FARMER PRODUCER ORGANIZATIONS' BEHAVIORAL INTENTIONS TOWARDS FOURTH INDUSTRIAL REVOLUTION TECHNOLOGIES ADOPTION

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ABSTRACT

The purpose of this paper is to investigate the factors that drive Farmer Producer Organisation (FPO)'s willingness to utilise fourth industrial revolution technologies (4IRT). A survey on hundred FPOs heads in India was conducted to examine the adoption attitude towards 4IRT using integrated model of Technology Acceptance Model (TAM), Diffusion of Innovation Theory (DoI) and Unified Theory of Acceptance and Use of Technology (UTAUT). The structural equation modelling (SEM) technique is applied using SmartPLS 3.0. Our study results shows that 4IRT adoption will increase value chain and business performance of FPO, Behavioural Intention is the key to increase 4IRT adoption. Policy makers can take care of usefulness and prices value of 4IRT for FPOs. To increase behaviour intention among FPO members, training programs and promoting rental model of agritech would help. This research studies FPOs adoption of 4IR technology in agribusiness. The study motivates agritech managers to address FPOs who are in need to upgrade technology and provide constant support to FPOs until FPO's employees become familiar with technology.

Keywords: Adoption, Empirical Study, Farmer Producer Organisation, Fourth Industrial Revolution Technologies, Performance.

INTRODUCTION

Technology has transformed every business and industrial sector in world, and food and agribusiness are no exception (Pillai & Srivanu, 2020). In India, most farmers are dependent on agricultural income for their livelihood. With the rapid population growth, technology must play a vital role in producing food and sustainable agriculture David (2020). Fourth Industrial Revolution Technologies (4IRT) like Artificial Intelligence, Blockchain etc can act as a catalyst for increasing farmers' income and sustainable growth. Innovative technology has several advantages, including the ability to increase production volume while lowering the chance of crop failure and use of agricultural inputs Ganeshkumar et al. (2021). Figure 1 depicts the evolution of the industrial revolution with time (Ilaria et al., 2019). In the first industrial revolution, our way of life and economy changed. It went from an agrarian and handicraft economy to one that was dominated by industry and machine-made goods David et al. (2022). Oil and electricity made it easier to make many things during the second industrial revolution. During the third industrial revolution, technology was used to make products easier. While each industrial revolution is generally thought of as a single event, it can be better understood as a succession of events that build on the achievements of the preceding revolution and result in more advanced modes of

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production when taken together (Prisecaru, 2016) Figure 1 Ab Hamid et al. (2017).

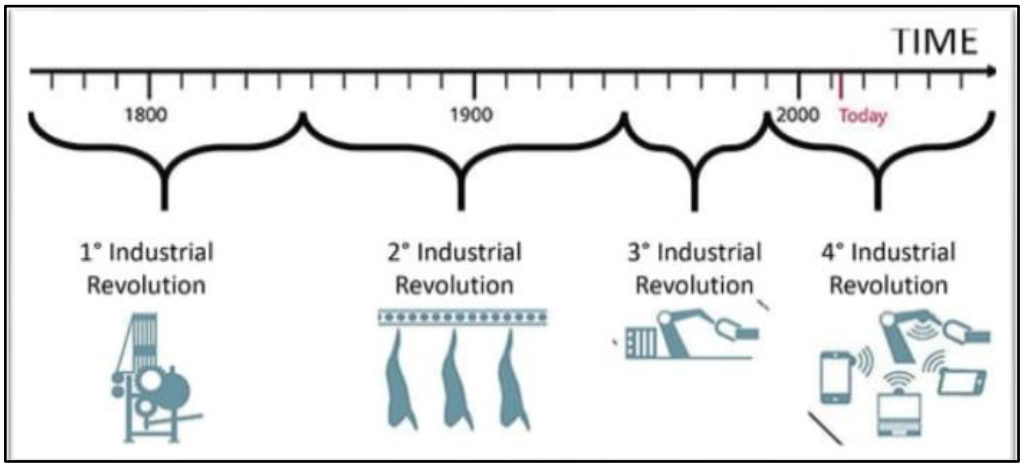

FIGURE 1
ROADMAP FROM INDUSTRY 1.0 TO 4.0

In the 4IRT were blended, and physical, digital, and biological spheres came together exponentially (Xu et al., 2018). These new digital technologies offer many benefits to agri-food value chain. 4IRT have revolutionised the agriculture industry from crop production to final consumer reach. The transformation and disruption of technology happened in every sector of the world but India lacks technology adoption in the agriculture sector (Tzachor, 2021).

Digital transformation is not only driving the 4IRT, but also lower transportation and communication costs, improved logistics, and more efficient supply chains to contribute to economic growth over the long run (Schwab, 2016). "The confluence of a range of digital technologies (e.g., 3D printing, IoT, drones) to new materials (e.g., bio or nano-based) to new processes (e.g., data-driven agriculture, artificial intelligence, synthetic biology)" is referred to as Industry 4.0 or 4IRT (Source: OECD, 2016). Industry 4.0 focuses on integrating the technology and simultaneously fulfilling customer demand faster, cheaper, efficient, and sustainable (Spath, 2013). Without the productive backing of innovative technical efficiency, agriculture's traditional system will be incapable of meeting the world's expanding food needs. To enhance 4IRT impacts in agriculture, a safe environment for rural living, cyber technology and cloud infrastructures must first be built (Ane & Yasmin, 2019).

