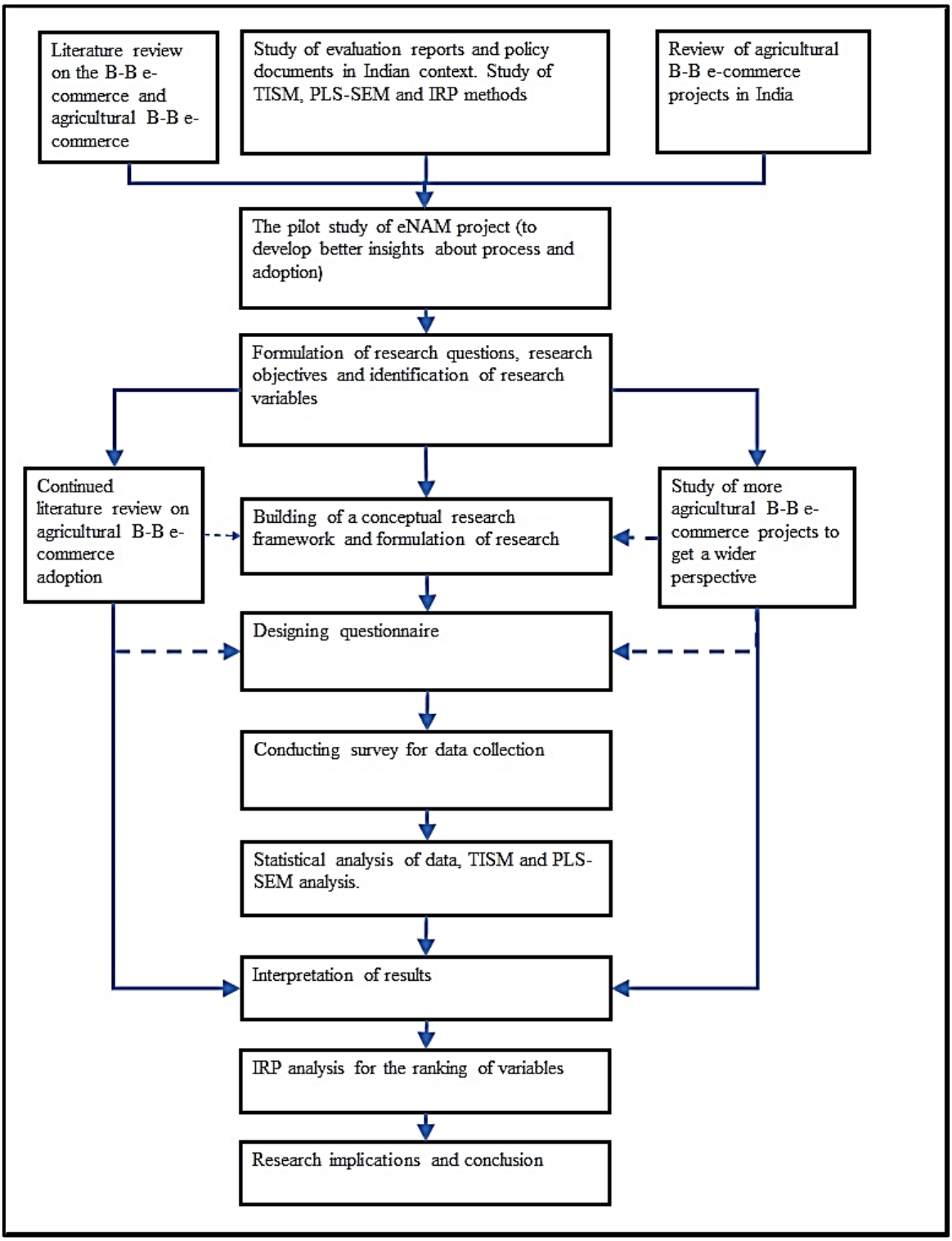


Figure 4.2 The Research Methodology

## 4.7 Development and Testing of Survey Questionnaire

A structured questionnaire was developed in the local language, i.e., Hindi, with the help of a person having a good knowledge of both the languages (English and Hindi) as well as agriculture. Two experts reviewed the draft questionnaire for language and content.

The pilot study questionnaire (*Appendix B*) is divided into two sections; the first part contains details like respondent identification, vocation, and traded commodity. Part two includes questions about different construct items in the proposed framework. In addition, the questionnaire was subjected to internal consistency improvement and context-specific adjustments based on a pilot study involving fifty respondents. The questionnaire was successfully tested for reliability with an acceptable Cronbach alpha at 0.9.

The specific questions were modified as per the context of the study (*Appendix C*), keeping the previous research in view (Garicano and Kaplan, 2001; Venkatesh et al., 2003; Casalo et al., 2011).

The final study questionnaire measures twenty-two items on a 7-point Likert scale, where one implies 'No Influence' and seven means 'Extreme Influence' (*Appendix A*). The reliability and validity of the questionnaire are shown in *Appendix D (Table D.1)*.

## 4.8 Sampling and Collection of Data

### 4.8.1 For Total Interpretive Structural Modelling

For TISM, a team (Team 1) of ten experts, including eight experts from academia and two industry experts, was formed to obtain an expert opinion via a questionnaire (*Appendix E*) and face-to-face discussion as per the inductive process during Sept. - Dec. 2018.

The deductive process includes insights into the interpretive logic, causal effects, and knowledge base development using the study of the eNAM project. It also included user interviews and opinions of a second expert panel of four members (Team 2).

The experts were chosen from varied professional backgrounds and geography. Each expert who has volunteered for the study is an experienced professional with knowledge of e-commerce and agriculture.

### 4.8.2 For Partial Least Squares - Structural Equation Modeling

Structural equation Modeling (SEM) recommends a sample size of two hundred as fair and three hundred as acceptable. The G*Power analysis (Faul et al., 2007) suggests an adequate sample size of 226. Another recommendation is that in multivariate research, the sample size should be at least ten times the number of items in the survey (Roscoe, 1975; Holter, 1983; Hair et al., 1998; Kline, 2015).

In this light, the realized sample size of five hundred is deemed appropriate for data analysis using PLS-SEM. The large sample size is considered as beneficial for accuracy.

The sampling unit is the farmer registered on the eNAM portal at the Agricultural produce market committee (APMC) wholesale market. The respondents are randomly selected via a random selection from the sampling frame (database in excel format) of registered farmers maintained by the five APMCs. It is expected that as a registered user of eNAM-enabled APMC, the respondent has an opinion about its functioning.

The survey is conducted offline - either at a farmer's home or the APMC location - for one year in 2019. Though the process is time-consuming, it has a higher response rate than surveys based on postal mail, telephone, or online in the rural population (Malhotra, 2008).

### 4.8.3 For Interpretive Ranking Process

The credibility of qualitative research is established using referential adequacy. A team of six experts from academia and industry was formed to apply the IRP method (Sushil, 2009). After this, no added information was elicited by adding more experts, so a

detailed questionnaire (*Appendix F*) response was restricted to the first panel of six experts (Morse, 2000; Berg, 2001; Astalin, 2013).

The transferability is established using the detailed description (interpretive logic, knowledge base, and context for the recommendation) obtained through a National Agriculture Market (eNAM) case study. The qualitative research's dependability and confirmability are established using the validity check of IRP findings by the second panel of five experts. The third panel of the five experts deliberated on the suggestions to improve factors leading to the high usage of the B-B e-commerce platform.

In all three expert panels, members are drawn from the mix of Academia, Industry, and Users. Each expert who has volunteered for the study is a professional (with experience) with knowledge of e-commerce and agriculture.

Overall, the total number of sixteen expert opinions via questionnaire and semi-structured interviews conducted during Sept. – Dec. 2019 is within the suggested range of 15 to 30 in information systems research and 5 to 25 for phenomenological studies (Creswell, 2007; Marshall *et al.,* 2013). The outlined research process is suited for understanding and clarifying current issues and exploring new issues (Bryman, 2008).

## 4.9 Description of eNAM Markets Selected for the Survey

Five Agriculture Produce Marketing Committee (APMC) markets spread over two states have been selected for data collection and comparative study.

The survey and interviews were conducted in the APMC markets of Meerut (Uttar Pradesh State, India), Aligarh (Uttar Pradesh State, India), Pilibhit (Uttar Pradesh State, India), Nadbai (Rajasthan State, India) and Nagar (Rajasthan State, India). The market details and the field visit sample photographs are shown in *Appendix G and Appendix H,* respectively.

The APMCs were chosen based on the criteria: lack of such studies in the context of North Indian markets, the large size of markets (in terms of transactions and eNAM users), trade in major commodities (Wheat, Paddy, Mustard, and Vegetables), geographical proximity, researcher’s familiarity with the culture and local language of

farmers and eNAM operational for more than a year. All these APMCs have many transactions, a massive user base, similar in terms of commodities transacted and eNAM has been operational for more than a year.

## 4.10 Software Tools

The software tools used in this study are listed in Table 4.4.

Table 4.4 Software Tools used in the Study

| Method | Software Used |
|---|---|
| IRP, TISM, and Univariate Statistical Analysis | Microsoft Excel for Microsoft 365 MSO |
| PLS-SEM | SmartPLS 3.3.2 |
| Text Analysis | NVivo 1.0 |
| Reference Management | Mendeley |

## 4.11 Concluding Remarks

The conceptual adoption framework of the research is based on a detailed review of literature about the agricultural B-B e-commerce adoption variables. The conceptual adoption framework has twenty-two observed variables linked to the seven direct or indirect determinant constructs. The primary dependent construct is ‘Adoption’.

Understanding about variables of the conceptual adoption framework helped in the formulation of a questionnaire and data collection.

The TISM analysis is used to identify the relationships among the constructs and transform the conceptual framework into the proposed framework. As per the quantitative research method, data collected through a survey questionnaire is analyzed with the help of PLS-SEM software to identify the influence of independent variables on the dependent construct. The ranking of variables is also attempted using the IRP methodology. A detailed analysis of data and findings is presented in the next chapter.

# Chapter 5

# Validation of the Conceptual Research Framework

## 5.1 Introduction

The chapter presents an analysis of data to meet the research objectives as per the study context.

This chapter has been organized as follows:

- First, the TISM analysis is done to firm up the relationship between the constructs and transform the conceptual adoption framework into a proposed adoption framework.
- Second, the data collected through a user survey of the eNAM project has been analyzed using the PLS-SEM methodology to validate the proposed adoption framework. Further, hypotheses as per the adoption framework are tested, and the results have been presented.

## 5.2 Total Interpretive Structural Modelling

The methodological steps of TISM, along with its implementation in the study context, are detailed below:

*Step 1: Identification of Constructs*

The seven identified constructs are presented in Table 5.1 as per the literature review in the B-B e-commerce adoption context (*Chapter 2*).

Table 5.1 Construct Identified

| Code | Construct |
|---|---|
| F1 | Perceived Usefulness |
| F2 | Perceived Ease of Use |
| F3 | Social Influence |
| F4 | Trust |
| F5 | Cost |
| F6 | Facilitating Conditions |
| F7 | Behavioural Intention |

*Step 2: Contextual Relationship between Constructs.*

In TISM, 'influences/enhance' is the contextual relationship between constructs. Therefore, the contextual relationship between the eight constructs is of the following form. The B-B e-commerce adoption construct 'I' will influence/enhance B-B e-commerce adoption construct 'j', e.g., 'Perceived Usefulness' will influence/enhance the 'Behavioural Intention' to Adopt.

*Step 3: Structured Self-Interaction Matrix*

As per the expert opinion, the Structured Self-Interaction Matrix (SSIM) was created (Table 5.2). The symbols represent:

- V - construct ‘i’ influences/enhances ‘j’.
- A - construct ‘j’ influences/enhances ‘i’.
- X - construct ‘i’ and ‘j’ influences/enhances one another; and
- O - construct ‘i’ and ‘j’ do not influences/enhances one another.

Table 5.2 Structured Self Interaction Matrix

| **Constructs i↓ j→** | **Code** | **F8** | **F7** | **F6** | **F5** | **F4** | **F3** | **F2** | **F1** |
|---|---|---|---|---|---|---|---|---|---|
| Perceived Usefulness | F1 | V | V | O | O | X | X | X | - |
| Perceived Ease of Use | F2 | V | V | O | O | X | X | - | - |
| Social Influence | F3 | V | V | V | O | X | - | - | - |
| Trust | F4 | V | V | O | O | - | - | - | - |
| Cost | F5 | V | O | O | - | - | - | - | - |
| Facilitating Conditions | F6 | V | O | - | - | - | - | - | - |
| Behavioural Intention to Adopt | F7 | V | - | - | - | - | - | - | - |
| Adoption | F8 | - | - | - | - | - | - | - | - |

***Remark***: Only if sixty per cent or more experts (i.e., six or more out of ten experts) have marked a relationship as 'Yes' it is counted; else, it is dropped, thus implying no relationship.

*Step 4: Reachability Matrix*

For Reachability Matrix (RM), each cell of the SSIM matrix (Table 5.2) is converted into the binary number ‘0’ or ‘1’ and transitivity (e.g., if X enhances/influences Y, and Y enhances/influences Z, then X enhances/influences Z) is incorporated (Table 5.3). The conversion to binary numbers is based on the following rules:

- If (i, j) cell value in SSIM is V, then (i, j) value is 1, and the (j, i) is 0.
- If (i, j) cell value in SSIM is A, then (i, j) value is 0, and the (j, i) is 1.
- If (i, j) cell value in SSIM is X, then (i, j) value is 1, and the (j, i) is 1.
- If (i, j) cell value in SSIM is O, then (i, j) value is 0, and the (j, i) is 0.

Table 5.3 Reachability Matrix

| **Constructs i↓ j→** | **Alpha-**Numeric Code | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **F7** | **F8** | **Driving Power** |
|---|---|---|---|---|---|---|---|---|---|---|
| Perceived Usefulness | **F1** | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1* | **6** |
| Perceived Ease of Use | **F2** | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1* | **6** |
| Social Influence | **F3** | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1* | **7** |
| Trust | **F4** | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1* | **6** |
| Cost | **F5** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | **2** |
| Facilitating Conditions | **F6** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | **2** |
| Behavioural Intention to Adopt | **F7** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | **2** |
| Adoption | **F8** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | **1** |
| **Dependence** | | **4** | **4** | **4** | **4** | **1** | **2** | **5** | **8** | |

***Remark*****:** *Transitivity Check: If X enhances/influences Y, and Y enhances/influences Z, then X transitively enhances/influences Z; in such case, if the cell value from X to Z is 0, it is converted to '1*'.*

*Step 5: Level Partitioning*

The Reachability Matrix (Table 5.3) is iteratively split into levels one to three. All constructs' reachability (corresponding row in the reachability matrix) and antecedents (corresponding column in the reachability matrix) are listed. At the same time, the intersection set of the reachability and antecedent sets is found. Level 1 is given to the construct, which has a similar reachability set and intersection set. In the next iteration, level 1 constructs are taken off, and the process is repeated with the remaining constructs. Finally, the level of each construct is arrived at, as shown in Level Partitioning (LP) Table 5.4.

Table 5.4 Level Partitioning of Reachability Matrix

| **Construct** | **Reachability** | **Antecedent** | **Intersection** | **Level** |
|---|---|---|---|---|
| **I. Iteration 1** | | | | |
| F1 | F1, F2, F3, F4, F7, F8 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F2 | F1, F2, F3, F4, F7, F8 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F3 | F1, F2, F3, F4, F6, F7, F8 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F4 | F1, F2, F3, F4, F7, F8 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F5 | F5, F8 | F5 | F5 | |
| F6 | F6, F8 | F3, F6 | F6 | |
| F7 | F7, F8 | F1, F2, F3, F4, F7 | F7 | |
| F8 | F8 | F1, F2, F3, F4, F5, F6, F7, F8 | F8 | **1** |
| **2. Iteration 2** | | | | |
| F1 | F1, F2, F3, F4, F7 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F2 | F1, F2, F3, F4, F7 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F3 | F1, F2, F3, F4, F6, F7 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F4 | F1, F2, F3, F4, F7 | F1, F2, F3, F4 | F1, F2, F3, F4 | |
| F5 | F5 | F5 | F5 | **2** |
| F6 | F6 | F3, F6 | F6 | **2** |
| F7 | F7 | F1, F2, F3, F4, F7 | F7 | **2** |
| **3. Iteration 3** | | | | |
| F1 | F1, F2, F3, F4 | F1, F2, F3, F4 | F1, F2, F3, F4 | **3** |
| F2 | F1, F2, F3, F4 | F1, F2, F3, F4 | F1, F2, F3, F4 | **3** |
| F3 | F1, F2, F3, F4 | F1, F2, F3, F4 | F1, F2, F3, F4 | **3** |
| F4 | F1, F2, F3, F4 | F1, F2, F3, F4 | F1, F2, F3, F4 | **3** |

***Remark*:** Logically based on expert opinion. Suppose two constructs are firmly connected; both must list together in the respective intersection. For example, if the intersection set equals (F4, F7) in construct F4, it must repeat for construct F7 as well.

*Step 6: Digraph*

The Digraph (Figure 5.1) graphically shows the constructs and their relationship in nodes and edges. The directional arrow between constructs shows the association as per the reachability matrix.