Rao et al. (1995) pointed that researchers and extension agencies often don't know what farmers value most. Therefore, technologies that farmers don't usually need are made and pushed. As a result, farmers have been unable to boost crop production and lack in technology adoption. Indian industry is rapidly evolving to keep pace with the world trends in use of technology across sectors. However, when it comes to adopting new technologies, agriculture has lagged well behind other industries. Government and Industry have long been concerned about agriculture's informal nature Pachayappan et al. (2020). The first step in turning Krishi (farmer) into "Atmanirbhar Krishi" is to form and promote Farmer Producer Organisation (FPOs). This will lead to more cost-effective production and productivity, as well as higher net earnings for FPO members. FPOs have helped agri-tech companies grow by encouraging new ideas and pushing the industry forward. Farmers' access to information can be improved by getting different groups in the agribusiness ecosystem to work together. Research and extension must work together to get farmers interested

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in and motivated to do technological based farming. An FPO is essential to this process, in which individual farmers collaborate in a systematic manner to increase their income and standard of life by leveraging economies of scale Ahmed et al. (2022).

During 2020-21, GoI allocated 2,200 FPO produce clusters for formation of FPOs, including specialised FPO produce clusters such as 100 for organic, 100 for oilseeds, etc. Of these, GOI plans to form 369 FPOs, during the current year in 115 aspirational districts. The ministry said that GoI would provide FPOs financial assistance up to Rs 18 lakh per FPO for a period of 3 years. Adding to it, provision has been made for matching equity grant up to Rs 2,000 per farmer member of FPO with a limit of Rs 15 lakh per FPO and a credit guarantee facility up to Rs 2 crore of project loan per FPO from the eligible lending institution to ensure institutional credit accessibility to FPOs. Experts predicted them to play an essential role in the growth of agriculture. Farmers who lack information frequently miss new farming trends/practices, timely access to crop pricing and weather conditions, new government policies or offers, and government-set aside emergency funds for farmers in natural disaster-prone areas (Rahman & Bhuiyan, 2016). The road ahead, although the agri-tech companies are still at a nascent stage in India, it is progressing quickly. With continuous efforts, such as the government's aim to support 10,000 FPOs in the country, and agri-tech start-ups propelling the change by leveraging cutting-edge technology, India's agri-tech sector is well on its way to evolving beyond its nascent stage and achieving dynamic growth in the Indian agriculture sector.

This study deals with 4IRT adoption intention among FPOs. The remaining study has been structured as follows: literature review with conceptual framework highlights the study variable and research gap identified, next section presents the research methodology. The following section details the results and discussion from the structural equation modelling and moderation analysis. This is followed by section on conclusion and implications. In the final section, the study highlights the limitation of the present study and future research directions.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

4IRT in agribusiness includes smart farming that enables agricultural locations to boost productivity while remaining competitive. It acts as a catalyst for increasing farmer's income and its sustainable growth. This paper investigates the possible factors that drive Farmer Producer Organisations (FPO)'s willingness to utilise 4IRT Ganeshkumar et al. (2021).

Many theoretical models, such as the TAM (Technology Acceptance Model) (Davis et al., 1989), DoI [Diffusion of Innovation Theory] (Rogers, 2003), and UTAUT [Unified theory of acceptance and use of technology] Venkatesh et al. (2012), have been widely employed in the literature. Organisational and consumer contexts are different when considering factors that influence FPO's intention and behaviour when utilising technology. In the study, FPO's intention to adopt 4IRT is analysed using an integration of three theoretical model Pantano & Priporas (2016). The models are DoI, TAM, and UTAUT models, which are interconnected models that are regularly validated, expanded, and elaborated Siddhartha et al. (2019).

Diffusion of Innovation Theory (DoI): Rogers (1962) proposed the DoI theory, which highlights five factors affecting innovation adoption (Rogers, 1995): relative benefit, compatibility, observability, complexity, and trainability. The rate of spread is influenced by these five factors. The DoI theory was chosen for this study because it is commonly used theoretical model for describing how new technologies are accepted Dwivedi et al. (2017). Only two of its factors were chosen: compatibility ("the degree to which potential users' needs, prior experiences, and existing values are consistent") and observability ("the extent of visibility of using innovation

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and its results") Venkatesh et al. (2012). These two factors influence technological diffusion rate in agriculture Mehra et al. (2020).

Unified theory of acceptance and use of technology (UTAUT): Venkatesh et al. (2012) proposed the UTAUT, which combines several previously recognised technology acceptance models (Barnard et al., 2013). This model was based on previous study employed after the complete exploration of eight prominent user adoption models, i.e., the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), PC Utilization Model, Combined TAM and TPB (C-TAM-TBP), Diffusion of Innovation Theory (DoI), and Social Cognitive Theory to explain information system usage behaviour. The conclusive model says that the behavioural intention comes before a specific behaviour when people use or accept technology Ajzen (1991). The extended UTAUT theory looks at how people utilise technology and has four components that determine their behaviour: effort expectancy, social influence, performance expectancy, and facilitating conditions. Performance expectation, effort expectancy, and social influence were taken from the original UTAUT model for this study. Venkatesh et al. (2012) UTAUT model was extended as UTAUT2 by Venkatesh et al. (2012) and is widely used to predict behavioural intention by multiple researchers Alalwan et al. (2014); Luo et al., 2010; Martins et al., 2014; Riquelme and Rios, 2010) Beza et al. (2018).

Technology Acceptance Model (TAM): The TAM model is one of the most popular models, and it contributes to the IT/IS literature (Luarn and Lin, 2005). TAM posits perceived usefulness (PU) and perceived ease of use (PEOU/EOU) as different beliefs that are important for computer acceptance behaviour Dwivedi et al. (2017). One of the critical components in the original TAM is the individual's trust in a specific IS to improve his or her work-related productivity and that it will be beneficial in each organisational context Pantano & Priporas (2016). A person's perceived ease (or effortlessness) in using technology, is another significant component of TAM. Many additional scholars modified TAM by adding one or more variables/models that were not included in original TAM Aboelmaged (2010); Aggelidis and Chatzoglou, 2009; Gefen et al., 2003) and similarly, Rogers' conclusions have been widely used in studies on IT/IS acceptance and adoption. Numerous studies have used the TAM to explain why a potential customer might accept using an innovative/new technology product/service Venkatesh et al. (2012).

The current study is a hybrid of the UTAUT, DoI, and extended TAM models. We use an integrated model to describe and interpret FPOs' behavioural intentions toward the 4IRT. Literature on technology acceptance was thoroughly examined to construct a conceptual framework and, later, a model to test in this study. The three major components of technology acceptance are Perceived Ease of Use (PEOU), Perceived Usefulness (PU) and Behavioural Intentions (BI). To validate the proposed conceptual framework theories considered were the Technology Acceptance Model (TAM); Diffusion of Innovation theory (DoI); Unified Theory of Acceptance and Use of Technology (UTAUT) and Theory of Reasoned Action (TRA). The conceptual framework depicts the importance of technology adoption and reasons for FPOs' technology acceptance in agriculture. The study proposes a model, where FPOs' attitude towards the 4IRT adoption and their perception on its effect on business performance are studied.

Performance expectancy: It is "the degree to which using a technology will provide benefits to users in performing certain activities" Venkatesh et al. (2012). Both performance expectancy and perceived utility are highlighted as prerequisites for e-adoption in the literature. According to UTAUT theory, performance expectancy refers to the "expected benefits" that a client anticipates from a product Venkatesh et al. (2012).

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***H_1**: Performance expectancy will positively influence perceived usefulness of 4IRT for FPO's*

Perceived Enjoyment: According to Davis et al. (1992), perceived enjoyment is "the extent to which an individual believes that the activity of using a particular technology (system) would be an enjoyable/exciting/playful experience, apart from the usual performance outcomes occurring from system usage" Lee et al. (2012). Perceived usefulness affects perceived enjoyment consequently influencing behavioural intention. It has been discovered that perceived utility and felt perceived enjoyment have an effect on behavioural intention (Kumar, 2017; Elkaseh et al. (2015).

***H_2**: Perceived enjoyment will positively influence the perceived usefulness of 4IRT for FPO's*

Compatibility: According to Rogers (2003), compatibility is the "extent to which the potential users regard an innovation to be consistent with needs, prior experiences, and existing values". From the literature it is found that compatibility has a direct relationship towards technology adoption (Kanchanatanee et al., 2014). Furthermore, compatibility and perceived utility were also found to boost adoption and performance Lui et al. (2021). Therefore, the following hypothesis is postulated:

***H_3**: Compatibility will positively influence the perceived usefulness of the 4IRT for FPO's*

Price Value: The price value is defined as "consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" Venkatesh et al. (2012). Price value has influenced behaviour intention in smart farming Kang et al. (2020). There is evidence that there is a link between price value and behavioural intention in the literature. Price, in general, has a significant impact on FPOs' buying and repurchase intentions along with brand loyalty. Thus, it leads to following hypothesis:

***H_4**: Price value will positively influence the perceived usefulness of the 4IRT for FPO's*
***H_5**: Price value will significantly influence Behavioural Intention towards 4IRT for FPO's*

Perceived Usefulness: Perceived usefulness is one of the key components of TAM Dasgupta et al. (2011). According to Hokroh & Green (2019) there is a direct relationship between perceived usefulness and behavioural intent. FPOs will be more ready to use 4IR technology if they believe it will enhance their efficiency and output. The TAM model also includes perceived usefulness, which determines behavioural desire to utilise a technology Siddhartha et al. (2021).

***H_6**: Perceived usefulness will positively influence Behavioural Intention towards 4IRT for FPO's*

Effort Expectancy: It is described by Venkatesh et al. (2012) as "the extent of ease related with the use of a technology (system)." According to Usman et al. (2020), there is a link between effort expectancy and behaviour intention, and to improve behaviour intention or use behaviour, effort expectancy must be increased. Thus, it leads to following hypothesis:

***H_7**: Effort expectancy will positively influence Behavioural Intention towards 4IRT for FPO's*

Social Influence: According to the UTAUT theory, social influence is "deeply affected by family, friends, co-workers, or other people who are important in the individual's eyes". In terms of determining behaviour intention, social influence is the most important variable after

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"performance expectations, attitude, facilitating conditions, and cost" Asvial et al. (2021). The literature has established a direct effect of social influence on behaviour intention. As a result, to improve behaviour or usage intention, the degree of social influence must be increased Usman et al. (2020).

***H_8**: Social influence will positively influence Behavioural Intention towards 4IRT for FPO's*

Observability: According to Roger's DoI theory, observability is "the degree of public exposure of every innovation's results." Observability is a necessity for new technology promotion Chao (2019) in sectors working on e-contracts or smart contracts Sharma et al. (2018).

***H_9**: Observability will positively influence Behavioural Intention towards 4IRT for FPO's*

Behavioral Intention: In 4IRT literature, behavioural intention has been most typically used to forecast adoption and actual usage of new technologies (Venkatesh et al., 2012). Behavioral intention not only influences, but also modifies, the usage and adoption of new technology Ajzen (1991). Behaviour intention has been proven to act as a mediating variable on numerous occasions therefore, the higher the behaviour intention, the stronger the customer adoption, Yuan et al. (2019); Madan & Yadav (2018). As a dependent variable, Behavioral Intention is influenced by all the aspects discussed earlier namely Perceived usefulness, Price value, Social influence, Effort expectancy, and Observability.