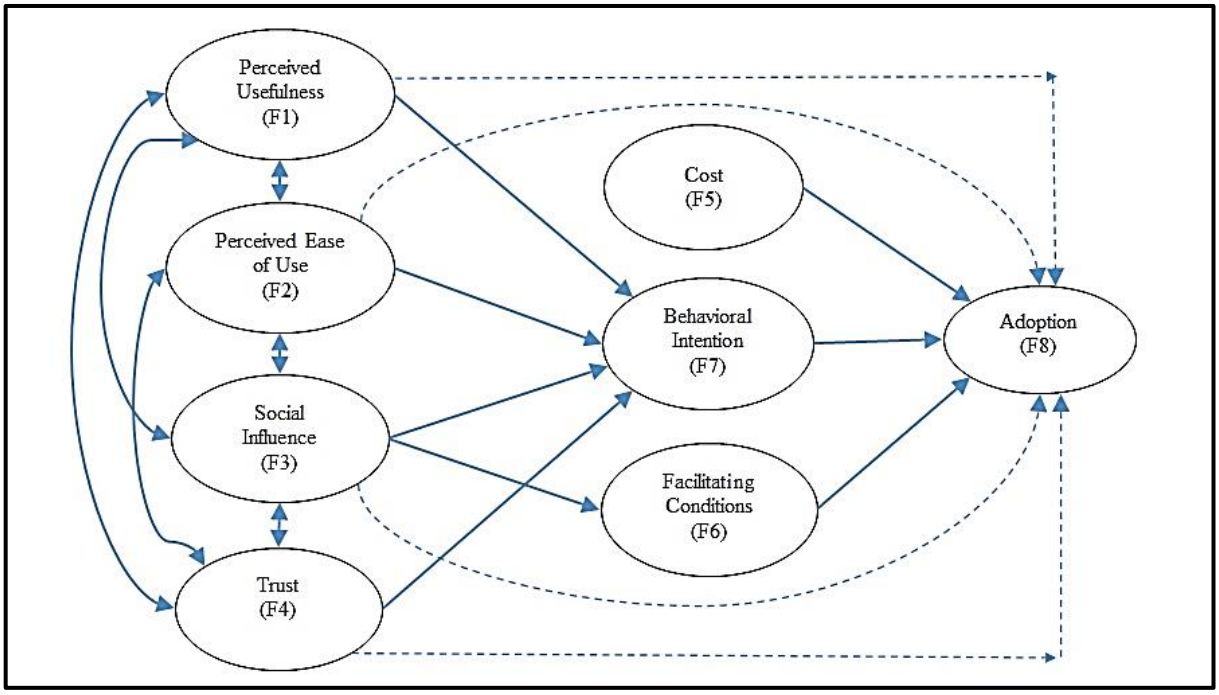


Figure 5.1 Digraph

***Remark*:** Retained transitive links (dotted line) must have two-thirds or more expert panel opinions about a clear causal logic.

*Step 7: Binary Interaction Matrix and Interpretive Matrix*

The digraph (Figure 5.1) is transformed into a Binary Interaction Matrix *(*BIM) (Table 5.5). All the influencers/enhancers are depicted by ‘1'; the remaining entries are '0’. The Indicative Interpretive Matrix (IM) and Explained Interpretive Matrix (EIM) are developed for all significant ‘1’ values in Binary Interaction Matrix and are shown in Tables 5.6 and 5.7.

Table 5.5 Binary Interaction Matrix

| **Factors i↓ j→** | **Code** | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **F7** | **F8** |
|---|---|---|---|---|---|---|---|---|---|
| **F1**: Perceived Usefulness | F1 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| **F2**: Perceived Ease of Use | F2 | 0 | | 0 | 0 | 0 | 0 | 1 | 0 |
| **F3**: Social Influence | F3 | 0 | 0 | | 0 | 0 | 1 | 1 | 0 |
| **F4**: Trust | F4 | 0 | 0 | 0 | | 0 | 0 | 1 | 0 |
| **F5**: Cost | F5 | 0 | 0 | 0 | 0 | | 0 | 0 | 1 |
| **F6**: Facilitating Conditions | F6 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 |
| **F7**: Behavioural Intention to Adopt | F7 | 0 | 0 | 0 | 0 | 0 | 0 | | 1 |
| **F8**: Adoption | F8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Table 5.6 Indicative Interpretive Matrix

| Construct | F8 | F7 | F6 | F5 | F4 | F3 | F2 | F1 |
|---|---|---|---|---|---|---|---|---|
| **F1:** Perceived Usefulness | | √ | | | | | | |
| **F2:** Perceived Ease of Use | | √ | | | | | | |
| **F3:** Social Influence | | √ | √ | | | | | |
| **F4:** Trust | | √ | | | | | | |
| **F5:** Cost | √ | | | | | | | |
| **F6:** Facilitating Conditions | √ | | | | | | | |
| **F7:** Behavioural Intention to Adopt | √ | | | | | | | |
| **F8:** Adoption | | | | | | | | |

**NOTE:** *Explanation for √ (Interpretations) is provided in the Interactive Matrix Explained (Table 5.7) in the Section: Findings and Suggestions*

*Step 8: Total Interpretive Structural Model (TISM)*

The Binary Interaction Matrix (Table 5.5), Interpretations (Table 5.6, Table 5.7), and the digraph (Figure 5.1) information are used to bring out a TISM-based adoption framework. The nodes in oval shapes show constructs. The interpretations are on the links—the resultant TISM-based adoption framework is presented in Figure 5.2.

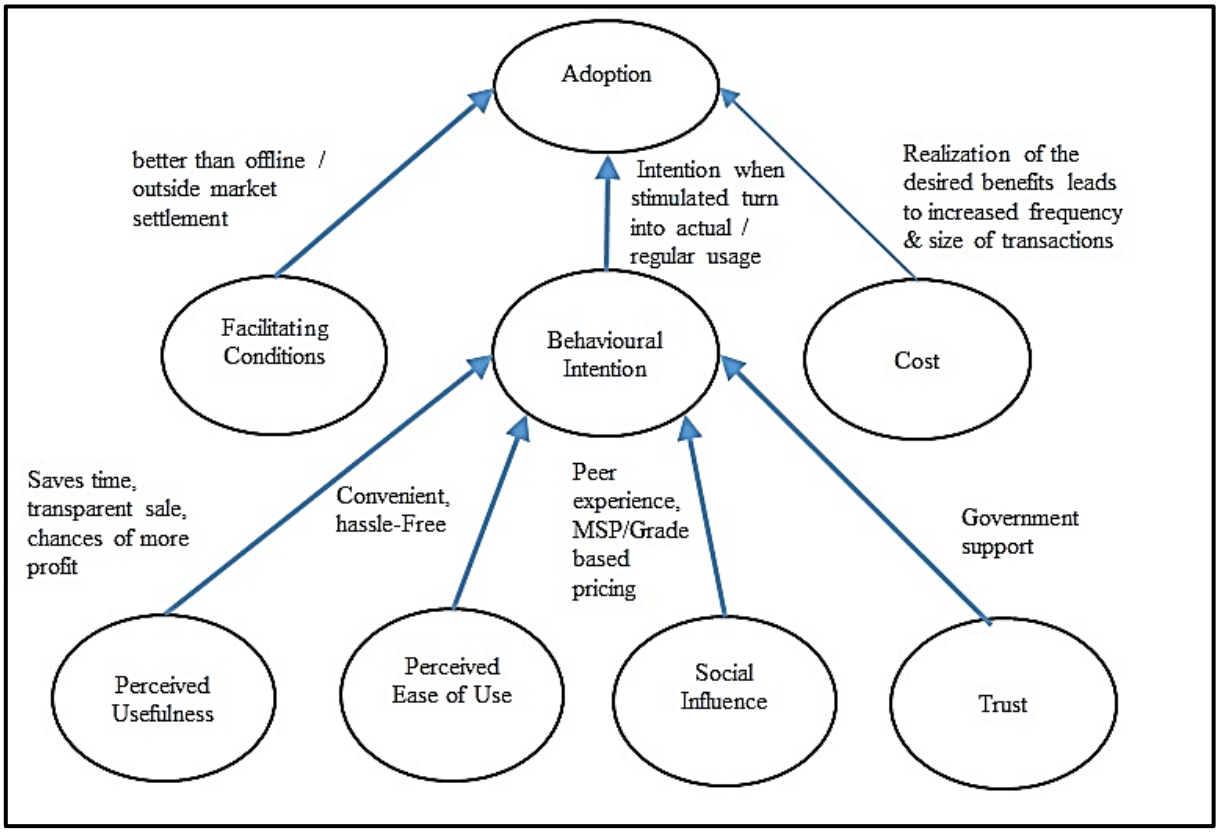


Figure 5.2 TISM based Adoption Framework

Remark:

- *Validity Check: No one-way link between the two constructs at the same level. The link direction shall be from the higher number to the lower-numbered level, not vice-versa.*
- *In the diagraph (Figure 11), the correlations between the Level 3 constructs are not significant. Thus, the direct and transitive links between them at the same level are dropped in the final TISM-based framework.*

The TISM adoption framework (Figure 5.2) shows the links (as the contextual relationships) and the direction of the relationships. The framework nodes are interpreted with a clear definition of respective elements, leading to a clear picture of constructs (enhancers/influencers) of B-B e-commerce adoption among farmers and traders. As explained in Table 5.7 below, these constructs and the relationships need to be kept in view while designing agricultural B-B e-commerce initiatives such as eNAM.

Table 5.7 Explained Interpretive Matrix

| S. No. | Construct (Influencer/Enhancer) | Construct (Influenced/ Enhanced) | Details of Influence with Reason [Explanation for Symbol √ (Table 14)] |
|---|---|---|---|
| 1 | **F1**: Perceived Usefulness<br><br>(The eNAM extends benefits to users in terms of better price and speed of the market transaction) | **F7**: Behavioural Intention to Adopt B-B e-commerce | B-B e-commerce saves the farmer/trader time as the gate entry to the payment sequence is completed within a day. The farmer completes the sale and returns to his home rather than wait overnight in the market. The transparent online sale process may yield a higher price due to intra-market and inter-market competition between traders and higher-quality produce yielding to a higher price. |
| 2 | **F2**: Perceived Ease of Use<br><br>(The eNAM is simple in operation and learnt without difficulty) | **F7**: Behavioural Intention to Adopt B-B e-commerce | Online B-B e-commerce is convenient due to the multilingual mobile application. The trained eNAM staff is available to support the user (farmer/trader) using the service. It is hassle-free as the competing bids are negotiable online without fear of collusion or forced selling. |
| 3 | **F3**: Social Influence<br><br>(The community of close friends, leading farmers, associated traders, and community leaders encourage or promote the eNAM) | **F7**: Behavioural Intention to Adopt B-B e-commerce | The experience of market officials and peers (farmer/trader) in terms of higher price realization and quick trade cycle influences the farmers/traders. The farmer will likely follow the co-operatives/farmer producer organizations/corporate buyers to use B-B e-commerce. Similarly, traders in the market go with the decision of the Association or APMC Secretary. |
| 4 | **F3**: Social Influence<br><br>(*Same as above*) | **F6**: Facilitating Conditions | Even though the farmer is not trained on a B-B e-commerce platform or does not wish to get e-payment into a bank account (as |

| | | | |
|---|---|---|---|
| | | | they prefer cash transactions), he is motivated by the community leader/influencer to use a B-B e-commerce platform. The community support may make up for shortcomings in the market infrastructure. |
| 5 | **F4**: Trust<br><br>(The user confidence in the information and trade based on the eNAM portal. It also signifies a belief that the eNAM is reliable and the management will act in the interest of farmers and other stakeholders) | **F7**: Behavioural Intention to Adopt B-B e-commerce | The eNAM is government-supported and implemented in all large APMCs. The government-mandated quality lab reports and digital payment via banks bring the safety aspect missing in the offline trade. The produce is sold through intra-market/inter-market competing bids - decreasing the fear of trader collusion. |
| 6 | **F5**: Cost<br><br>(The transaction costs in the eNAM platform) | **F8**: Adoption | The cost (transaction costs) consists of search, coordination, motivation, and commitment costs. The wholesale B-B e-commerce platform is likely to reduce search and coordination costs via increased efficiency due to process improvement, marketplace benefits, and indirect improvements. The reduced transaction cost and fixed market fee lead to better margins, thus motivating continued usage of the B-B e-commerce platform. |
| 7 | **F6**: Facilitating Conditions<br><br>(The infrastructure, including quality testing laboratories, bidding hall, logistics support, IT/product Training, and customer care, complements the use of eNAM) | **F8**:<br><br>Adoption | As the desired benefits of better pricing, quick cycle, convenience, and logistics tie-ups get realized, it encourages users (farmers/traders) to increase the frequency and size of the B-B e-commerce platform. Also, the awareness drives and training camps encourage hesitant users to register and trade on the e-trade platform. |
| 8 | **F7**: Behavioural Intention | **F8**: Adoption | The intention, when stimulated, turns into actual usage and then regular usage by the farmer/trader. |

| | | | |
|---|---|---|---|
| | (The degree to which a person has made an informed plan to buy/sell on eNAM) | | |

The TISM based conceptual eNAM adoption framework (Figure 5.2) is validated using PLS-SEM analysis and presented next.

## 5.3 Partial Least Squares - Structural Equation Modeling Analysis

The conceptual adoption framework, post TISM analysis, is transformed into the proposed adoption framework (Figure 5.3). The relationships between the constructs which were unclear (represented as the dotted lines in Figure 4.1) are now explained (depicted as the solid lines in Figure 5.3).

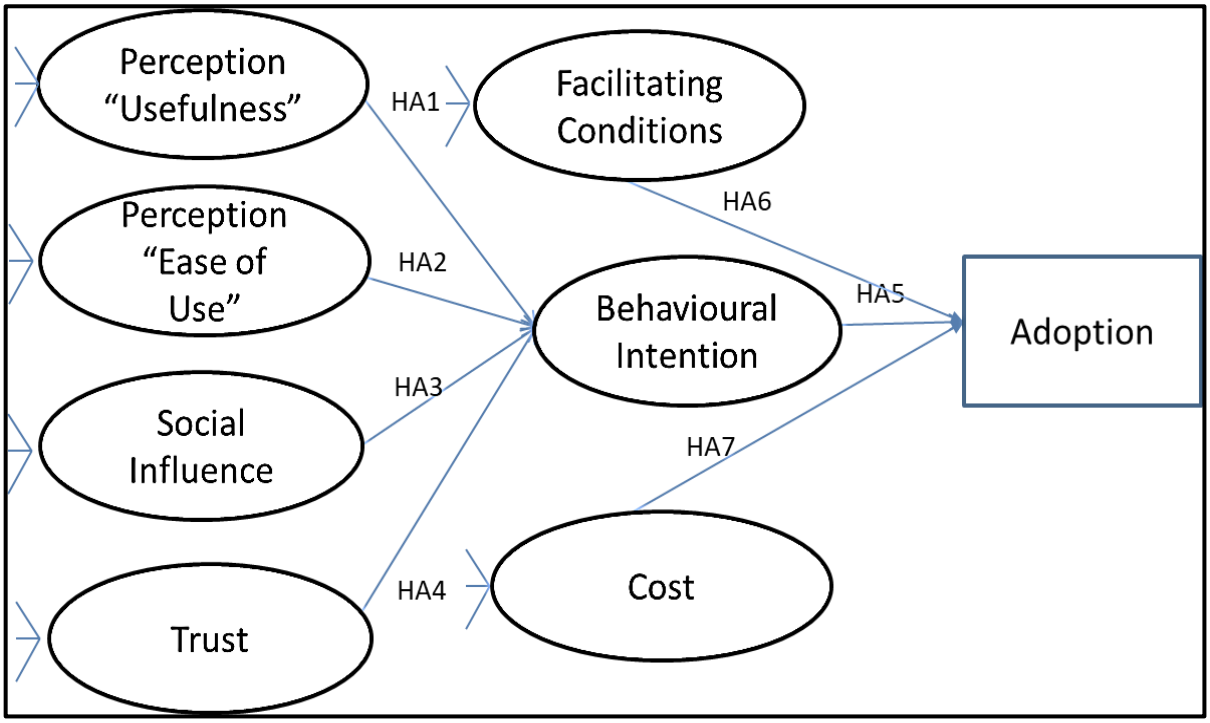


Figure 5.3 Proposed Adoption Framework

### 5.3.1 Demographic Characteristics of the Sample

Out of 661 survey questionnaires collected, five hundred responses were found complete and considered for further analysis. The respondents were farmers registered at the five APMCs, viz. Meerut, Aligarh, Nagar, Nadbai, and Pilibhit. Out of five hundred respondents, 42.6 per cent deal in vegetables, 29.4 per cent deal in wheat, 18 per cent deal in paddy, 6 per cent deal in mustard and 4 per cent in maize.

### 5.3.2 Measurement Model

The measurement model was assessed as per the PLS-SEM validation metrics. All the observed constructs' loadings are above 0.708, implying that the construct explains more than half of the indicator's variance, thus providing acceptable item reliability. The internal consistency reliability (CR) is established as good since all the CR values are between 0.8 and 0.9, and the Cronbach's alpha (α) values are more than 0.70. Convergent validity is checked by average variance extracted (AVE). All the AVE values are found to be more than 0.5 (Drolet and Morrison, 2001; Diamantopoulos et al., 2012; Hair et al., 2019). The calculated values are presented in Table 5.8.

Table 5.8 Reliability and Validity Assessment

| **Construct** | **Observed Variable (Micro-Variable)** | **Item Loading** | **Composite Reliability (CR)** | **Cronbach's Alpha** | **Average Variance Extracted (AVE)** |
|---|---|---|---|---|---|
| Perceived Usefulness (PU) | Useful in Trade (PU1) | 0.94 | 0.9 | 0.9 | 0.85 |
| | Accomplish Task Quickly (PU2) | 0.93 | | | |
| | Price Increase (PU3) | 0.89 | | | |
| Perceived Ease of Use (PEU) | Good User Interface (PEU1) | 0.89 | 0.9 | 0.85 | 0.78 |
| | Easy to use (PEU2) | 0.88 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Easy to Learn (PEU3) | 0.89 | | | |
| Social Influence (SI) | Influencers (SI1) | 0.88 | 0.87 | 0.78 | 0.69 |
| | Helpful Management (SI2) | 0.80 | | | |
| | Organization support (SI3) | 0.82 | | | |
| Facilitating Condition (FC) | Infrastructure (FC1) | 0.91 | 0.9 | 0.86 | 0.78 |
| | Training (FC2) | 0.89 | | | |
| | Support (FC3) | 0.87 | | | |
| Trust (T) | Accurate Information (T1) | 0.93 | 0.9 | 0.9 | 0.84 |
| | Trust in Seller (T2) | 0.92 | | | |
| | Trust in Buyer (T3) | 0.91 | | | |
| Cost (C) | Transaction cost (C1) | 0.87 | 0.86 | 0.76 | 0.67 |
| | Value for Money (C2) | 0.83 | | | |
| | Overall Cost (C3) | 0.76 | | | |
| Behavioural Intention (BI) | Intend - within 1 year (BI1) | 0.82 | 0.88 | 0.79 | 0.7 |
| | Intend - next 1 year (BI2) | 0.90 | | | |
| | Intend – no time-period specified (BI3) | 0.81 | | | |

The discriminant validity is evaluated using two methods: Fornell and Larcker and the Heterotrait-Monotrait (HTMT) criteria (Fornell and Larcker, 1981; Henseler et al.,

2015). The Fornell and Larcker criterion is satisfied, as each construct's AVE is more than the squared inter-construct correlation of that same construct and all other reflectively measured constructs. The HTMT criteria are also satisfied. The values in Table 5.9 are below the recommended value of 0.9, conforming to discriminant validity. The two exceptions (0.92, 1) in values are noted as the respondents being farmers (at varying literacy levels) and, as such, might have faced problems in differentiating between the constructs.

Table 5.9 Discriminant Validity

| | **BI** | **C** | **FC** | **PEU** | **PU** | **SI** | **T** | **BI** | **C** | **FC** | **PEU** | **PU** | **SI** | **T** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Fornell and Larcker Criteria** | | | | | | | **HTMT Criteria** | | | | | | |
| **BI** | 0.84 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **C** | 0.86 | 0.82 | - | - | - | - | - | 1 | - | - | - | - | - | - |
| **FC** | 0.76 | 0.78 | 0.89 | - | - | - | - | 0.9 | 0.9 | - | - | - | - | - |
| **PEU** | 0.71 | 0.76 | 0.80 | 0.88 | - | - | - | 0.8 | 0.9 | 0.9 | - | - | - | - |
| **PU** | 0.73 | 0.77 | 0.79 | 0.85 | 0.92 | - | - | 0.8 | 0.9 | 0.8 | 0.9 | - | - | - |
| **SI** | 0.70 | 0.75 | 0.77 | 0.80 | 0.78 | 0.83 | | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | | |
| **T** | 0.79 | 0.86 | 0.79 | 0.76 | 0.80 | 0.74 | 0.92 | 0.9 | 1 | 0.8 | 0.8 | 0.8 | 0.8 | |
| **U** | 0.79 | 0.81 | 0.70 | 0.73 | 0.72 | 0.68 | 0.71 | 0.8 | 0.9 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |

NOTE: Instead of Confirmatory factor analysis (CFA), the PLS-SEM analysis entails doing confirmatory composite analysis (CCA) to confirm measurement models. CCA done as a part of this study confirms the reflective measurement model of established measures updated/adapted to a different context and developing new measures (Hair et al., 2020)

### 5.3.3 Structural Model

The structural model (Figure 5.4) shows the relationships among the constructs in the research framework. The association is tested using path coefficients (β) and t-statistics.

Most of the VIF values are less than 3. Almost all values in the inner model are less than 5; thus, the collinearity between the predictor constructs does not bias the regression results. The dependent construct 'Behavioural Intention' (BI) lowest coefficient of determination ($R^2$) value is 0.67, a near substantial value in behavioural sciences research. The value of $R^2$ for the primary dependent construct 'Adoption' (U) is higher at 0.7, indicating that the model accounts for a substantial proportion of the dependent construct variance. The structural model has a near substantial in-sample explanatory power (Henseler et al., 2009; Hair et al., 2011; Becker et al., 2015). The $R^2$ of the structural equation and PLS-SEM Fit indices are presented in Table 5.10.

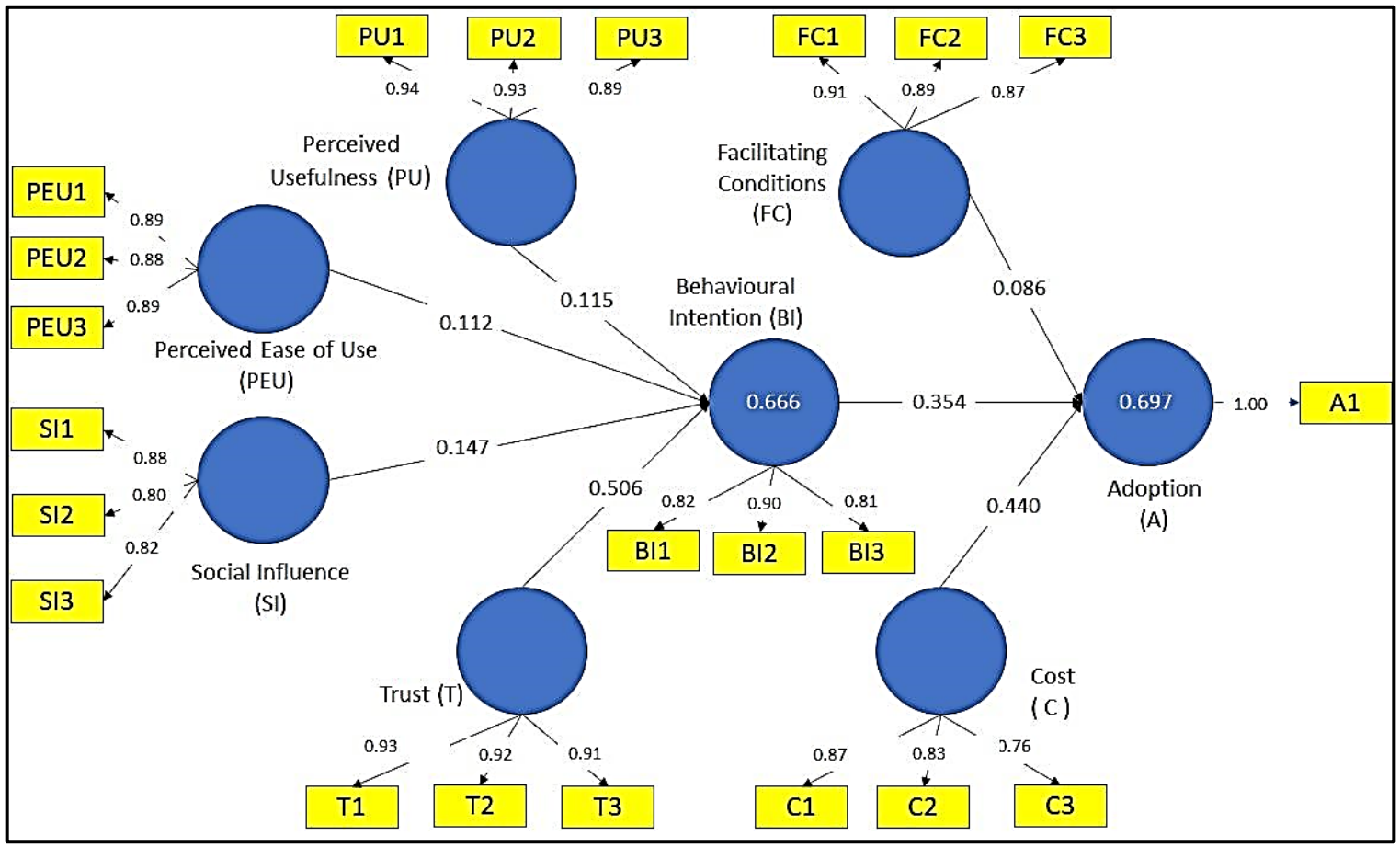


Figure 5.4 Structural Model as a Validated Adoption Framework

The model fit indices for the structural model of the adoption framework are given in Table 5.10. The standardized root-mean-square residual (SRMR) value is 0.064, and the non-fuzzy index (NFI) value is 0.81. The model is a good fit since the SRMR value is less than 0.08 (Hu and Bentler, 1999; Ringle, 2016)

Table 5.10 PLM -SEM Fit Indices

| **Model Elements** | **Values** |
|---|---|
| $R^2$ for 'Behavioural Intention' (BI) | 0.67 |
| $R^2$ for 'Adoption' (U) | 0.7 |
| Chi-square | 1991 |
| SRMR | 0.064 |
| NFI | 0.8 |

### 5.3.4 Hypothesis Testing Results

The PLS-SEM results for the structural model (Figure 5.4) are presented in Table 5.11. For significant P-values < 0.05, hypotheses $HA_{01}$, $HA_{02}$, $HA_{03}$, $HA_{04}$, $HA_{05}$, $HA_{06}$, and $HA_{07}$ are supported.

Table 5.11 Structural Results

| Hypotheses | Notation | Path Coefficients | t-Values | P-Values | Remarks |
|---|---|---|---|---|---|
| $H_{A1}$: 'Perceived – Usefulness' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | PU -> BI | 0.119 | 2.016 | 0.044 | Supported* |
| $H_{A2}$: Perceived Ease of Use' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | PEU -> BI | 0.111 | 2.168 | 0.031 | Supported* |
| $H_{A3}$: 'Social Influence' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | SI -> BI | 0.145 | 3.134 | 0.002 | Supported* |
| $H_{A4}$: 'Trust' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | T -> BI | 0.504 | 9.610 | 0.000 | Supported* |
| $H_{A5}$: The 'Behavioural Intention' affects the 'Adoption' of the B-B e-commerce platform (eNAM). | BI -> U | 0.348 | 6.301 | 0.000 | Supported* |
| $H_{A6}$: The 'Facilitating Conditions' affect the 'Adoption' of the B-B e-commerce platform (eNAM). | FC -> U | 0.088 | 2.110 | 0.035 | Supported* |
| $H_{A7}$: The 'Cost' affects the 'Adoption' of the B-B e-commerce platform (eNAM). | C -> U | 0.443 | 9.271 | 0.000 | Supported* |

*Significant at P-values < 0.05, and t-values>1.96 (at 5 per cent significance level).

The relationship between the constructs is significant as all the t values are more than 1.96. The Stone-Geisser criterion ($Q^2$) is investigated to assess the predictive relevance of the model. It measures the reconstruction of the observed values by the model and its parameter estimates. The models are expected to have $Q^2$ greater than zero to have predictive relevance. $Q^2$ values for the construct 'Adoption' is 0.661, and for the construct 'Behavioural Intention' is 0.661. The values are above the zero-threshold value, representing a considerable predictive accuracy of the PLS path model (Shmueli et al., 2016; Hair et al., 2019).

As for the $f^2$ effect sizes, the construct 'Cost' has a moderate effect on the 'Adoption', whereas the 'Trust' has a moderate effect on the 'Behavioral Intention' since the $f^2$ size effect is more than 0.15 but less than 0.35. The rest other constructs have a small effect since the $F^2$ effect size is less than 0.15 (Cohen, 1988). The 'Behavioural Intention' partially mediates the relationship between the constructs 'Social Influence' - 'Adoption', and 'Trust' - 'Adoption' with a p-value less than 0.05 and the indirect effects 95 per cent boot confidence interval bias-corrected does not straddle a zero in between lower limit and upper limit (Preacher and Hayes, 2008), for other constructs 'Perceived Ease of Use' and 'Perceived Usefulness', the effect pass through 'behavioural intention' and there is full mediation.

## 5.6 Concluding Remarks

The chapter has presented a TISM analysis to transform the conceptual research framework into the proposed adoption framework. The PLS-SEM analysis validates the proposed adoption framework to analyze the influence constructs on the adoption of the B-B e-commerce platform in the agricultural wholesale markets of India, i.e., eNAM. The proposed research hypotheses have also been tested and found to be supporting the structural model.

The next chapter ranks the constructs influencing the adoption of B-B e-commerce in agricultural marketing.

# Chapter 6
# Ranking of Constructs for the Continued Use

## 6.1 Introduction

The B-B e-commerce platform is viewed as a game-changer and a valuable instrument to address supply chain improvement by offering an alternative to the rigid Agricultural Produce Market Committee (APMC) controlled markets. The electronic National Agriculture Market (eNAM) is the national B-B e-commerce platform. Within four years, it has been launched in one thousand wholesale markets - reaching 14 per cent of its Year 2022 target of 7500 markets.

So far, just 14 per cent of India's farmers have registered for eNAM. Out of these, only about 50 per cent have started using eNAM. Thus, transaction growth and continued usage are relatively low.

The domain experts have identified the need to improve the post-adoption usage of eNAM among the participants (farmers, traders, corporate agents) to deliver the intended benefits (Hindu, 2019; Naik, 2019; Sajwan, 2020).

Empirically, it is shown that high user registration and use are critical for deriving value in a B-B e-commerce system. The critical mass of farmers and traders with many usage transactions contributes to B-B e-marketplace success, e. g. eNAM. The high number of transactions also enhances market efficiency (Chircu and Kauffman, 2000; Subramaniam and Shaw, 2002; Li and Li, 2005; Engström and Salehi-Sangari, 2007; Chordia, Roll, and Subrahmanyam, 2008).

So, keeping the facts described above in view, this chapter aims to rank the constructs in the adoption framework for the post-adoption usage of B-B e-commerce platforms in the eNAM context. The scarce resources and efforts may be prioritized for the higher-ranking constructs in the post-adoption scenario.

## 6.2 Research Methodology

The constructs in the adoption framework are ranked using the efficient Interpretive Ranking Process (IRP) to cross-verify the findings with an independent approach.

The IRP method involves developing binary and interpretive matrices. The development of metrics is followed by a detailed interpretive logic knowledge base (Sushil, 2009). Then, a dominance matrix is prepared for ranking the constructs concerning the three reference constructs (criterion). The final Interpretive Ranking Model is based on a dominance index derived from the construct's adjusted net dominance. The ranking of constructs has been kept in view while making recommendations (*Chapter 8*).

This part of the research's trustworthiness is established using Lincoln and Guba's Evaluative Criteria of credibility, transferability, dependability, and conformability (Lincoln and Guba, 1985).

The credibility of qualitative research is established using referential adequacy. Then, a team of six experts from academia and industry is formed to apply the IRP method. After this, no added information was elicited by adding more experts, so a detailed questionnaire response was restricted to six experts in the first panel (Morse, 2000; Berg, 2001; Astalin, 2013).

The transferability is established using a thick description (interpretive logic, knowledge base, and context for the recommendation) obtained through a National Agriculture Market (eNAM) case study.

The qualitative research's dependability and confirmability are established using the validity check of IRP findings by the second panel comprising five experts.

The third panel of five experts deliberated on suggestions to improve constructs leading to the high usage of the B-B e-commerce platform.

In all three expert panels, members are drawn from a mix of academia, industry, and users (farmers). Overall, a total of sixteen expert opinions captured through questionnaires and semi-structured interviews conducted during the year is within the

suggested range of 15 to 30 in the information systems research and 5 to 25 for the phenomenological studies (Cresswell, 2007; Marshall et al., 2013). The outlined research process for this part of the study is suited to understanding and clarifying current issues and exploring new issues (Bryman, 2008).

## 6.3 Analysis and Findings

The Interpretive Ranking Process (IRP) has been applied to influencing variables. The eight steps in the methodological process are outlined next.

*Step 1: Identification of ranking constructs concerning the reference constructs*

The six ranking constructs (Table 6.1) were identified in Chapter 2 based on reviewing the scholarly articles, reports, and news articles relevant to the research. In this stage of analysis, besides the 'Start of Transaction' reference construct, which was considered in the previous chapter with respect to 'Adoption', two additional reference constructs ('Frequency of Transactions', and 'Total Volume of Transactions'), as suggested by experts, are also included (Table 6.2).

Table 6.1 Ranking Constructs

| Code | Ranking Constructs |
|---|---|
| F1 | Perceived Usefulness |
| F2 | Perceived Ease of Use |
| F3 | Social Influence |
| F4 | Trust |
| F5 | Cost |
| F6 | Facilitating Conditions |

Table 6.2 Reference Constructs

| Code | Reference Constructs |
|---|---|
| C1 | Start Actual Transactions |
| C2 | Frequency of Transactions |
| C3 | Total Volume of Transactions |

*Step 2: The relationship between the ranking and the reference constructs in the context*

Suppose the construct 'Fx' enhances/influences the construct 'Fy' in terms of dominance. In that case, the construct 'Fx' dominates the construct 'Fy.' If it is otherwise, then the construct 'Fx' is dominated by 'Fy.'

*Step 3: Development of a cross-interaction matrix*

The cross-interaction matrix (CIM) listing the contextual relationship between the ranking and reference construct is shown in Table 6.3. The cell value '1' indicates a contextual relationship in which the corresponding ranking construct 'Fx' 'enhances/influences' the reference construct 'Fy,' and '0' show no contextual relationship.

Table 6.3 Cross Interaction Matrix

| **Ranking Construct** | **Code** | | | |
|---|---|---|---|---|
| Perceived Usefulness | F1 | 1 | 1 | 1 |
| Perceived Ease of Use | F2 | 1 | 1 | 0 |
| Social Influence | F3 | 1 | 0 | 0 |
| Trust | F4 | 1 | 1 | 1 |
| Cost | F5 | 0 | 1 | 1 |
| Facilitating Conditions | F6 | 1 | 1 | 0 |
| | | C1 | C2 | C3 |
| **Reference Construct** | | Start Actual Transactions | Frequency of Transactions | Total Volume of Transactions |

An interpretive matrix (Table 6.4) is developed by explaining the '1' values in the cross interactions matrix (Table 6.3) (Sushil, 2005).

Table 6.4 Interpretive Matrix

| **Alternatives (Ranking Factor)** | **Code** | **Criteria (Reference Factor)** | | |
|---|---|---|---|---|
| | | Start Actual Transactions | Frequency of Transactions | Total Volume of Transactions |
| | | C1 | C2 | C3 |
| Perceived Usefulness | F1 | A trial of a useful (possibility of higher price, quick transaction cycle) system | Higher price/return than the offline market average due to quality linked pricing and reduction in trade to payment cycle time. | Why not use B-B e-commerce for more significant transactions? Even aggregation of produce and e-trade is attempted for small farmers. |
| Perceived Ease of Use | F2 | A simple procedure, an intuitive website, and the logical graphical user interface of the application. APMC | The user gains confidence in handling transactions due to familiarity with the website/mobile application. The intuitive and logical | |

| | | | | |
|---|---|---|---|---|
| | | support staff is available to help. | graphical user interface in the local language also makes the use easy. | |
| Social Influence | F3 | Many farmers adopt it due to uncertainty reduction and encouragement from influencers. It is a follower approach. | | |
| Trust | F4 | Knowledge acquisition/Awareness Camps build Trust in the government-promoted platform. | Using knowledge, transparency, and experience for further gains from e-trade | Taking advantage of application expertise, process transparency, and e-trade experience for higher benefits |
| Cost | F5 | | After comparing with the offline market, the user makes decisions, and lower transaction cost matters for traders and farmers. | An incentive of better margins on higher volume. |
| Facilitating Conditions | F6 | Understanding of stakeholders, physical infrastructure commitments, quality laboratories, training, and customer care staff to answer queries and get going on the platform | Increased realization of benefits. The quality-linked pricing and inter-market trade possibility both increase trade frequency. | |

*Step 4: Dominating interaction matrix*

The pairwise interaction of ranking constructs concerning the reference construct (s) listed in Table 6.3 is shown in Table 6.5. For each reference construct, the cell value for the pairwise dominance is '1' if the ranking construct 'Fx' dominates the ranking construct 'Fy.' If there is no dominance, the cell value is '0'.