Adoption: Adoption is defined as "the stage of mental acceptance of technology by embracing and using it entirely by either an individual or an organization" (Renaud and van Biljon, 2008). Adoption means a relatively stable change in one's behavior in using technology. The DoI theory of Rogers (1995) has been studied extensively to understand innovation and adoption of innovative products in various sectors ranging from agriculture to IT/IS innovations Mehra et al. (2021). Farmer's intention to adopt new technology leads to better value chain performance Victer Paul et al. (2020). Thus, it leads to following hypothesis:

***H_{10}**: FPOs' 4IRT adoption will positively influence Value Chain Performance.*

Value Chain Performance: It refers to the process of adding value to products to increase their form and place utility. Farmers create collectives like FPOs, allowing them to boost their income by contributing to the agricultural value chain. Logistical and multifunctional drivers are included in the value chain. To assist farmers in enhancing value chain performance, a holistic approach should be necessary. Farmers' intent to utilise new technology leads to value chain performance. Thus, it leads to following hypothesis:

***H_{11}**: The adoption of the 4IRT by FPO's will positively influence the Value Chain Performance.*

FPO Business Performance: Majority of the FPOs are dependent on value chain performance using 4IRT. Literature shows that FPO business model is an ideal business model in agri-business as a strategic approach for doubling farm income and sustainability (Vijaykumar, 2021) Figure 2.

***H_{12}**: 4IRT based Value Chain Performance will positively influence FPO Business Performance.*

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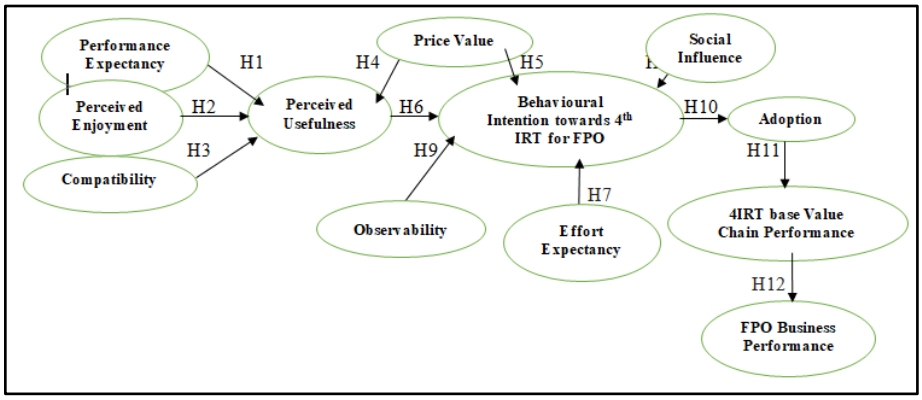

FIGURE 2
PROPOSED CONCEPTUAL FRAMEWORK

RESEARCH METHODOLOGY

The research study is descriptive research design with the purpose to investigate the possible factors that drive FPC's willingness to utilise 4IRT's for doubling farmers' income and sustainable growth. A survey on hundred FPOs heads in India through random sampling was conducted to examine the adoption attitude towards 4IRT using integrated model of Technology Acceptance Model (TAM), Diffusion of Innovation Theory (DoI) and Unified Theory of Acceptance and Use of Technology (UTAUT). The validation and test the proposed conceptual model and hypotheses, the structural equation modelling (SEM) technique was applied using Smart PLS software. The proposed model was analysed and evaluated using the SEM to do the path analysis. The instrument was developed after a thorough review of the literature on the three theoretical models employed in the study, as well as the scales used in key studies related to these theories. Collected data were tested for the current study to validate the hypothesized relationships and the proposed research model. As the research is quantitative in nature, a structured questionnaire was used. Google Forms was used to administer and contacted. This study's data was collected using a five-point Likert scale; with responses, ranging from strongly disagree to strongly agree (1 to 5). The standardisation of the measure is accomplished through the determination of reliability and validity. The factors (constructs) were validated using confirmatory factor Analysis through convergent and discriminant validity and the hypothesised was tested Panpatte & Ganeshkumar (2021).

RESULTS AND DISCUSSION

To understand the profile of the FPO in the study area, the designation, market coverage, how old is the FPO, land scale and FPO leader details are recorded from the sample population. The data collected variables are represented in the forms of tables are summarized below Table 1.

Table 1
PROFILE OF FPO ANALYSIS

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Profile of FPO Analysis N=100	%/ Mean(Std. Dev)
Distribution of FPOs in different regions	
Karnataka	70
Assam	30
Designation of the Respondent	
CEOs	81
Directors	8
Managing Directors	4
Chairmen	2
President	2
Board Members	3
Market Coverage	
Domestic Market	90
International Markets	0
Both	10
Time of Establishment	
Less than 3 years	47
More than 3 to 10 years	32
More than 5 to 10 years	20
More than 10 years	1
Number of FPO Members	729(872.12)
FPO Leader Details: Age	41(12.09)
Land Scale	
Less than 15 Ha	13
15 to 30 Ha	12
30 to 45 Ha	20
More than 45 Ha	55
FPO Leader: Education	
Uneducated	2
10^{th} standard	4
12^{th} standard	7
Graduation (UG)	56
Post-graduation	28
PhD	3
FPO Leader: Length of Service	
Less than 1 year	5
1 to 5 years	50
6 to 10 years	32
More than 10 years	13

Table 1 depicts that the majority of FPOs from the sample size are from Karnataka that is 70% (70 Samples) and remaining 30% (30 Samples) are from Assam state. This is because more FPOs are registered in Karnataka compared to Assam. The reason might be that Karnataka is larger in size and population compared to Assam so there are higher numbers of registered FPOs. It is observed from the table that most of the respondents of the FPOs are CEOs (81% of the sample) followed by Directors 8%, Managing Directors 4%, Chairmen 2%, President 2% and Board Members 3%. There are a greater number of CEOs among the respondents because, CEOs are jointly appointed by board members and supporting institutions of FPOs like NABARD, SFAC, KSDA, KSDH etc. They are technically sound and handle FPO communication with various agencies and are available for communication. The other designated people responded in the unavailability of CEOs FAO (2019) Hair (2009) Kumar Kakar (2017).

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It can be observed from the table that, the maximum number of members in the FPO is 6500, which can be said a great achievement by respective FPO because many FPOs found struggling to make 500 members or even some of them could not even reach the minimum standard fixed by government. The government fixes that FPOs should have a minimum of 300 members in plain area and 100 members in Northeast and hilly areas. As per our data, minimum number of members was found 300, which is very essential to avail any scheme for FPOs. The mean of the data is 729.24 because usually the FPOs will have the number of members between 500 and 1000. The standard deviation is 871.581. While this is a very high level of deviation from mean, most of them fall under 500-1000 category.

From the table, it can be interpreted that 90% (90 Samples) of the FPOs are covering only domestic market and only 10% (10 samples) cover both domestic and international markets. This may be because the FPOs majorly does agri-input business with the member farmers as their customers and output business of various commodities procured from farmers and traded in APMCs, local mandis, processing units, NCDEX, local wholesale buyers etc. There are only few FPOs who are dealing with commercial and cash crops, processed products that can be exported. Majority of the FPOs that is 47% (47 samples) from our study sample are established recently and they are less than 3 years old business followed by 32% (32 samples) which falls under more than 5 years to 10 years old category. The remaining FPOs fall under more than 3 to 10 years and more than 10 years old category as 20% (20 samples) and 1% (1 Sample) respectively. This is because, government of India aimed to establish 10000 FPOs as early as possible to promote collective farming and provide better market linkage to farmers so there are more newly established FPOs under the category of less than 3 years old Ganeshkumar et al. (2019) Foster & Rosenzweig (2011).

From the table it can be depicted that there are a greater number of FPOs covering higher land scale in their business that is more than 45 hectares which account for 55% (55 Samples) from our study sample followed by 20% (20 samples) which covers land scale of 30 to 45 hectares. Other FPOs covers less than 15 hectares and 15 to 30 hectares which accounts for 13% (13 samples) and 12% (12 samples) respectively. The FPOs have farmers as their members and the numbers of these members vary according to the age of FPO or the business operation volume of FPOs. There will be n number of members, as the greater number of members there will be larger land scale covered by the FPOs. It is found from the table that, the maximum age of the FPO respondent is 75 years and minimum age is 23 years. The mean is calculated and resulted as 40.75, and standard deviation is 12.091. Therefore, it can be said that the difference between youngest to oldest ages among respondents is very high and there are a greater number of mid-aged persons from our study sample. From our interaction during the data collection, it is found that the retired government officials took interest in collective farming schemes and helping out FPOs for their sustainable development by using their service experience Ganeshkumar et al. (2022).

From the table we can observe that majority of the FPO members are graduates which accounts for 56% (56 samples) from our study sample out of 100 samples followed by postgraduates accounting 28% (28 samples). Other qualifications include 12th standard, 10th standard, PhD accounting 7% (7 Samples), 4% (4 Samples), 3% (3 Samples) respectively. In addition, it is observed that 2% (2 samples) are not having formal education. The majority of graduates among the respondents are because, government made it mandatory for the CEOs of the FPOs to have minimum graduation as their qualification and our majority of respondents are CEOs. The other qualification respondents are board of directors, presidents, secretaries, or

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directors for whom the minimum education qualification has not been set by the government regulations.

It is observed from the table that, the majority of the FPO leaders fall under 1–5-year service category accounting 50% (50 Samples) and 32% (32 Samples) fall under 6–10-year service category. Others account for less than 1 year and more than 10 years as 5% (5 Samples) and 13% (13 Samples) respectively. There are more FPOs established recently and a greater number of FPOs fall under this young category so we can see majority of the respondents under 1-5-year category. Many members change their occupation and many FPOs have become non-functional so there is less number under more than 10 years category Kumari et al. (2021) Yu (2012).

The conceptual model was validated and analysed using Smart PLS 3.0. PLS SEM helps data analysis during the validation (Tsang, 2002). It was also used to assess data reliability and validity, including measurement and structural model. It was used to bootstrap our model for testing hypotheses and their relationship with independent and dependent variables Ganeshkumar (2020).

Measurement Model

Construct Validity was assessed using Cronbach's Alpha and Composite Reliability. For Convergent Validity, we look at Average Variance Extracted (AVE). These three characteristics are the most commonly used to assess the validity and reliability of data in the Confirmatory Factor Analysis Bagozzi & Yi (2012); Chin (1998); Mikhalkin and colleagues 2017; Rahi (2017). The observed AVE values are more than the threshold limit (0.5) and range from 0.671 (Value chain Performance) to 0.895 (Performance Expectancy) (Fornell & Larcker 1981). In addition, Cronbach alpha values are within the threshold limit (0.7) and range from 0.857 (Observability) to 0.986 (Value chain performance) (Hair et al. 1992; Hair, Black, Babin & Anderson, 2010) Figure 3 and Table 2-4 Hult et al. (2018) Vijayakumar (2021).