Table 6.5 Dominance Interaction Matrix for each Reference Construct

| **FOR C1** (Weight of reference construct =1) | | | | | | | **FOR C2** (Weight of reference construct =1) | | | | | | | **FOR C3** (Weight of reference construct =1) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** |
| F1 | 0 | 0 | 0 | 0 | 1 | 1 | F1 | 0 | 0 | 1 | 0 | 0 | 0 | F1 | 0 | 1 | 1 | 0 | 0 | 1 |
| F2 | 1 | 0 | 1 | 1 | 1 | 0 | F2 | 1 | 0 | 1 | 0 | 0 | 0 | F2 | 0 | 0 | 0 | 0 | 0 | 0 |
| F3 | 1 | 0 | 0 | 0 | 1 | 0 | F3 | 0 | 0 | 0 | 0 | 0 | 0 | F3 | 0 | 0 | 0 | 0 | 0 | 0 |
| F4 | 1 | 0 | 0 | 0 | 1 | 0 | F4 | 1 | 1 | 1 | 0 | 1 | 0 | F4 | 1 | 1 | 1 | 0 | 0 | 1 |
| F5 | 0 | 0 | 0 | 0 | 0 | 0 | F5 | 1 | 1 | 1 | 0 | 0 | 0 | F5 | 1 | 1 | 1 | 1 | 0 | 1 |
| F6 | 0 | 0 | 0 | 0 | 1 | 0 | F6 | 0 | 1 | 1 | 1 | 0 | 0 | F6 | 0 | 0 | 0 | 0 | 0 | 0 |

The comprehensive reference construct-dominated interaction matrices for the three reference constructs (C1, C2, C3) are collated (Table 6.6).

Table 6.6 Overall Reference Construct Wise Dominant Interactions Matrix

| | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** |
|---|---|---|---|---|---|---|
| **F1** | | C3 | C2, C3 | | C1 | C1, C3 |
| **F2** | C1*, C2 | | C1, C2 | C1 | C1 | |
| **F3** | C1 | | | | C1 | |
| **F4** | C1, C2*, C3 | C2*, C3 | C2, C3 | | C1, C2 | C3 |
| **F5** | C2*, C3* | C2, C3 | C2, C3 | C3 | | C3 |
| **F6** | | C2* | C2 | C2 | C1 | |

*Step 5: Development of ranking and interpretation*

The number of dominating interactions in Table 6.5 is aggregated in a dominance matrix (Table 6.7). The total 'D' is the weighted sum of the number of instances where the ranking construct(s) dominate other ranking constructs. The column 'B' is the weighted sum of the number of instances in which other ranking constructs dominate a ranking construct. The difference between 'D' and 'B' is termed as a ranking

construct's net dominance. The net dominance is adjusted to the scale by adding the positive value equivalent to the maximum negative net dominance value to each net-dominance value. Then the index value is determined as the percentage of the total. The ranking construct with maximum dominance index value is ranked first, and so on.

Table 6.7 Dominance Matrix

| | | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **D*** | **ND**** | **AND***** | **DI ******** | **Rank ********* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Perceived Usefulness** | F1 | | 1 | 2 | 0 | 1 | 2 | 6 | -2 | 5 | 12% | 4 |
| **Perceived Ease of Use** | F2 | 2 | | 2 | 1 | 1 | 0 | 6 | 0 | 7 | 17% | 3 |
| **Social Influence** | F3 | 1 | 0 | | 0 | 1 | 0 | 2 | -7 | 0 | 0% | 5 |
| **Trust** | F4 | 3 | 2 | 2 | | 2 | 1 | 10 | 7 | 14 | 33% | 1 |
| **Cost** | F5 | 2 | 2 | 2 | 1 | | 1 | 8 | 2 | 9 | 21% | 2 |
| **Facilitating Conditions** | F6 | 0 | 1 | 1 | 1 | 1 | | 4 | 0 | 7 | 17% | 3 |
| **Number Being Dominated (B)** | | 8 | 6 | 9 | 3 | 6 | 4 | 36 | 0 | | | |

Note*: *Number Dominating, **Net Dominance (D-B), ***Adjusted Net Dominance, ****Dominance Index, *****Rank Dominating*

The percentage of each type of paired comparison of ranking constructs for a particular reference construct in Table 6.1, leading to the cell value entries in Table 6.7, is shown in Table 6.8.

In implicit dominance, if the ranking constructs 'Fxi' has '1' entry and 'Fxj' has '0' entry for a reference construct, positive criterion, then cell entry' 1' in Table 6.5, or vice-versa. For implicit non-dominance comparison, both ranking 'Fxi' and 'Fxj' has a '0' entry for a reference construct, leading to a '0' cell entry.

If both 'Fxi' and 'Fxj' cells have '1' entries in Table 6.3, we refer to the interpretive matrix (Table 6.4). If the interpretation is the same, then the corresponding entry is '0' in Table 6.5, with implicit non-dominance. However, if the interpretations are different, then the expert opinion is taken. The opinions lead to the interpretive dominance comparison. If 'Fxi' dominates 'Fxj,' then the corresponding cell entry in Table 6.5 is '1', and vice versa. Sometimes, the cell values' Fxi', 'Fxj', and 'Fxk', are all '1' in Table 6.3. Then, if 'Fxi' dominates 'Fxj,' and 'Fxj' dominates 'Fxk,' 'Fxi' dominates 'Fxk' with corresponding paired dominance comparison cell entry '1' in Table 6.5 and marking it as the transitive dominance comparison in Table 6.8.

The IRP advancements are used as per the efficient IRP method due to the implicit or transitive dominance relationships, weights of reference variables, and computation of the dominance index. The experts' interpretive dominance comparisons are limited to a small set of 33 per cent (Table 6.8) or twelve comparisons, which are further detailed for suggestions after discussion with the second panel of experts (Sushil, 2017b, 2020; Parmeshwar, Dhir and Sushil, 2020).

Table 6.8 Different Types of Dominance Comparisons

| **Reference Construct** | **Implicit Dominance Comparisons** | **Implicit Non-Dominance Comparisons** | **Transitive Dominance Comparisons** | **Interpretive Dominance Comparisons** | **Total Comparisons** | **% Interpretive Comparisons** |
|---|---|---|---|---|---|---|
| **C1** | 5 | 0 | 1 | 5 | 11 | **45%** |
| **C2** | 5 | 0 | 4 | 4 | 13 | **31%** |
| **C3** | 8 | 0 | 1 | 3 | 12 | **25%** |
| **Total** | 18 | 0 | 6 | 12 | 36 | |
| **Percentage** | 50% | 0% | 17% | 33% | 36 | |

*Step 6: Validation of ranks derived*

The ranking of constructs derived from the dominance matrix (Table 6.7) is validated for the confidence-building in the ranking, which is interpretive. The multiple validations (Sushil, 2017b) done are as follows:

- A structured walk-through for the cross-interaction matrix was done in the expert panel (second) workshop. All relevant ranking and reference constructs were included. Though the list may not be exhaustive, and a reference construct may be missed out.
- The interpretations and wording were corrected based on a structured walk-through in an expert panel discussion.
- For the correct assessment of dominance relationships, the system graphs are drawn for the reference constructs. The arrows in the digraph are expected to be unidirectional with no feedback loop/cycle. The feedback loop indicates unclear dominance relationships. The dominance interactions of various ranking constructs concerning reference constructs C1, C2, and C3 are unidirectional, as shown in Figure 6.1, thereby passing the internal validation test for the paired comparisons and assessment.

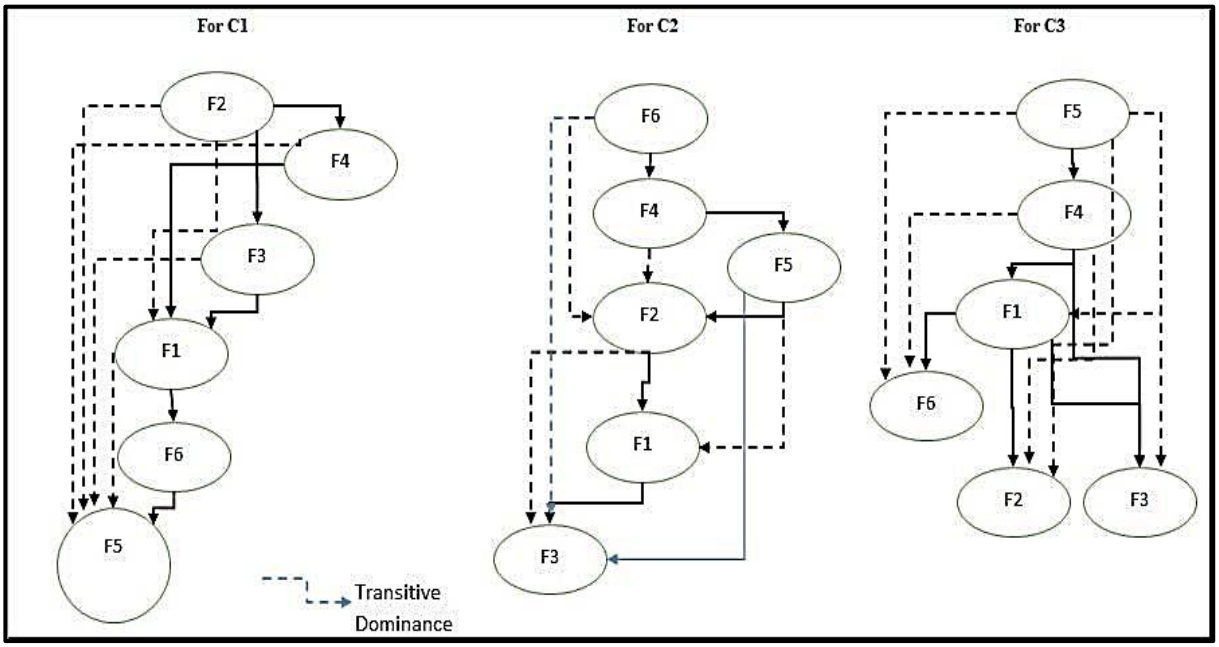


Figure 6.1 Diagraph for Validity Check

- The cross-validation test is passed as the net dominance values' sum is zero in the dominance matrix (Table 6.7).
- The sensitivity analysis gives different ordinal weights to the reference constructs (Sushil, 2020). The results are summarized below (Table 6.9). The sensitivity analysis of ranking is not highly sensitive as the original

weights assigned to reference constructs change, and evident modifications are minor. Thus, the efficient IRP ranking is quite robust.

Table 6.9 Comparison of Ranks using Sensitivity Analysis

| **Code** | **Ranking Construct** | **Base Case** | **Case 1** | **Case 2** | **Case 3** | **Case 4** |
|---|---|---|---|---|---|---|
| | | Reference Construct Weights: C1=1, C2=1, C3=1 | Reference Construct Weights: C1=1, C2=2, C3=3 | Reference Construct Weights: C1=3, C2=2, C3=1 | Reference Construct Weights: C1=2, C2=3, C3=1 | Reference Construct Weights: C1=2, C2=1, C3=3 |
| F1 | Perceived Usefulness | 5 | 3 | 4 | 5 | 4 |
| F2 | Perceived Ease of Use | 3 | 5 | 2 | 3 | 3 |
| F3 | Social Influence | 6 | 6 | 6 | 6 | 6 |
| F4 | Trust | **1** | **1** | **1** | **1** | **1** |
| F5 | Cost | 2 | 2 | 4 | 4 | 2 |
| F6 | Facilitating Conditions | 3 | 4 | 3 | 2 | 5 |

- The rankings obtained were cross-checked in a five-member expert panel discussion.

- A third expert panel discussed the real-life implications of ranking and related suggestions. The discussion includes prioritizing one construct over another. For example, suppose the usage of B-B e-commerce must be improved. In that case, the highest-ranking construct, "Cost," may be given more management attention, and supported with more financial and organizational resources, plus the "lower transaction cost" benefit may be promoted in public interactions.

*Step 7: An 'Interpretive Ranking Model' diagram*

The ranks of six constructs concerning their influence on the usage of B-B e-commerce in the Indian agriculture marketing sector are diagrammatically represented in an 'Interpretive Ranking Model" (IRM), shown in Figure 6.2.

The arrows in the IRM diagram show a reference construct whose ranking construct dominates the other ranking construct. The interpretation of how a specific construct influences various reference constructs are also provided. It can also be read in conjunction with the Interpretive Matrix (Table 6.4).

*Step 8: Ranking decision and knowledge base*

The findings section details the IRP model output (Figure 16). Based on the IRP model's ranking, one may prioritize the higher-ranking constructs (Trust, Cost, Facilitating Conditions, Perceived Ease of Use). Suggestions for action are provided in the conclusion section of this research study.

The interpretive logic – knowledge base (Table 6.2) generated in this research study is the starting point for the conclusion section's suggestions. In the future, improvements may be made by adding more constructs and additional learning about relationships.

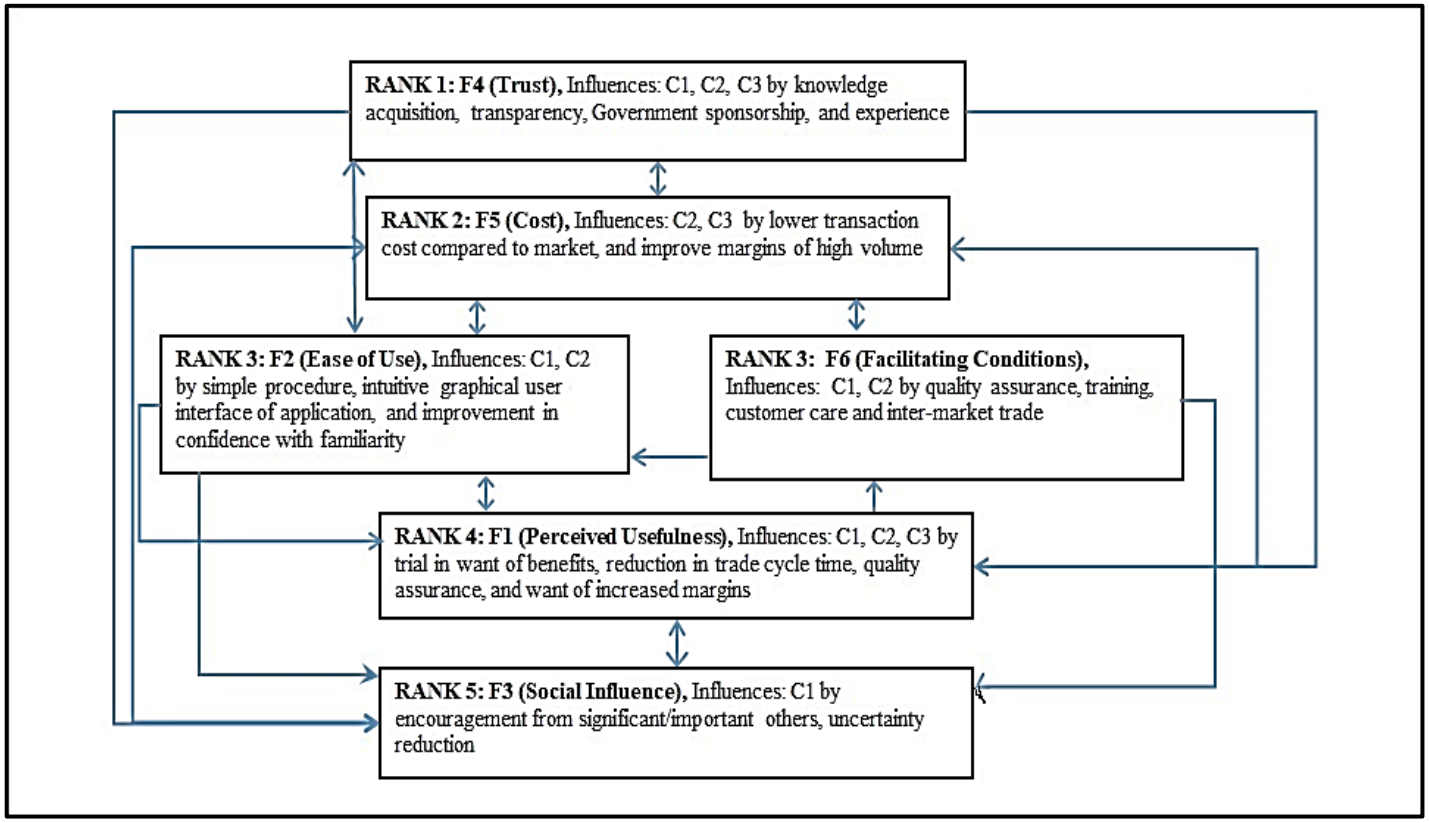


Figure 6.2 Interpretive Ranking Model

As per the first research objective of ranking the constructs influencing the continued use of B-B e-commerce, the IRP model of six constructs ranked based on three criteria is shown in Figure 6.2. The rank values are taken from the dominance matrix (Table 6.7).

## 6.4 Concluding Remarks

This chapter ranks the constructs influencing B-B e-commerce platform (eNAM) continued post-adoption usage in Indian agricultural marketing while considering multiple criteria in the framework.

Indian policymakers and managers may consider the six constructs ranking (equated to relative priority) for increasing the usage of B-B e-commerce in the Indian agricultural marketing sector. Therefore, the scarce resources and priority actions may be directed towards the top-ranking constructs, e.g., lowering the transaction 'Cost' and increasing 'Trust' in B-B e-commerce while improving 'Facilitating Conditions' and 'Ease of Use' the maximum benefit/desired output.

With its pan-India presence, many transactions and high-volume use are expected to ensure the success of B-B e-commerce and other similar digital initiatives such as direct benefit transfer and food traceability using blockchain.

The next chapter presents the empirically validated adoption framework and the significant constructs of the adoption framework.

# Chapter 7
# Empirically Validated Framework

## 7.1 Introduction

This chapter aims to synthesize the qualitative and quantitative analysis done in chapters five, six and seven. It explains the empirically validated framework concerning the adoption of agricultural B-B e-commerce. The results of the survey data analysis are presented to meet the research objectives.

The constructs of the adoption variable are listed to give the proper perspective to the empirically validated framework. Also, the results of hypothesis tests are presented to highlight the relationship between the constructs.

Subsequently, the constructs (latent variables) and the observed variables are ranked in priority concerning the order of influence on improving the adoption of agricultural B-B e-commerce.

## 7.2 Constructs in the framework

This section lists all the constructs used in the adoption framework of B-B e-commerce. The constructs in the framework are listed in Table 7.1. The details and references for the constructs are detailed in Literature Review (*Chapter 2*). The constructs are considered and analyzed in the agricultural marketing context (Saghafian, Laumann and Skogstad, 2021).