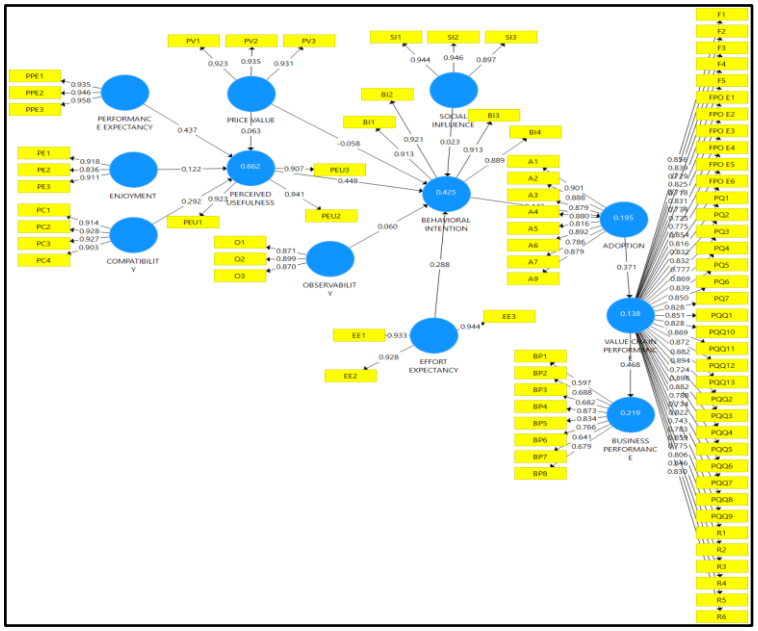

FIGURE 3
PATH ANALYSIS RESULTS

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Table 2
MEASUREMENT MODEL WITH FACTOR LOADING, VALIDITY AND RELIABILITY

Code	Variables	Factor Loading	Composite Reliability	AVE
	Perceived Performance Expectancy (PPE)			
PPE1	We feel that the 4IRT is useful in our FPO	0.931		
PPE2	Using the 4IRT enables us to finish our tasks more quickly in our FPO	0.93		
PPE3	Using the 4IRT increases our FPO efficiency.	0.936	0.962	0.895
	Perceived Enjoyment (PE)			
PE1	We think that using the 4IRT in our FPO is pleasant	0.9		
PE2	We think that using the 4IRT in FPO is exciting.	0.812	0.919	0.79
PE3	We think that using the 4IRT in our FPO is entertaining	0.904		
	Perceived Compatibility (PC)			
PC1	We believe that using the 4IRT in FPO is suitable for us	0.915		
PC2	We believe that using the 4IRT will fit our FPO operations	0.906		
PC3	We think that using 4IRT fits well with the way we like to work in FPO.	0.907	0.956	0.843
PC4	Using the 4IRT fits the way we like to do things in our FPO	0.89		
	Perceived Ease of Use (PEU)			
PEU1	Using the 4IRT will enhance the productivity of our FPO activities	0.92		
PEU2	Using the 4IRT will enhance effectiveness in FPO operations	0.936	0.946	0.853
PEU3	Overall, the 4IRT can be useful for our FPO operations	0.902		
	Price Value (PV)			
PV1	We are willing to buy the 4IRT even if its price is high	0.918		
PV2	We prefer to buy the 4IRT even if it is a little expensive for flagship 4IRT like Blockchain/AI etc.	0.931	0.95	0.864
PV3	We think that paying a little extra price for the latest 4IRT is worth spending.	0.919		
	Effort Expectancy (EE)			
EE1	We believe that using the 4IRT for our FPO is easy	0.927		
EE2	Learning ‘how to use’ the 4IRT for our FPO is easy for us	0.916		
EE3	We think that not much effort will be required in using the 4IRT in our FPO	0.942	0.954	0.875
	Social Influence (SI)			
SI1	Supply Chain Partners/ People (like farmers/society members customer and supplier) who are important to us, think that we should use the 4IRT in our FPO	0.937		
SI2	Supply Chain Partners / People who could influence our behavior think that we should use the 4IRT in our FPO	0.933		
SI3	Supply Chain Partners whose valuable opinions we consider, suggests us to use the 4IRT in our FPO since they are already using it.	0.883	0.95	0.863
	Observability (O)			
O1	We have had enough opportunity to see the 4IRT being used in our FPO.	0.887		
O2	It is easy for us to observe others using the 4IRT in their FPO	0.9		
O3	Supply chain partners can tell us that they know more about the 4IRT in FPO operations since they are already using it.	0.866	0.912	0.775
	Behavioral Intention (BI)			
BI1	We intend to use the 4IRT in our FPO as much as possible	0.913		
BI2	We intend to continue/proactive using new 4IRT in our FPO in the future	0.905		
BI3	We intend to upgrade my existing version and shift to the latest 4IRT available in the market	0.899		
BI4	We intend to buy the latest 4IRT in the future as a plenty of benefits/features are provided by them over the old version of 4IRT	0.889	0.95	0.827
	Adoption			

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A1	We will use the latest version of the 4IRT in our FPO as it is available in the market	0.88		
A2	We would update the latest version of 4IRT whenever we get a notification in the market and ads update.	0.859		
A3	We will use latest version of 4IRT in our FPO in future.	0.874		
A4	Farmers' Income will increase double when we adopt 4IRT in our FPO	0.86		
A5	FPO/FPC will get sustainable growth when we adopt 4IRT in our FPO	0.816		
A6	Our FPO are willing to adopt 4IRT	0.874		
A7	Our FPOs will adopt 4IRT	0.777	0.96	0.75
A9	We will recommend 4IRT to others FPOs for sustainable growth and income	0.875		
	Value Chain Performance			
	FPO Efficiency			
FPO 1	Less Production Costs	0.827		
FPO 2	Less Transaction Costs	0.76		
FPO 3	Less Transportation Costs	0.692		
FPO4	Optimal Inventory	0.764		
FPO5	Increase Sustainable growth	0.85		
FPO6	Doubling Farmers Income	0.797		
	Flexibility			
F1	Better Customer Satisfaction	0.845		
F2	Better Volume Flexibility	0.823		
F3	Better Delivery Flexibility	0.706		
F4	Better Backorder	0.823		
F5	Less Last Sales	0.72		
	Responsiveness			
R1	Better Order Fill Rate	0.754		
R2	Better Customer Response Time	0.843		
R3	Less Customer Complaints	0.758		
R4	Better Lead time	0.791		
R5	Less Shipping Errors	0.846		
R6	Less Product lateness	0.826		
	Product Quality			
PQ1	Good Appearance	0.808		
PQ2	Good Taste	0.817		
PQ3	Less Shelf Life	0.773		
PQ4	Good Salubrity/Nutrition	0.841		
PQ5	Better Product Safety	0.821		
PQ6	Better Product Reliability	0.829		
PQ7	Better Convenience	0.808		
	Process Quality			
PQQ1	Better Traceability	0.844		
PQQ2	Better Storage & Transport Condition	0.891		
PQQ3	Less Pesticide/ Chemical use	0.72	0.987	0.671
PQQ4	Good Promotion	0.895		
PQQ5	Good Working Conditions	0.874		
PQQ6	Less Energy use	0.767		
PQQ7	Less Water Use	0.719		
PQQ8	More Re-use	0.803		
PQQ9	Less Pesticide use	0.726		
PQQ10	Less Emissions	0.834		
PQQ11	Better Client Services	0.855		
PQQ12	Better Awareness in Retail/Supermarket/End Customer	0.851		

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PQQ13	Increase Employees Creativity	0.876		
	FPO Business Performance			
BP1	Market share	0.685	0.898	0.527
BP2	Sales growth	0.655		
BP3	Profit margin	0.641		
BP4	Overall product quality	0.882		
BP5	Overall competitive position	0.827		
BP6	Average selling price	0.746		
BP7	Return on investment.	0.698		
BP8	Return on sales	0.632		

Table 3
DISCRIMINANT VALIDITY

Variables	Adoption	Behavioral Intention	Business Performance	Compatibility	Effort expectancy	Enjoyment	Observability	Perceived usefulness	Performance expectancy	Price value	Social influence	Performance
Adoption	0.866											
Behavioral intention	0.441	0.909										
Performance	0.292	0.388	0.726									
Compatibility	0.31	0.524	0.319	0.918								
Effort Expectancy	0.172	0.509	0.253	0.52	0.935							
Enjoyment	0.275	0.506	0.289	0.783	0.512	0.88						
Observability	-0.024	0.413	0.308	0.439	0.611	0.40	0.881					
Perceived Usefulness	0.45	0.597	0.374	0.741	0.475	0.68	0.445	0.924				
Performance Expectancy	0.382	0.446	0.297	0.723	0.286	0.68	0.38	0.758	0.946			
Price value	0.086	0.425	0.185	0.604	0.724	0.61	0.613	0.499	0.424	0.93		
Social Influence	0.332	0.49	0.304	0.554	0.574	0.57	0.559	0.679	0.567	0.63	0.929	
Performance	0.371	0.543	0.468	0.572	0.326	0.74	0.38	0.652	0.648	0.43	0.542	0.819

Table 4
HETERO-TRAIT MONO-TRAIT RATIO (HTMT) VALIDITY

Variables	Adoption	Behavioral Intention	Business Performance	Compatibility	Effort Expectancy	Enjoyment	Observability	Perceived Usefulness	Performance expectancy	Price Value	Social Influence	Performance
Adoption												
Behavioral intention	0.465											
Business Performance	0.371	0.305										
Compatibility	0.324	0.558	0.2									
Effort Expectancy	0.186	0.539	0.212	0.558								
Enjoyment	0.298	0.564	0.175	0.869	0.575							
Observability	0.072	0.447	0.258	0.482	0.689	0.46						
Perceived Usefulness	0.48	0.646	0.257	0.797	0.518	0.77	0.504					
Performance Expectancy	0.396	0.474	0.169	0.768	0.308	0.76	0.415	0.816				
Price value	0.108	0.451	0.187	0.644	0.785	0.68	0.68	0.533	0.448			
Social Influence	0.356	0.525	0.228	0.596	0.618	0.64	0.631	0.74	0.611	0.67		
Performance	0.369	0.565	0.269	0.586	0.346	0.80	0.413	0.684	0.669	0.45	0.568	

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From Table 3, the square root of each variable's AVE is calculated, and discriminant validity is tested. According to the Fornell Lacker Criterion, this value should be higher than the correlations with other factors to achieve the required DV (Huit et al. 2018; Mikhalkin et al. 2017; Rahi (2017). Table 4 presents these values that are greater than the off-diagonal correlations, showing discriminant validity Slade et al. (2015). The Heterotrait – Monotrait Ratio is another approach to assess discriminant validity (HTMT). Table 2 provides HTMT values that are found to have a higher specificity and sensitivity rate than cross loading and the Fronell – Lacker criterion (97 percent to 99 percent). If the HTMT readings are close to 1, it means discriminant validity is lacking.

Structural Equation Model (SEM) Analysis

The model consists of 12 hypotheses that are validated using SmartPLS 3.0. The model was examined, and the hypothesis' p-value was calculated ($p<0.05$). It was examined using the bootstrapping standard, which involved calculating t-statistics to determine the significant p-value. Table 3 provides t-statistics, p-value of significant observations and hypothesis related decisions Table 5 and Figure 4.