Table 7.1 Constructs in the Research Framework

| Code | Construct | Nature of Construct | Explanation In Study Context |
|---|---|---|---|
| PU | Perceived Usefulness | Indirect Determinant Latent Variable | eNAM extends benefits to users in terms of better pricing and speed of market transactions. |
| PEU | Perceived Ease of Use | Indirect Determinant Latent Variable | eNAM is easy to learn and simple to use |
| SI | Social Influence | Indirect Determinant Latent Variable | A community of close friends, leading farmers, associated traders, and community leaders encourage and promote the eNAM. |
| T | Trust | Indirect Determinant Latent Variable | The user has confidence in the eNAM portal trade and information. It is also a belief that the eNAM is reliable. The management will act in the interest of farmers and other stakeholders. |
| C | Cost | Direct Determinant Latent Variable | Transaction Costs on the eNAM platform |
| FC | Facilitating Conditions | Direct Determinant Latent Variable | The infrastructure, including quality testing laboratories, bidding halls, logistics support, IT training, and customer care, complement the use of eNAM. |
| BI | Behavioural Intention | Mediating Latent Variable | The level to which an individual has made a conscious plan to e-trade on eNAM |
| U | Adoption | Dependent Observed Variable | Actual usage of eNAM |

## 7.3 Empirically Validated Framework

After the key constructs' identification, the high-level framework is presented in Figure 7.1.

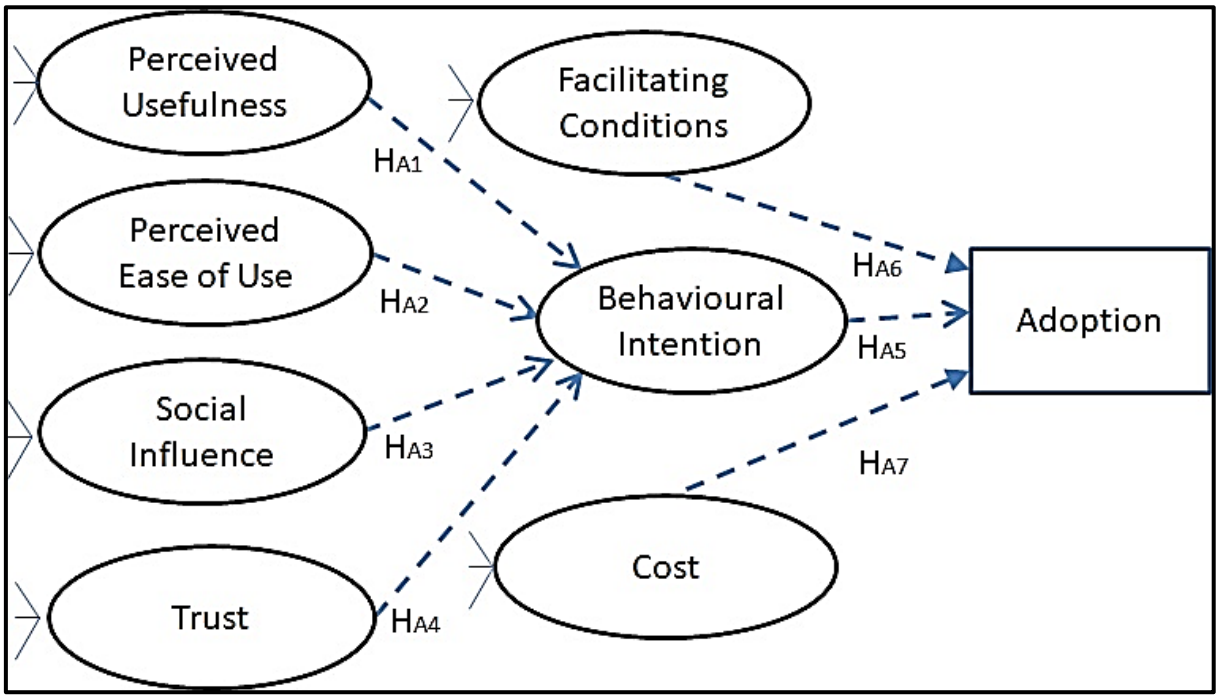


Figure 7.1 Conceptual Adoption Framework

The framework links the seven conceptualized constructs as significant direct or indirect determinants of B-B e-commerce adoption in Indian agricultural markets. The six determinant latent variables (Constructs) are each derived from three observed independent variables. The 'Behavioral Intention' is the potentially mediating latent variable (Construct). The dependent variable is 'Adoption'.

The TISM analysis is done to firm up the relationship between the constructs and convert the conceptual adoption framework into a proposed adoption framework. As per the TISM analysis process detailed in *Chapter 5*, the resultant TISM-based adoption framework is presented in Figure 7.2.

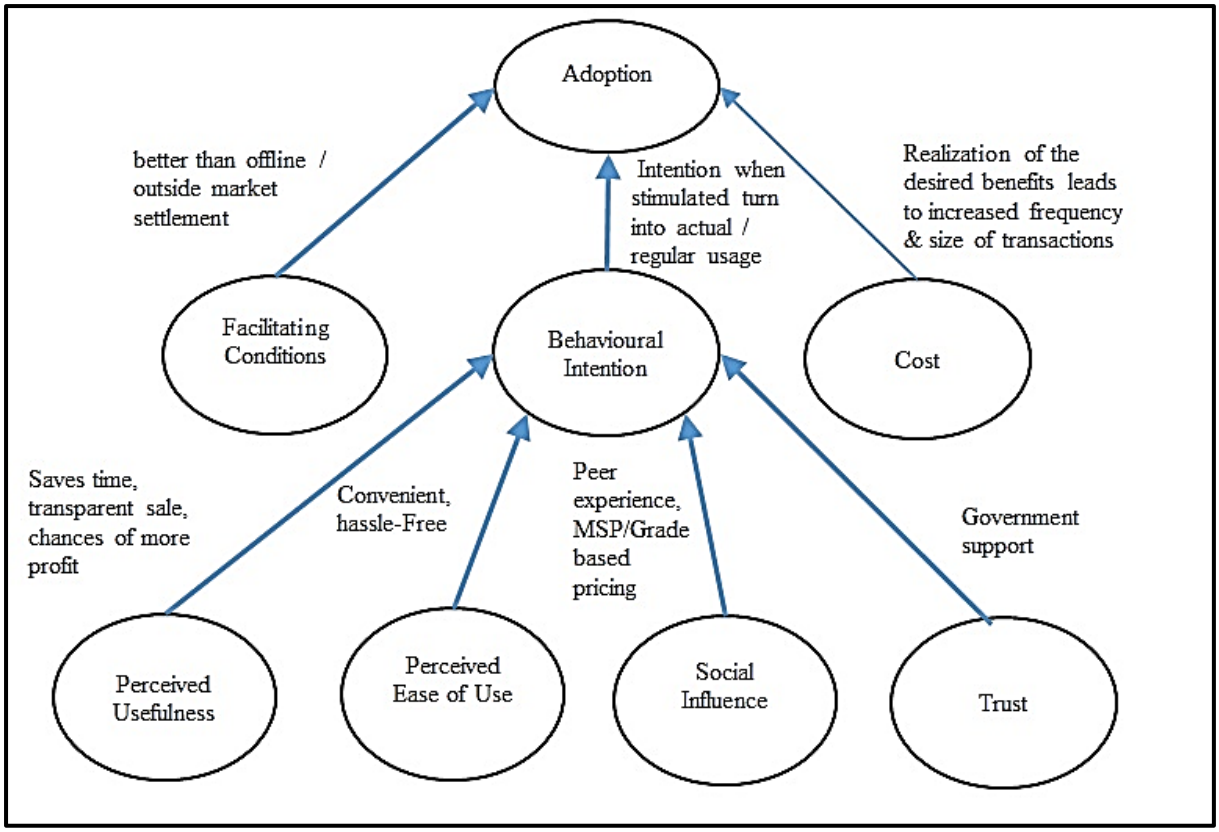


Figure 7.2 TISM-based Adoption Framework

The TISM based adoption framework shows the links (as the contextual relationships) and the direction of the relationships. The framework nodes are interpreted with a clear and distinct definition of respective elements, leading to a clear picture of constructs (enhancers/influencers) of B-B e-commerce adoption among farmers and traders.

The TISM based conceptual eNAM adoption framework is next validated using Partial Least Squares - Structural Equation Modeling (PLS-SEM) analysis detailed in *Chapter 5*.

The structural model (Figure 7.3) shows the relationships among the validated adoption framework constructs. The association between the constructs is tested using P-values and t-statistics, which is significant. The relationship between constructs is positive. The Path-coefficient values (*Table D.2*), t-values (*Table D.3*), P-values (*Table D.4*), and VIF values (*Table D.5*) are shown in Part 2, *Appendix D.*

The lowest coefficient of determination ($R^2$) value of the dependent construct 'Behavioural Intention' (BI) is 0.67, a near substantial value in behavioural sciences research. The value of $R^2$ for the primary dependent variable 'Adoption' (U) is high at 0.7, indicating that the model accounts for a substantial proportion of the dependent variable variance. The structural model has a near substantial in-sample explanatory power (Henseler et al., 2009; Hair et al., 2011; Becker et al., 2015).

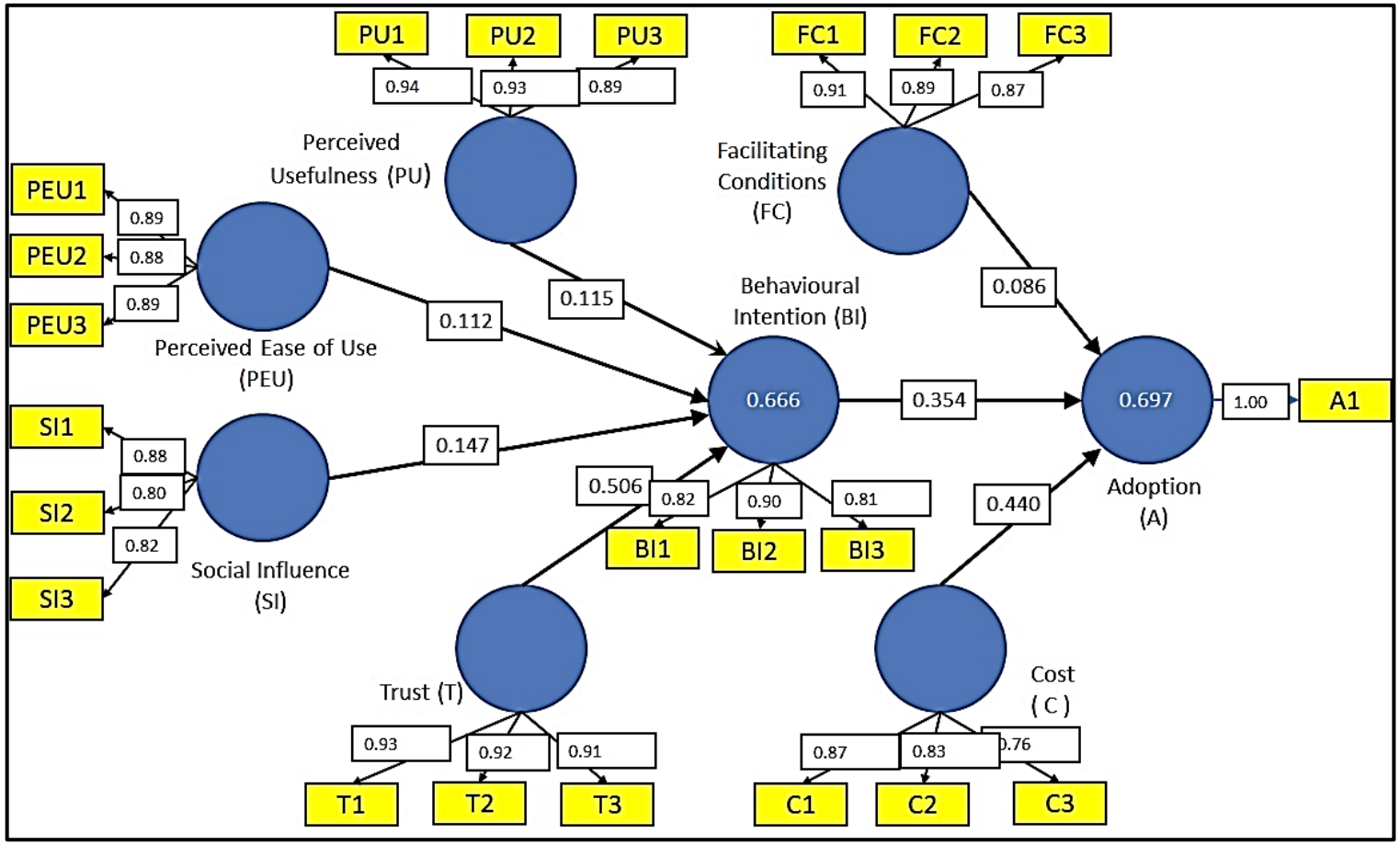


Figure 7.3 Validated Adoption Framework

## 7.4 Validated Framework: Differentiation and Comparison

The construct's manifestation in the respondent sample group of farmers differs from other Industry groups. The constructs are explained in the study context (Table 7.1). The adoption framework is distinct as, unlike other sectors, the agriculture sector is characterized by a lack of support infrastructure, low literacy levels of farmers, and low ICT awareness among farmers and traders. In a unique B-B trading context, users' adoption factors are yet to be adequately addressed, and consideration must be done in a broader societal context (Bettencourt, Lusch, and Vargo, 2014).

The validated adoption framework adds to the existing knowledge base by redefining constructs, adding two new constructs ('Trust' and 'Cost') to the UTAUT, and altering the strength of relationships between constructs (Johns, 2006).

The model accounts for 70 per cent of the variance for the dependent variable 'Adoption'. The variance explained is better than most other competing models. The variance explained for the dependent variable in the competing models are, Theory of Reasoned Action (TRA) - (36 per cent), Technology Acceptance Model (TAM) - 53 per cent, Theory of Planned Behaviour (TPB) - 36 per cent, and Innovation Diffusion Theory (IDT) - 40 per cent). Comparatively, the Unified Theory of Acceptance and Use of Technology (UTAUT) explains about 70 per cent of the variance (adjusted R2) in usage intention (Venkatesh et al., 2003) with four direct determinants latent construct, that is, two less determinant latent constructs used in this study.

The participants were students in three of the five model comparison studies (Davis et al., 1989; Mathieson, 1991; Taylor and Todd, 1995) reviewed. Only two model comparison studies (Plouffe et al., 2001; Venkatesh et al., 2003) have respondents as merchants or employees. This study is conducted using data analysis of the survey of farmers in a voluntary usage context.

However, more studies based on the validated framework of this study need to be conducted.

## 7.5 Hypothesis Testing

The results of the hypothesis tests are listed in Table 7.2, showing the relationship between the constructs. For significant P-values < 0.05, hypotheses $HA_{01}$, $HA_{02}$, $HA_{03}$, $HA_{04}$, $HA_{05}$, $HA_{06}$, and $HA_{07}$ are supported. The relationship between the constructs is significant as all the t values are more than 1.96.

Table 7.2 Hypotheses Test Results

| Hypothesis | t-Values | P-Values | Remarks* |
|---|---|---|---|
| HA1: 'Perception – Usefulness' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | 2.016 | 0.044 | Supported. Statistically Significant. |
| HA2: Perceived Ease of Use' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | 2.168 | 0.031 | Supported. Statistically Significant. |
| HA3: 'Social Influence' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | 3.134 | 0.002 | Supported. Statistically Significant. |
| HA4: 'Trust' affects the 'Behavioural Intention' to adopt the B-B e-commerce platform (eNAM). | 9.610 | 0.000 | Supported. Statistically Significant. |
| HA5: The 'Behavioural Intention' affects the 'Adoption' of the B-B e-commerce platform (eNAM). | 6.301 | 0.000 | Supported. Statistically Significant. |
| HA6: The 'Facilitating Conditions' affect the 'Adoption' of the B-B e-commerce platform (eNAM). | 2.110 | 0.035 | Supported. Statistically Significant. |
| HA7: The 'Cost' affects the 'Adoption' of the B-B e-commerce platform (eNAM). | 9.271 | 0.000 | Supported. Statistically Significant. |

*Significant at P-values < 0.05, and t-values>1.96 (at 5 per cent significance level).

The Stone-Geisser criterion ($Q^2$) is investigated to assess the predictive relevance of the model. It measures the reconstruction of the observed values by the model and its parameter estimates. The models are expected to have $Q^2$ greater than zero to

have predictive relevance. $Q^2$ values (i.e., 'Adoption' at 0.661, 'Behavioral Intent' at 0.661) are above the zero-threshold value, representing a considerable predictive accuracy of the PLS path model (Shmueli et al., 2016; Hair et al., 2019).

As for the $f^2$ effect sizes, the construct 'Cost' has a moderate effect on the 'Adoption', whereas the 'Trust' has a moderate effect on the 'Behavioral Intention' since the $f^2$ size effect is more than 0.15 but less than 0.35. The rest other constructs have a small effect since the $F^2$ effect size is less than 0.15 (Cohen, 1988). The $F^2$ values are shown in *Appendix D (Table D.6)*.

The 'Behavioural Intention' partially mediates the relationship between the constructs 'Social Influence' - 'Adoption', and 'Trust' - 'Adoption' with a p-value less than 0.05 and the indirect effects 95 per cent boot confidence interval bias-corrected does not straddle a zero in between lower limit and upper limit (Preacher and Hayes, 2008), for other constructs 'Perceived Ease of Use' and 'Perceived Usefulness', the effect pass through 'behavioural intention' and there is full mediation.

## 7.6 Ranking of the Variables

To further extend the analysis of variables in the adoption framework, the results of IRP analysis in Chapter 6 are briefly mentioned below.

The ranking of the latent variables concerning their influence on post-adoption usage as per the IRP methodology is given in Table 7.3. In the post-adoption phase, high 'Trust' and low 'Cost', remains important for the farmer, but they also look for 'Perceived Ease of Use' for frequent use. In post-adoption behaviour, the end-user gets less sensitive to social influence and reduces the high price-seeking behaviour.

Table 7.3 Ranking of Constructs for Post-Adoption Usage

| **Construct (Latent Variables)** | **Rank as per IRP of Expert Opinions (For Post-Adoption Usage)** |
|---|---|
| Trust | 1 |
| Cost | 2 |
| Perceived Ease of Use | 3 |
| Facilitating Conditions | 4 |
| Perceived Usefulness | 5 |
| Social Influence | 6 |

The practitioners and policymakers may use the ranking to prioritize the resource and effort allocation to influence the adoption and subsequent post-adoption usage of the agricultural B-B e-commerce.

## 7.7 Concluding Remarks

In this chapter, the critical outcome of the study (an empirically validated framework) is presented to analyze the influence of observed and latent variables on the adoption of B-B e-commerce in India. The variables are to be considered, promoted, and managed in the agricultural sector adoption context.

The B-B e-commerce adoption framework consideration in the context of 'agricultural marketing in India' adds new latent variables (Constructs) and observed variables to the previous frameworks. It also alters the size of relationships in the earlier models. Such modification and extension result in creating a new knowledge base (Alvesson and Kärreman, 2007).

The next chapter presents significant findings and the conclusion of the study.

# Chapter 8
# Recommendations and Conclusion

## 8.1 Introduction

The study has bought out a research-based framework to improve B-B e-commerce adoption in the agricultural sector in India. In this pursuit, the adoption framework-related variables are based on the literature review and relationships explained using the TISM analysis. The variables in the adoption framework are expected to influence B-B e-commerce adoption in the agricultural sector. A conceptual research framework is developed based on TISM analysis to answer the first research question raised in chapter one. National Agricultural Market (eNAM) is selected to provide the context. A few other initiatives were also analyzed to develop better insights. Further, the proposed adoption framework is tested and validated using the PLS-SEM analysis of the survey data.

The key recommendations based on the study are bought out here and followed by a research conclusion. The recommendations are sequenced as per the constructs' ranking using the Interpretive ranking process (IRP) Analysis. The implications for B-B e-commerce researchers, practitioners and society are discussed next. Finally, the last section of this chapter outlines the study's limitations and scope for future research.

## 8.2 Recommendations

The adoption framework is proposed and tested using a multi-staged analysis in light of the first and second research objectives. The logical interpretation of relationships is available in the TISM based adoption framework. The adoption framework is found to be suitable based on model-fit indices in PLS-SEM analysis. The adoption framework for agricultural B-B e-commerce adoption is discussed in detail in *Chapter 7*.

The constructs 'Trust', 'Cost', 'Social Influence', 'Perceived Usefulness', 'Perceived Ease of Use' and 'Facilitating Conditions' influence the adoption of B-B e-commerce in the eNAM context.

The third research objective is, 'Using eNAM and similar initiatives, suggest possible ways to improve wholesale agricultural B-B e-commerce adoption'. Concerning this research objective, the synthesis of analysis and discussions held with experts, farmers, and traders during the study at the five APMCs have led to the following recommendations in order of the IRP ranking.

### 8.2.1 Trust

The local Agri-community engagement may help in improving the 'Trust'. The interaction of eNAM officials with the volunteers and the farmer's group (farmer producer organizations, co-operatives, self-help groups) needs to be strengthened. Organizing regular community awareness camps may help in this regard. Market managers also need to ensure the proper functioning of facilities related to assaying, grading, sorting, delivery, and quality check.

Quality laboratories in many markets are dysfunctional due to a scarcity of testing equipment or staff. Acceptance of authorized private lab reports for trade may be a solution. Also, suppose the quality of delivered agri-produce fails to meet the quality standard as per terms and conditions. In that case, a penalty for an errant farmer/trader or payment reversal from the escrow account may be provisioned. As for inter-state trade, the dispute settlement process may be detailed and formalized.

In a conventional setup, farmers are compelled to trust the commission agents because of a lack of financing options (e.g., loans during the off-season) and cash payments for products sold. To avoid such a situation, the e-payment in an e-trading transaction is quick on delivery. Moreover, the ATMs are made available in/near the market complex, where the farmers can withdraw cash. Besides various financing schemes by the banks (Kisan credit card, livestock credit card, Jan-Dhan cards, FPO credit guarantee, export benefits), the government schemes (PM: crop insurance scheme, annual financial support scheme, Irrigation scheme, Agri-development

scheme, pension scheme, livestock insurance scheme) has reduced the dependence of farmers on the agents for financing.

In recent times data privacy and Internet security have raised concerns among users. In this regard, eNAM has taken due precautions to protect user information digitally. The various methods used are access protection via password, web services with basic security profile 1.0, open standards for interoperability, SSL/TLS authentication mechanism for anti-spoofing, data encryption during storage, and transfer for confidentiality java-based customized security settings. As per the privacy policy, the user data is used only for digital transactions and shared with authorized employees and partners. Such features need to be further enriched from time to time with the emergence of new technological vulnerabilities.

### 8.2.2 Lower Transaction Cost

The low 'Transaction Cost' is a critical adoption factor for inter-market trade. The high transaction cost and the existing variation between state taxes and market fees hinder cross-state agricultural produce transactions.

The potential of the B-B e-commerce platform for e-trading is reflected in inter-state and inter-market trade. With uniform taxes and fees, traders with one national license can bid across markets without requiring multiple registrations. In inter-market trade, the market fee goes to the originating/selling market. Thus corporates/traders register in the market with low/discounted market fees for better margins. The uniformity in market fees will simplify settlement procedures and reduce conflicts. Thus, taxes and fees need to be lowered with uniformity across Indian states to promote inter-market trade.

The model APMC Act is the right step since it proposes capping the APMC Mandi tax at 1 per cent (for food grains) and 2 per cent (for fruits and vegetables). It also pegs the commission agent's levy at 2 per cent (for non-perishables) and 4 per cent (for perishables) of the total transaction cost. The implementation of this Act by state governments has to be expedited.

Banks may not use e-payments from eNAM to settle loan EMIs unless the farmers give written consent for the same. Also, providing easy access to bank credit by registered farmers and friendly credit terms to traders for buying and selling on eNAM may be introduced to compete against commission agents' conventional and informal credit systems.

### 8.2.3 Perceived Ease of Use

The 'Perceived Ease of Use' may be improved by making the website easy to navigate, with multilingual content. The mobile application is popular among users but needs to strengthen its interaction with other government and partner applications. More government scheme applications related to the agriculture supply chain may be integrated into the portal, e.g., logistics, financial inclusion, and UPI-based payments.

Smartphone usage is expected to boost access to digital agribusiness, as the rural user base will likely reach at least 332 Million in 2022. Ninety-two per cent of the rural users' have access to the Internet, primarily through mobile phones. The Internet user base in rural India shall reach 305 Million in 2022 (KPMG, 2020; Mahapatra, 2020; Sharma et al., 2020).

The existing intuitive eNAM mobile application, when scaled to support all twenty-two major local languages with a better graphical user interface, is expected to have a broader user base. It shall appeal to the local language Internet user base growing at more than 13 per cent annually. In addition, the features such as local language interface, video and image content with inbuilt Agri-dictionary, mobility, basic bank account (Jan-Dhan), and Digital Identity (Aadhar number) may further help farmers access digital services without intermediaries (Aravindh and Karthikeyan, 2018; Dhaygude and Chakraborty, 2020).

The eNAM system's flexibility may be further enhanced by incorporating the system's capacity to address future uncertainty and risk management. Furthermore, the provision of flexibility in terms of modular design, configurable add-on new features, open-source innovation, and cloud computing functionality may increase the system's life cycle and return on investment. Furthermore, artificial intelligence and the Internet of Things may automate problem-solving and non-routine tasks. In

addition, improving the customer relationship orientation of the eNAM-enabled APMCs is expected to enhance their flexibility. This helps to adapt to the changing needs and market conditions, improving organizational performance (Tsai and Lasminar, 2021).

### 8.2.4 Facilitating Conditions

'Facilitating Conditions' need ramping up via the 'Infrastructure' upgrade. The availability of amenities in and around APMCs, such as quality assaying labs with robust mechanisms, computer terminals for users, electronic weighing, and trade-rooms with broadband Internet connectivity, is maintained in bare suboptimal conditions. The storage and logistics economics may be enhanced by the involvement of the Indian Railways freight discounting. More licences may be made available through open and transparent criteria-based registration to reduce the cartel effect. As observed in the Karnataka-based Unified Market Platform (UMP), a group of small farmers may still prefer cash payments. For them, ATMs have been made available in the market yard for encashing online payments. Such provisions are required to be made across all markets.

Each eNAM market has an e-trading room with computers, Internet connectivity, and trained outsourced staff. The trained staff helps/handhold farmers visiting markets and organizes weekly/monthly eNAM awareness sessions both within market premises and at local fairs. The existing limited information technology literacy efforts by eNAM staff may be integrated with similar e-Kranti and Pradhan Mantri Gramin Digital Saksharta Abhiyaan (PMGDISHA) initiatives. The integration, coupled with support from the volunteers (gram sevaks), Krishi Vigan Kendras, and common service centres, may help strengthen the trained user base of eNAM (Modekurti, 2016; Raja Lakshmi, 2017; Singh, 2017; Hindustan Times Digital Content Services, 2018; DACFW, 2021).

The B-B e-commerce-based trading acceptance is more for inter-market and inter-state trades, considering the higher price expectation due to competition and an increased number of bids. In such cases, the logistics functionality of the B-B e-commerce portal may include preferential freight charges and preferential warehousing. The e-trade of aggregated produce by the farmer-producer organization

(FPO) may help the marginal farmers to benefit from the e-trade. The mobile-based application's usage must be promoted to small farmers and small traders so that B-B e-commerce-based e-trade functionality adds to the Mandi premises' offline presence.

The 'Customer Care' may be improved through the dedicated contact centre and on-ground staff. As of now, there is no periodic assessment of skills and competency. The implementing agency may go for required user capacity building through regular training.

### 8.2.5 Perceived Usefulness

The 'Perceived Usefulness' may be improved by unifying the state and national market on a single legal framework. Thus, all state governments need to amend the respective state APMC acts to sync with the model APMC Act 2017. The full benefits of the digital online platform may be realized in inter-market and inter-state market transactions. Such inter-market trade is yet to be streamlined with the dispute resolution at the trade originating APMC.

The fast transaction cycle is a critical aspect for farmers. The proliferation of mobile applications and digital payment is expected to be the right step. The inter-market e-trade (with the dispute resolution at the trading APMC) may be streamlined further. The total flow time of the trading process, including digital payment, may be reduced to less than a working day hour.

Many responding farmers believe that the eNAM has increased the 'Price' realization for their commodity sales. Provision needs to be made for easy access to bank credit for registered farmers and friendly credit terms made available to traders buying and selling on eNAM so that the digital system can compete against offline unofficial credit systems of commission agents.

### 8.2. 6 Social Influence

The 'Social Influence' may be improved by increasing the small farmer and trader involvement in eNAM. Promoting awareness among the farming community and using

influencer users and agriculture extension officers to facilitate decision-making is expected to build a favourable environment for eNAM and other similar future initiatives.

The eNAM platform is based on an open technical standard. The scope of offerings and range of services may be widened on the lines of the Aadhar scheme. It may release its open application programmable interface (API) to the public. The open API shall make it easily discoverable and interoperable with numerous related applications. From a social welfare perspective, it is wise to open a more sizeable portion of the eNAM platform to the public (Parker and Alstyne, 2018).

### 8.2.7 Entrepreneurship Support

The B-B e-commerce start-ups also need support for their venture viability. The entrepreneur opinions (*Chapter 3*) that need to be addressed to increase the adoption and growth of agricultural e-commerce start-ups are the availability of low-interest and creative models of financing, Infrastructure availability/resource support, cross-domain quality solutions with multiple levels of features, supportive mindset of business customers and partners and the awareness-building plus training of farmers. Now is the need for the government to support the B-B e-commerce start-ups in the post-pandemic situation with working capital, funding, compliance, and fiscal policy support, as they are doing for other micro and small enterprises.

The other potential initiatives that support the fledgling agricultural start-ups' ecosystem are the open-source digital platform for agriculture 4.0, an open database of core agricultural parameters, and low-cost cloud hosting. Recently, large technology companies, such as Bayer, Cargill, Cisco, Monsanto, Microsoft, and IBM, have also rolled out B-B e-commerce initiatives. It is prudent for start-ups to make their solutions interoperable with technology majors and sync with global platforms.

B-B e-commerce is an essential precursor to blockchain technology use in the agricultural supply chain (Kim et al., 2018). Along with the blockchain solutions, the integrated pre-harvest and post-harvest e-commerce platform, artificial intelligence-based solutions, and advanced farm analytics may define the agriculture sector's next growth phase. Currently, digitalization via B-B e-commerce is transforming the existing

approaches to India's agricultural marketing and supply chain. It is expected to aid in resolving the issue of fragmented and inefficient agricultural supply chains and facilitate the ease of doing business and living standards of the farming community.

## 8.3 Conclusion

eNAM is a priority strategic intervention in the Indian agriculture sector. The digital platform-based electronic trading is expected to act as a growth catalyst for supply chain activities. e.g., collection, grading, trading, storage, packaging, and transport.

The adoption framework proposed and validated in this study may help improve the adoption of agricultural B-B e-commerce in terms of better organizational readiness and strategies to strengthen the enablers of adoption by farmers and traders. The high 'Trust', low 'Cost', and the positive 'Social Influence' are identified as the significant enablers of adopting the B-B e-commerce initiative (eNAM). Other enablers have been identified as 'Perceived Ease of Use', 'Perceived Usefulness', and 'Facilitating Conditions'.

The study provides a detailed description of the eNAM case and the constructs of the adoption framework to enable readers to assess the appropriateness of findings in their respective contexts. The adoption framework may be used to identify the key enablers of the B-B e-commerce or digital platform in new geographies and thus rapidly improve upon them to succeed in a fast-changing situation.

The PLS-SEM-based model of the adoption framework is assessed to have considerable predictive accuracy. It may be used to predict the adoption of agricultural B-B e-commerce using the new data (new farmer registration in the same wholesale market or farmers in the new wholesale market). It can identify farmers with a propensity to adopt B-B e-commerce and offer them some early movers' incentives to ramp up the frequency of use. Also, the non-adopters may be approached more proactively for counselling.

The study's suggestions are expected to help practitioners effectively deliver intended benefits, such as administrative ease, better cycle time, and better price realization. The benefits associated with B-B e-commerce trading have increased with

growing familiarity and liquidity. Higher adoption will lead to higher liquidity, which is essential for the initiative's success. In the past, Indian farmers have adopted technology to achieve high and sustainable agricultural growth. It is expected that they will draw significant benefits from ICT based eNAM.

The study extends the applicability of UTAUT in the agricultural marketing area. The UTAUT is extended into the B-B e-commerce technology area and among farmers in the agricultural marketing context in India. The scope of the UTAUT theory is also expanded via the inclusion of new constructs 'Cost' and 'Trust'. Thus, corresponding new observed variables were included too. The constructs are theorized and put through systemic analysis to expand the understanding of 'Adoption' and the theoretical boundaries of the theory. It is expected to fill the gap related to the limited research literature in this area. It is expected to pave the way for researchers to conduct further studies in the agricultural e-commerce adoption domain.

## 8.4 Significant Research Contributions

The study has contributed in terms of:

- Addresses the knowledge gap related to the scarce literature on B-B e-commerce adoption in the context of agricultural marketing in India.
- Demonstration of the influence of behavioural and non-behavioural variables on the adoption of B-B e-commerce. There is hardly any such past attempt that could be traced in the context of agriculture, particularly in the Indian context.
- Extended the theoretical knowledge base concerning technology adoption.
- Bringing out an empirically validated adoption framework which is expected to guide practitioners in improving B-B e-commerce adoption.
- Bringing out recommendations for improving the adoption of agricultural B-B e-commerce in India, based on the study of the National Agriculture Market and nine other private sector initiatives.
- The study's recommendations are expected to help practitioners effectively deliver intended benefits to the farming community in terms of administrative ease, better cycle time, and better price realization.

## 8.5 Research Limitations and Suggestions for Future Research

Despite positive results and practical implications of this research in agricultural B-B e-commerce, the study has a few limitations:

- Due to the time limitations, the study measures perceptions at one point in time. A longitudinal study over an extended period may add more insights into causality and interrelationships.
- The research period utilized is over three years to fine-tune the findings and make suggestions. Repetitive studies of this nature are required to further refine the results and recommendations.
- The study opens many opportunities for further research. The framework may be further explored for enrichment by including 'user type' (Farmer/Trader/Corporate) or Farmer transaction volume (large/medium/small) as a moderating variable.
- The research scope can further be enhanced through a cross-country or comparative study.
- The degree of openness of the B-B e-commerce platform and its role in ecosystem growth is also an open topic for further exploration.
- The efficiency of last-mile e-commerce marketing operations and supply chains in developing countries may be reviewed in future studies.

## 8. 6 Concluding Remarks

The study has addressed all the identified research objectives and attempted to answer the research questions logically.

The main objective to identify the influencer variables of the agricultural B-B e-commerce adoption is met by identifying these as 'Trust', 'Cost', 'Social Influence', 'Perceived Ease of Use', 'Perceived Usefulness', and 'Facilitating Conditions'. The influencer variables were arranged in a framework as per the TISM analysis and tested using PLS-SEM.

One main initiative (eNAM) and eight other small agricultural B-B e-commerce domain initiatives were studied to validate the framework in a practical context.

Both quantitative and qualitative research methods have been used for conducting the study. Qualitative research methods, TISM, and IRP have helped link the constructs (latent variables) in the adoption framework and rank them as per the dominance of influence on post-adoption usage. As part of the quantitative research, data is collected through a field survey questionnaire. The survey data is analyzed with the help of PLS-SEM to test the hypothesis on the influence of latent variables on the adoption of agricultural B-B e-commerce.

The empirically validated adoption framework can be treated as a stepping-stone for enhancing the adoption of agricultural e-commerce projects. The results may be refined and enriched based on learning from further studies in this direction.

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## Appendices

### APPENDIX A:

Main Survey Questionnaire (in Hindi)

**सर्वेक्षण प्रश्नावली**

विष्य : ई–राष्टीय कृषि बाजार (E-NAM) की अपनाने के कारण

नाम : _____

मोबाइल / Email आई डी : _____

पेशा : ☐ किसान ☐ व्यापारी ☐ एंजेट ☐ आधिकारी

फसल : ☐ गेहूं ☐ मक्का ☐ चावल ☐ सब्जी (नाम) _____

E-Namपंजीकृत : ☐ हाँ ☐ नही

E-Namउपयोग कर्ता : ☐ हाँ ☐ नही, जानकारी है

E-Namअपनाने के कारण, कृपया चुने विकल्प जो आप की राय या समझ के द्वारा उचित है। (✔) मार्क करे, यदि:

1= कुछ नही, 2=नगण्य प्रभाव, 3= छोटा प्रभाव, 4= मध्यम प्रभाव, 5= उच्च प्रभाव, 6= बहुत उच्च प्रभाव, 7= चरम प्रभाव

**(ई–एनएम) आपके जवाब**

1. E-Nam(ई–एनएम)बेचने / खरीदने / व्यापार में उपयोगी है।
   1 2 3 4 5 6 7
2. E-Nam (ई–एनएम) से बेचना / खरीदना / व्यापार आसान और तेज बनता है।
   1 2 3 4 5 6 7
3. E-Nam (ई–एनएम) से अधिक लाभ होने की संभावना में वृद्धि होगी।
   1 2 3 4 5 6 7
4. E-Nam (ई–एनएम) सिस्टम स्पष्ट है और समझ आता है।
   1 2 3 4 5 6 7
5. E-Nam (ई–एनएम) सिस्टम मेरे लिए उपयोग करना आसान होता है।
   1 2 3 4 5 6 7
6. E-Nam (ई–एनएम) सिस्टम का इस्तमाल सीखना मेरे लिए आसान है। होगा
   1 2 3 4 5 6 7
7. जा लोग मेरे खास है, उन्हे लगता है कि मुझे E-Nam (ई–एनएम) का उपयोग करना चाहिए।
   1 2 3 4 5 6 7
8. मंडी प्रबंधनE-Nam (ई–एनएम) के उपयोग में मददगार है / होगा
   1 2 3 4 5 6 7
9. सामान्यता, मुझे E-Nam (ई–एनएम) उपयोग के लिये सर्मथन मिलता है।
   1 2 3 4 5 6 7
10. E-Nam (ई–एनएम) के उपयोग के लिए आवश्यक संसाधन (मोबाइल / बैक खाता / इटंरनेट आदि) मेरे पास है।
    1 2 3 4 5 6 7
11. मेरे पास E-Nam (ई–एनएम) के उपयोग करने के लिए आवश्यक ज्ञान / प्रशिक्षण है।
    1 2 3 4 5 6 7
12. E-Nam (ई–एनएम) की कठिनाइयों में सहायता के लिये व्यक्ति (समुह) उपलब्ध है।
    1 2 3 4 5 6 7

1

13. E-Nam (ई–एनएम) वेबसाइड/ऐप की जानकारी मान्य तथा सटीक है।
    1 2 3 4 5 6 7
14. E-Nam (ई–एनएम)के सूची–बद्ध विकेता अपना वादा पूरा करेगा।
    1 2 3 4 5 6 7
15. E-Nam (ई–एनएम) के सुची–बद्ध खरीददार अपना वादा पूरा करेगा।
    1 2 3 4 5 6 7
16. E-Nam (ई–एनएम) में लेनदेन की लागत पांरपरिक बाजार से कम होगी।
    1 2 3 4 5 6 7
17. E-Nam (ई–एनएम) का इस्तमाल फायदे का सौदा है।
    1 2 3 4 5 6 7
18. E-Nam (ई–एनएम) इस्तमाल की लागत उचित है।
    1 2 3 4 5 6 7
19. E-Nam (ई–एनएम) जागरूकता शिवर में प्रश्नों का उत्तर मिलता है।
    1 2 3 4 5 6 7
20. E-Nam (ई–एनएम) में सलाहा प्रतिकिया का प्रवधान है।
    1 2 3 4 5 6 7
21. E-Nam (ई–एनएम) में शिकायत करने पर समाधान मिलता है।
    1 2 3 4 5 6 7
22. E-Nam (ई–एनएम) मै अगले 1 साल के भीतर नियमित उपयोग करूगा।
    1 2 3 4 5 6 7
23. E-Nam (ई–एनएम) मै अगले 1 साल के भीतर नियमित उपयोगकी योजना बना रहा हुँ।
    1 2 3 4 5 6 7
24. मै अगले 1 साल में E-Nam का नियमित उपयोग करने की आशा करता हुँ।
    1 2 3 4 5 6 7
25 क्या आप अपनी फसल के दाम से सन्तुष्ट है ?
    1 2 3 4 5 6 7
26 E-Nam (ई–एनएम) पर फसल के दाम मंडी के बाहर से बेहतर है
    1 2 3 4 5 6 7
27 अच्छे दाम के लिए क्या आप अपनी फसल किसी ओर मंडी में ले जाना चाहेगें ?
    1 2 3 4 5 6 7
28 क्या आप मंडी के वाहन, गोदाम व क्वालिटी लैब की व्यवस्था से सन्तुष्ट है ?
    1 2 3 4 5 6 7

**कोई टिप्पणीः**

**"धन्यवाद"**

**शंका समाधान के लिए लिखे : sanjay030@gmail.com**

2

**APPENDIX B**:

Pilot Study Questionnaire (in Hindi)

सर्वेक्षण प्रश्नावली

विषयः– राष्टोय कृषि बाजार (एनएएम/NAM) को अपनाने के कारण

कृप्या चुनेः

पेशाः किसान ◯ व्यापारी ◯ एजेंट/कॉर्पोरेट ◯ मंडी आधिकारी ◯

कारोबार/व्यवसाय का आकारः छोटा ◯ मध्यम ◯ विशाल ◯

एनएएम उपयोगकर्ताः हाँ ◯ नहीं ◯

उपयोग का इरादाः योजना (3 महीनें) ◯ योजना (1वर्ष) ◯ कोई योजना नहीं ◯

किस हद तक आपको लगता हैं। कपया अपनी पंसद चुनें ।

1. नागण्य 2. थोड़ी हद तक 3. मध्यम हद तक 4. बड़ो हद तक 5. बहुत बड़ी हद तक

1. एनएएम (NAM) मेरे काम/व्यापार में उपयोगी होगा।

   1. 2. 3. 4. 5.

2. एनएएम ( NAM ) और अधिक तेजी से कार्यों को पूरा करने के लिए मुझे सक्षम बनाता है।

   1. 2. 3. 4. 5.

3. एनएएम ( NAM ) मुझं बोनस/अधिक लाभ प्राप्त करने की मेरी संभावना बढ़ाता है।

   1. 2. 3. 4. 5.

4. एनएएम ( NAM ) सिस्टम स्पष्ट है और मुझें समझ आता है।

   1. 2. 3. 4. 5.

5. एनएएम ( NAM ) प्रणाली का उपयोग मेरे लिए आसान है/होगा।

   1. 2. 3. 4. 5.

6. एनएएम ( NAM ) प्रणाली संचालित करने का सीखना मेरे लिए आसान है/ होगा।

   1. 2. 3. 4. 5.

7. जो लोग महत्वपूर्ण हैं या मेरी व्यवहार को प्रभावित करतें हैं वह चाहतें है, मेरा एनएएम (NAM) सिस्टम उपयोग करना।

   1. 2. 3. 4. 5.

8. वरिष्ठ प्रबंधन एनएएम (**NAM**) प्रणाली के उपयोग में सहायक रहा है/रहेगा

1. 2. 3. 4. 5.

9. सामान्य संगठन एनएएम (**NAM**) प्रणाली का उपयोग का समर्थन करता है/रहेगा

1. 2. 3. 4. 5.

10. मेरी संसाधनों की समझ और ज्ञान एनएएम (**NAM**) का उपयोग करने के लिए काफी है/होगी

1. 2. 3. 4. 5.

11. एनएएम (**NAM**) सिस्टम की अन्य प्रणालियों या प्रक्रिया के साथ संगत नहीं है।

1. 2. 3. 4. 5.

12. एक विशिष्ट व्यक्ति (या समूह) एनएएम (**NAM**) प्रणाली की कठिनाइयों में सहायता के लिए उपलब्ध है।

1. 2. 3. 4. 5.

13. एनएएम (**NAM**) वेबसाइट की जानकारी मान्य, विश्वसनीय और सटीक है।

1. 2. 3. 4. 5.

14. मेरा एनएएम (**NAM**) में विश्वास हैं की सूची–बद्ध विक्रेता ठीक से वितरण, पूर्ण करेगा और उसके उत्पाद/सेवाओं को पूर्ण करेंगे।

1. 2. 3. 4. 5.

15. मेरा एनएएम (**NAM**) में विश्वास हैं की सूची–बद्ध खरीदार अपना वादा पूरा करेगा।

1. 2. 3. 4. 5.

16. एनएएम (**NAM**) मं लेन–देन की लागत पंरपरागत बाजारों की तुलना में कम है/होगी

1. 2. 3. 4. 5.

17. उत्पादों या सेवा की लागत एनएएम (**NAM**) के माध्यम से कम हैं/होगी

1. 2. 3. 4. 5.

18. एनएएम (**NAM**) प्रणाली में सरकारी स्वामित्व नें इस प्रश्नावली में मेरे विकल्पों के चुनावों को प्राभावित किया है।

1. 2. 3. 4. 5.

धन्यवाद

**APPENDIX C**:

Mapping of Construct – Questionnaire for PLS-SEM Analysis

| S. No. | Latent Construct | Question Number | Observed Variables | Questions For the Observed Variables |
|---|---|---|---|---|
| 1 | Perceived Usefulness | Q1 | Useful in Trade | The eNAM is/will be useful in sell/buy/trade |
| | | Q2 | Accomplish Task Quickly | The eNAM makes it easy and quick to sell/buy/trade. |
| | | Q3 | Price Increase | The eNAM is/will increase the chances of getting more profit in sell/buy/trade. |
| 2 | Perceived Ease of Use | Q4 | Good User Interface | My interaction with eNAM System is/would be clear and understandable. |
| | | Q5 | Easy to use | eNAM System is/would be easy to use for me. |
| | | Q6 | Easy to Learn | Learning to operate the eNAM system is easy for me. |
| 3 | Social Influence | Q7 | Influencers | People who are important to me think that I should use the eNAM System. |
| | | Q8 | Helpful Management | The Mandi management has been helpful in the use of the eNAM System. |
| | | Q9 | Organization support | In general, I get support in the use of the eNAM system. |
| 3 | Facilitating Conditions | Q10 | Infrastructure | I have the resources (PC/Mobile/Internet/App/Bank Account/facility) necessary to use the eNAM System. |
| | | Q11 | Training | I have the knowledge and training necessary to use the eNAM System. |

| | | | | |
|---|---|---|---|---|
| | | Q12 | Support | A specific person (or group) is available for assistance with eNAM system difficulties. |
| 4 | Trust | Q13 | Accurate Information | Do you trust the information on the website/application as valid, credible, and accurate? |
| | | Q14 | Trust in Seller | Do you believe that the eNAM listed seller will deliver and fulfil his commitment? |
| | | Q15 | Trust in Buyer | Do you believe that the eNAM-listed buyer will deliver and fulfil his commitment? |
| 5 | Cost | Q16 | Transaction cost | The transaction costs in eNAM are/will be lower than those of the traditional market. |
| | | Q17 | Value for Money | The eNAM is good value for money and effort |
| | | Q18 | Overall Cost | The overall cost to use eNAM is reasonable |
| 7 | Behavioural Intent | Q22 | Intend within one year | I intend to use eNAM within one year |
| | | Q23 | Intend in next one year | I plan to use eNAM within the next year |
| | | Q24 | Intend (no time specified) | I predict the use of eNAM |
| NOTE: Q19, Q20, and Q21 relate to the effect of the eNAM on the wholesale prices of the commodities | | | | |

**APPENDIX D**:

Reliability of the Questionnaire

**PART 1**

**Table D.1: Values Associated with the Reliability of the Questionnaire**

| Construct | Observed Variable (Micro Variable) | Question Number | Item Loading | CR | Cronbach's Alpha | AVE |
|---|---|---|---|---|---|---|
| U | Useful in Trade | Q1 | 0.94 | 0.9 | 0.9 | 0.85 |
| | Accomplish Task Quickly | Q2 | 0.93 | | | |
| | Price Increase | Q3 | 0.89 | | | |
| PEU | Good User Interface | Q4 | 0.89 | 0.9 | 0.85 | 0.78 |
| | Easy to use | Q5 | 0.88 | | | |
| | Easy to Learn | Q6 | 0.89 | | | |
| SI | Influencers | Q7 | 0.88 | 0.87 | 0.78 | 0.69 |
| | Helpful Management | Q8 | 0.80 | | | |
| | Organization support | Q9 | 0.82 | | | |
| FC | Infrastructure | Q10 | 0.91 | 0.9 | 0.86 | 0.78 |
| | Training | Q11 | 0.89 | | | |
| | Support | Q12 | 0.87 | | | |
| T | Accurate Information | Q13 | 0.93 | 0.9 | 0.9 | 0.84 |
| | Trust in Seller | Q14 | 0.92 | | | |
| | Trust in Buyer | Q15 | 0.91 | | | |
| C | Transaction cost | Q16 | 0.87 | 0.86 | 0.76 | 0.67 |
| | Value for Money | Q17 | 0.83 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Overall Cost | Q18 | 0.76 | | | |
| BI | Intend within one year | Q22 | 0.82 | 0.88 | 0.79 | 0.7 |
| | Intend in next one year | Q23 | 0.90 | | | |
| | Intend (no time specified) | Q24 | 0.81 | | | |

Relationship Between Constructs in the Framework

**Table D.2: Path-coefficient Values in the Framework**

| Construct Relationship | Path-coefficients Value | Criteria | Result |
|---|---|---|---|
| Behavioural Intention (BI) → Adoption (U) | 0.348 | >0, <1 | Positive relationship |
| Cost (C) → Adoption (U) | 0.443 | | Positive relationship |
| Facilitating Condition (FC) → Adoption (U) | 0.088 | | Positive relationship |
| Perceived Ease of Use (PEU) → Behavioural Intention (BI) | 0.111 | | Positive relationship |
| Perceived Usefulness (PU) → Behavioural Intention (BI) | 0.119 | | Positive relationship |
| Social Influence (SI) → Behavioural Intention (BI) | 0.145 | | Positive relationship |
| Trust (T) → Behavioural Intention (BI) | 0.504 | | Positive relationship |

**Table D.3: t-Values in the Framework**

| Construct Relationship | t-Value | Criteria | Statistically Significance? |
|---|---|---|---|
| Behavioural Intention (BI) → Adoption (U) | 6.301 | > 1.96 | Yes |
| Cost (C) → Adoption (U) | 9.271 | | Yes |
| Facilitating Condition (FC) → Adoption (U) | 2.110 | | Yes |
| Perceived Ease of Use (PEU) → Behavioural Intention (BI) | 2.168 | | Yes |

| | | | |
|---|---|---|---|
| Perceived Usefulness (PU) → Behavioural Intention (BI) | 2.016 | | Yes |
| Social Influence (SI) → Behavioural Intention (BI) | 3.134 | | Yes |
| Trust (T) → Behavioural Intention (BI) | 9.610 | | Yes |

**Table D.4: P-Values in the Framework**

| Construct Relationship | P-Value | Criteria | Statistically Significance? |
|---|---|---|---|
| Behavioural Intention (BI) → Adoption (U) | 0.000 | < 0.05 | Yes |
| Cost (C) → Adoption (U) | 0.000 | | Yes |
| Facilitating Condition (FC) → Adoption (U) | 0.035 | | Yes |
| Perceived Ease of Use (PEU) → Behavioural Intention (BI) | 0.031 | | Yes |
| Perceived Usefulness (PU) → Behavioural Intention (BI) | 0.044 | | Yes |
| Social Influence (SI) → Behavioural Intention (BI) | 0.002 | | Yes |
| Trust (T) → Behavioural Intention (BI) | 0.000 | | Yes |

**Table D.5: VIF Value in the Inner Model of Framework**

| Construct | Variance Inflation Factor (VIF) | Criteria | Result |
|---|---|---|---|
| Behavioural Intention (BI) → Adoption (U) | 4.040 | < 5 | Fulfilled |
| Cost (C) → Adoption (U) | 4.406 | | Fulfilled |
| Facilitating Condition (FC) → Adoption (U) | 2.769 | | Fulfilled |

| | | | |
|---|---|---|---|
| Perceived Ease of Use (PEU) → Behavioural Intention (BI) | 4.409 | | Fulfilled |
| Perceived Usefulness (PU) → Behavioural Intention (BI) | 4.675 | | Fulfilled |
| Social Influence (SI) → Behavioural Intention (BI) | 3.276 | | Fulfilled |
| Trust (T) → Behavioural Intention (BI) | 3.096 | | Fulfilled |

**Table D.6: $f^2$ Value of the Structural Model**

| Construct Relationship | $f^2$ Value | Criteria | Result |
|---|---|---|---|
| Behavioural Intention (BI) | 0.102 | >0.35 = Large,<br>>0.15, <0.35 = Moderate,<br><0.15 = Small | Small |
| Cost (C) | 0.150 | | Moderate |
| Facilitating Condition (FC) | 0.009 | | Small |
| Perceived Ease of Use (PEU) | 0.008 | | Small |
| Perceived Usefulness (PU) | 0.008 | | Small |
| Social Influence (SI) | 0.020 | | Small |
| Trust (T) | 0.248 | | Moderate |

**APPENDIX E**:

TISM Questionnaire

The following questionnaire is intended to register the perception of professionals and Academicians on the pairwise relationship (section 2) between "Enablers of B-B E-commerce Adoption in Agriculture Sector".

1. Email address:

2. Name:

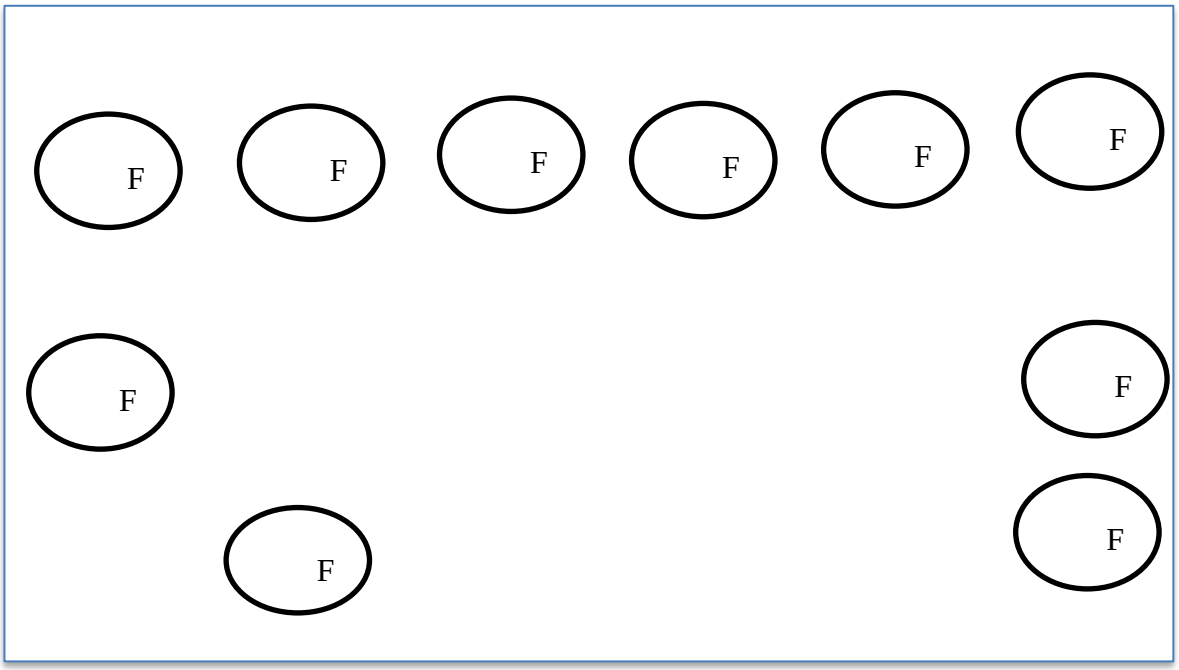
| FOR EXECUTIVES: | FOR ACADEMICIANS: |
|---|---|
| 1. Size of Company:<br>Small<br>Medium<br>Large | 1. What is your research area? |
| 2. Nature of Business<br>Seller<br>Buyer<br>Trader<br>Corporate | 2. Affiliation (University/College/Institute/Other) |

**Note:** eNAM is a Pan India electronic trading portal which networks the existing APMC and market yards to create a unified national market for agricultural commodities.

RELATIONSHIP BETWEEN ENABLERS OF B-B E-COMMERCE ADOPTION IN AGRICULTURE SECTOR, e.g., ENAM ADOPTION

| | | | |
|---|---|---|---|
| F1: | Job Performance Improvement | F6: | Fees or Transaction Cost |
| F2: | Ease of Use | F7: | Facilitating Conditions (Infra.) |
| F3: | Social Influence | F8: | Knowledge and Training |
| F4: | Trust | F9: | Behavioural Intention |
| F5: | Customer Care | F10: | Actual Usage |

**Please link the enablers (with directional arrows) as per your opinion/knowledge:**




Legends:

Influence/

Enhances Direct Link

Indirect Link

RELATIONSHIP INTERPRETATION

We shall appreciate it if you add a comment about "Reason" OR "In What Way" the Factor “Fi” Influences/Enhances “Fj”, if applicable:

| Factor "Fj" → <br> Factor "Fi" ↓ | F10 | F9 | F8 | F7 | F6 | F5 | F4 | F3 | F2 | F1 |
|---|---|---|---|---|---|---|---|---|---|---|
| F1: Job Performance Improvement | | | | | | | | | | |
| F2: Ease of Use | | | | | | | | | | |
| F3: Social Influence | | | | | | | | | | |
| F4: Trust | | | | | | | | | | |
| F5: Customer Care | | | | | | | | | | |
| F6: Fees or Transaction Cost | | | | | | | | | | |
| F7: Facilitating Conditions (Infra.) | | | | | | | | | | |
| F8: Knowledge and Training | | | | | | | | | | |
| F9: Behavioural Intention | | | | | | | | | | |
| F10: Actual Usage | | | | | | | | | | |

**THANK YOU**

**APPENDIX F**:

IRP Questionnaire

| **PERSONAL PARTICULARS:** | |
|---|---|
| Name: | Email ID: |
| Designation: | Organization: |
| Research Interest: | |

**REASON OF QUESTIONNAIRE**: **To rank (importance) the factors** influencing the **B-B e-commerce (e-trading) usage** in the Indian agriculture sector. e.g., National Agriculture Market (eNAM).

**BACKGROUND:**

| **Alphanumeric Code** | **Ranking Variables (To be Ranked)** |
|---|---|
| F1 | Perceived Usefulness |
| F2 | Perceived Ease of Use |
| F3 | Social Influence |
| F4 | Trust |
| F5 | Cost |
| F6 | Facilitating Conditions |
| | **Reference Variables (Criteria)** |
| A1 | Start Actual Transactions |
| A2 | Frequency of Transactions |
| A3 | Total Size of Transactions |

NOTE:

- The Contextual Relationship between Ranking Factor and Reference Factor is that the Ranking Factor ‘Fx’ enhances/influences the reference Factor ‘Ay’.
- In term of dominance among Factors, one for one reference factor/criteria, does one ranking factor ‘Fx’ dominates another ranking Factor ‘Fy’

**QUESTIONNAIRE START**

Please provide your expert opinion based on your knowledge/experience below:

1. **CROSS-INTERACTION MATRIX:**

The Contextual Relationship between the ranking Factor and reference factor/criteria is that the Factor 'Fx' enhances/influences the reference factor 'Ay'. If 'Yes' = '1', If 'No' = '0'.

| | | | | |
|---|---|---|---|---|
| Perceived Usefulness | F1 | | | |
| Perceived Ease of Use | F2 | | | |
| Social Influence | F3 | | | |
| Trust | F4 | | | |
| Cost | F5 | | | |
| Facilitating Conditions | F6 | | | |
| | | C1 | C2 | C3 |
| | | Start Transactions | Increasing Frequency of Transactions | Increasing Size of Transactions |

2. **AN INTERPRETIVE MATRIX**

Kindly provide logic for '1' entries in various cells of the above table.

| | | | | |
|---|---|---|---|---|
| Perceived Usefulness | F1 | | | |
| Perceived Ease of Use | F2 | | | |
| Social Influence | F3 | | | |
| Trust | F4 | | | |
| Cost | F5 | | | |
| Facilitating Conditions | F6 | | | |

| | | C1 | C2 | C3 |
|---|---|---|---|---|
| **Reference Factor** | | Start Transactions | Increasing Frequency of Transactions | Increasing Size of Transactions |

**REFERENCE VARIABLE-WISE DOMINANCE MATRIX**

For a particular reference factor ‘C1’ variable, if the ranking factor ‘Fx’ dominates the other ranking factor ‘Fy’, Yes = 1, No = 0.

| **FOR C1:** Start Transactions | | | | | | |
|---|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 | F6 |
| F1 | | | | | | |
| F2 | | | | | | |
| F3 | | | | | | |
| F4 | | | | | | |
| F5 | | | | | | |
| F6 | | | | | | |
| **FOR C2:** Increasing Frequency of Transactions | | | | | | |
| | F1 | F2 | F3 | F4 | F5 | F6 |
| F1 | | | | | | |
| F2 | | | | | | |
| F3 | | | | | | |
| F4 | | | | | | |
| F5 | | | | | | |
| F6 | | | | | | |
| **FOR C3:** Increasing Size of Transactions | | | | | | |
| | F1 | F2 | F3 | F4 | F5 | F6 |
| F1 | | | | | | |
| F2 | | | | | | |
| F3 | | | | | | |
| F4 | | | | | | |
| F5 | | | | | | |
| F6 | | | | | | |

**THANK YOU**

**APPENDIX G**:

APMC Market Information

| S. No. | Item | Details |
|---|---|---|
| **1** | **Location** | **Aligarh** |
| 1.1 | APMC name | Aligarh |
| 1.2 | State | Uttar Pradesh |
| 1.3 | Year of regulation | 1969 |
| 1.4 | Name of market legislation | UP APMC Act |
| 1.5 | Population served | 1274408 |
| 1.6 | Market area served (No. Of villages) | 274 |
| 1.7 | Address | Agriculture Produce Market Committee, Aligarh, Dist. Aligarh |
| 1.8 | Commodities traded | Bajra, Banana, Cabbage, Green pea, Oat, Onion, Paddy, Papaya, Potato, Wheat |
| 1.9 | Commission | 2.5 per cent (Grain), 3 per cent (fruit and vegetable) |
| 1.1 0 | Market fee, Weighment, Brokerage | 2 percent, 2 per cent, 0.5 per cent |
| | | |
| **2** | **Location** | **Bharatpur** |
| 2.1 | APMC Name | Nadbai |
| 2.2 | State | Rajasthan |
| 2.3 | Year of Regulation | 1966 |
| 2.4 | Name of Market Legislation | Raj Agri Produce Market Act |
| 2.5 | Population served | 250000 |
| 2.6 | Market area served (No. Of villages) | 126 |

| | | |
|---|---|---|
| 2.7 | Commodities Traded | Bajara, Barley, Dhaincha, Gawar, Gram, Gur, Mustard, Sugar, Wheat |
| 2.8 | Commission | 2 Per cent |
| 2.9 | Market Fee, others | 1.60 per cent , 1.51 per cent |
| | | |
| **3** | **Location** | **Bharatpur** |
| 3.1 | APMC Name | Nagar |
| 3.2 | State | Rajasthan |
| 3.3 | Year of Establishment | 1977 |
| 3.4 | Population served | 200000 |
| 3.5 | Commodities Traded | Bajara, Barley, Gram, Gwar, Jowar, Mustard, Sesamum, Wheat |
| 3.6 | Commission | 2 per cent |
| 3.7 | Market Fee | 0.5 percent - 1.6 per cent |
| 3.8 | Weighment | INR 7/Qtl. |
| | | |
| **4** | **Location** | **Meerut** |
| 4.1 | APMC name | Meerut |
| 4.2 | State | Uttar Pradesh |
| 4.3 | Year of establishment | 1967 |
| 4.4 | Year of Regulation | 1967 |
| 4.5 | Name of Market Legislation | UP APMC Act |
| 4.6 | Market area served (No. Of villages) | 240 |
| 4.7 | Commodities Traded | Arbi, Banana, Bitter Gourd, Bottle Gourd, Brinjal, Cabbage, Capsicum, Carrot, Cauliflower, Chilli, Cucumber, Lady Finger, Masoor, Mustard, Paddy, Potato, Wheat, White Chilli, White Peas |

| | | |
|---|---|---|
| 4.8 | Commission | 3 per cent |
| 4.9 | Market Fee, Cess | 2 per cent, 0.5 per cent |
| | | |
| **5** | **Location** | **Pilibhit** |
| 5.1 | APMC Name | Pilibhit |
| 5.2 | State | Uttar Pradesh |
| 5.3 | Year of establishment | 1972 |
| 5.4 | Year of Regulation | 1986 |
| 5.5 | Population served | 794886 |
| 5.6 | Market area served (No. Of villages) | 453 |
| 5.7 | Commodities Traded | Banana, Green Chili, Gur, Mango, Onion, Paddy, Potato, Tomato, Wheat, Wood |
| 5.8 | Commission | 2.5 per cent |
| 5.9 | Market Fee, Cess | 2 per cent, 0.5 per cent |

**APPENDIX H**:

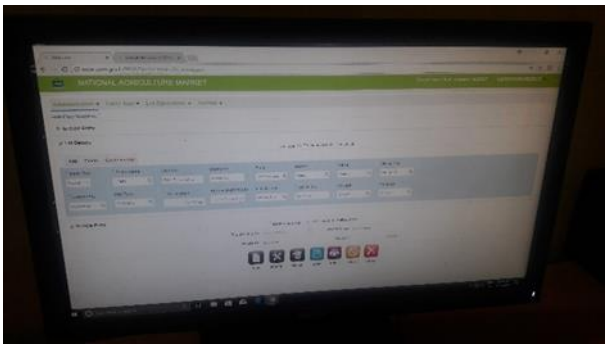
Field Visit Photos

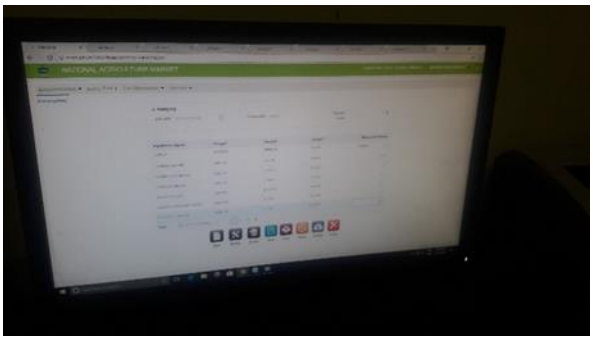
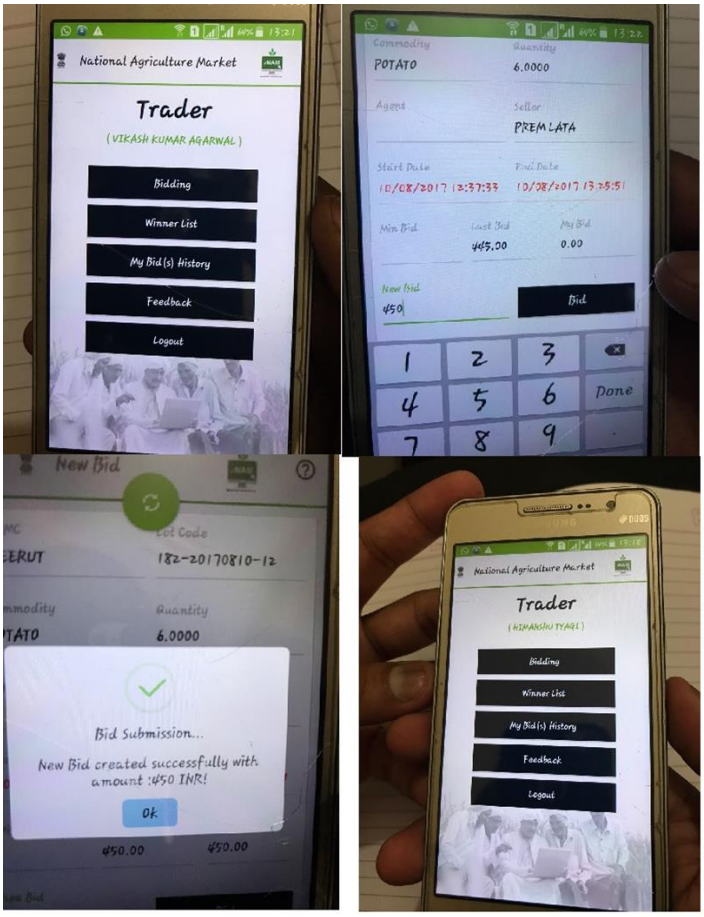
Please see next page.

| S. No. | Description | Photograph |
|---|---|---|
| 1 | APMC Ghaziabad: APMC Entry Gate |  |
| 2 | APMC, Ghaziabad: Agri Price Announcements – offline |   |
| 3 | APMC, Ghaziabad: Trader and Farm Inputs Shop |  |

| | | |
|---|---|---|
| 4 | APMC, Nagar: Wheat Lot Inspection |  |
| 5 | APMC, Nagar: Mustard Bagging Area |  |
| 6 | APMC, Nadbai: eNAM Trading Room |  |
| 7 | APMC, Nadbai: Quality Control Laboratory |  |

| | | |
|---|---|---|
| 8 | APMC, Nadbai: eNAM Trading Terminals for Farmers |  |
| 9 | APMC, Meerut: APMC Entry Gate |   |
| 10 | APMC, Meerut: Administrative Building |   |
| 11 | APMC, Meerut: eNAM Trading Room |   |

| | | |
|---|---|---|
| 12 | APMC, Meerut: Farm Inputs Shop at APMC |  |
| 13 | APMC, Meerut: Traders Shop at APMC |  |
| 14 | APMC, Aligarh: Wheat Bagging Area |  |
| 15 | APMC Aligarh: eNAM Portal- Bid Entry |  |

| | | |
|---|---|---|
| 16 | APMC Aligarh: eNAM Portal – Bids Announcement |  |
| 17 | General: eNAM Mobile Application |  |

**APPENDIX I**:

Curriculum Vitae and List of Publications

**Name:** Sanjay Chaudhary

**Date of Birth:** 14th November 1968

## EDUCATIONAL QUALIFICATIONS

MS (Management Information System), State University of New York, 2008,

CGPA: 3.8/4.0

MBA (International Business), Asian Institute of Technology, 1996,

CGPA: 3.9/4.0

PGDP (International Trade), Indian Institute of Foreign Trade, 1994,

Marks: 73 per cent

B. Tech. (ECE), Indian Institute of Technology, Roorkee, 1991,

Marks: 70 per cent

## PROFESSIONAL EXPERIENCE

Delhi School of Business, Vivekananda Institute of Professional Studies, Delhi
June 2015 – Till Date: Associate Professor

Ericsson, Gurugram
July 2010 – January 2013: General Manager

Reliance Communications, Mumbai
February 2003 – May 2009: Deputy General Manager

Others
Samsung: August 2000 – October 2002:Regional Manager
SingTel: February 1998 – August 2000: Business Manager
Thaimex: June 1996 – January 1998: Associate
Uptron: June 1991 – May 1993: Engineer

**PUBLICATIONS (as part of present research work at DTU, Delhi)**

**Journals**

Chaudhary, Sanjay, and Suri, P. K. (2022). A multivariate analysis of agricultural electronic trading adoption. *Journal of Scientific & Industrial Research*, 81(2), 932-939. https://doi.org/ 10.56042/jsir.v81i09.59538

Chaudhary, Sanjay, and Suri, P. K. (2022). Experiential Learning from the Agri-tech Growth Leaders. *Technology Analysis & Strategic Management*, 1-14. https://doi.org/10.1080/09537325.2022.2100755

Chaudhary, Sanjay, and Suri, P. K. (2022). Modelling the enablers of e-trading adoption in agricultural marketing: A TISM based analysis of eNAM. *Vision-the Journal of Business Perspective*, 26(1), 65-79. https://doi.org/10.1177/0972262920977979

Chaudhary, Sanjay, and Suri, P. K. (2021). Ranking the Factors Influencing e-Trading Usage in Agricultural Marketing, *Global Journal of Flexible Systems Management*, 22(3), 233-249. https://doi.org/10.1007/s40171-021-00276-8

Chaudhary, Sanjay, and Suri, P. K. (2021). Framework For Agricultural e-Trading Platform Adoption Using Neural Networks. *International Journal of Information Technology*, 13, 501–510. https://doi.org/10.1007/s41870-020-00603-9

**Conferences**

Chaudhary, Sanjay, & Suri, P. K. (2019). Modeling the Enablers of E-Trading Adoption in Agriculture: Learning from Indian eNAM. Smart marketing in the digital age. *In Proceedings of IIM Indore – NASMEI summer marketing information systems conference*. New Delhi: Emerald. (ISBN: 978-1-78635-428-0)

Chaudhary, Sanjay, and Suri, P. K. (2019). Interpretive ranking of the factors influencing e-trading usage in Indian agriculture marketing. Driving Marketing Excellence through Experiences in Emerging Economies. *In Proceedings of emerging markets conference board conference*. Ghaziabad; IMT. (ISBN 978-93-5346-669-5)