Table 5
RESULTS OF HYPOTHESIS TESTING

Hypothesis Relationships		Path Coefficient	T Statistics	P-Value	Decision (Hypothesis)
H11	Adoption-> Value Chain Performance	0.371	3.317	0.001	Accepted
H9	Behavioral intention -> Adoption	0.442	3.923	0	Accepted
H3	Compatibility-> Perceived Usefulness	0.292	2.231	0.026	Accepted
H6	Effort Expectancy -> Behavioral Intention	0.288	2.201	0.028	Accepted
H2	Enjoyment -> Perceived Usefulness	0.122	0.863	0.388	Rejected
H8	Observability -> Behavioural Intention	0.06	0.514	0.607	Rejected
H10	Perceived Usefulness -> Behavioral Intention	0.448	3.312	0.001	Accepted
H1	Performance Expectancy -> Perceived Usefulness	0.437	3.626	0.00	Accepted
H5	Price Value -> Behavioral Intention	-0.058	0.454	0.65	Rejected
H4	Price Value -> Perceived usefulness	0.063	0.638	0.523	Rejected
H7	Social Influence -> Behavioral Intention	0.023	0.139	0.889	Rejected
H12	Value Chain Performance -> FPO Performance	0.468	3.045	0.002	Accepted

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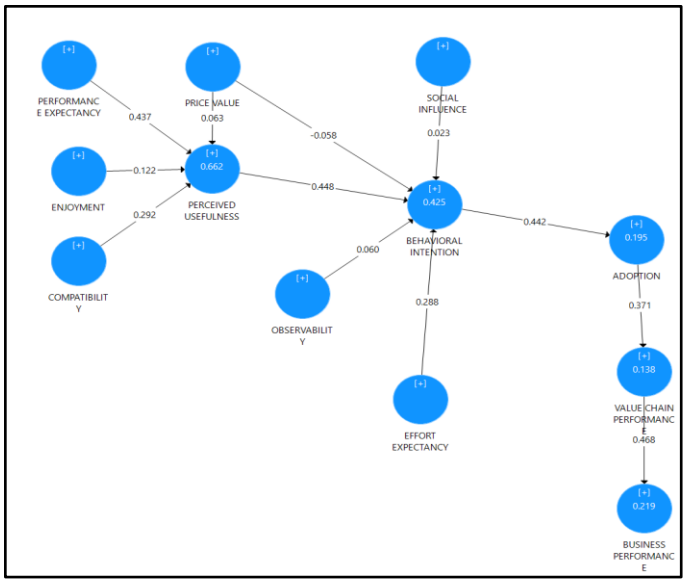

FIGURE 4
HYPOTHESIS TEST RESULT

Figure 4 shows the path coefficients levels which are used for hypothesis testing. H1 proposes Performance Expectancy -> Perceived Usefulness; which is accepted as the values are significant. H2 (Enjoyment -> Perceived Usefulness) is rejected as the effect is insignificant. H3 (Compatibility -> Perceived Usefulness) is accepted with the significance value of 0.026. H4 & H5 (Price Value -> Perceived Usefulness) and (Price Value -> Behavioral Intention) are rejected due to the insignificant values. H6 (Effort Expectancy -> Behavioral Intention) is accepted with the significance value of 0.028. H7 (Social Influence -> Behavioral Intention) is rejected since the effect is not significant. H8 (Observability -> Behavioral Intention) is also rejected because of the insignificant values. H9 (Behavioral Intention -> Adoption) is accepted due to significance at 0.00 level. H10 (Perceived Usefulness -> Behavioral Intention), is also accepted with the significance value of 0.001 which is less than the threshold value of $p<0.005$. H11 (Adoption -> Value Chain Performance) is accepted with same significance value of 0.001. H12 (Value Chain Performance -> FPO Business Performance), is accepted with a 0.002 significance level. Of the 12 hypotheses, 7 hypotheses have been accepted and 5 have been rejected. Perceived usefulness has a strong influence on behavioural intention. If FPO perceived greater usefulness with use of 4IRT in their activities, they will tend to adopt these technologies. Alalwan et al. (2014); Hoque & Sorwar (2017); Martins et al., 2014; Riffai et al., 2012; Venkatesh et al., 2003; Yu, 2012; Zhou et al. (2010). Performance expectancy is directly related to the perceived usefulness and indirectly supports the behavioural intention of 4IRT. FPO performance was perceived to increase with use of 4IRT and due to its effect on organisational efficiency. Perceived enjoyment does not have a significant impact on perceived usefulness and therefore does not impact behavioural intention towards 4IRT. This construct is used to understand whether FPOs liked using 4IRT Curran & Meuter (2007). While they were excited to use 4IRT in their FPO but needed some support. The fourth construct is compatibility, which has positive significant relation with the perceived usefulness, and it indirectly supports behavioural intention. This finding is consistent with adoption of technology as observed in earlier studies Mehra et al. (2021), Putzer & Park (2010) and Park and Chen (2007). It gives us the insight that the FPOs believe in using technology which

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will fit their operations.

Price-value as a construct is related to perceived usefulness and behavioural intention, but relationship is not significant. The construct used for analysing whether these FPO are willing to pay higher amount for 4IRT, and it is found that they are willing to pay higher price for 4IRT, if they are useful for the FPO and they want to invest in technologies like blockchain/AI. The FPO's are willing to look at the opportunities to use 4IRT and the construct observability is not significant with the behavioural intention. But the previous studies give us the insights that the construct observability is significant with the behavioural intention (Yang and Forney (2013), Zhou et al. (2010), and Yu (2012).). The FPO's are observing that other FPOs are using the technology which paves way for them to use the technology, but they are hesitating to invest to money in technology. Social influence is one of the prime factors in UTAUT model in order to analysis that whether FPOs are being attracted by the social factor like close people recommended to use the technology. Social influence does not significantly influence behavioural intention Yadav et al. (2016), Kim et al. (2016). Supply chain partners however have been influencing FPO's to adopt 4IRT. Effort expectancy is found to have significant positive influence on behavioural intention and this finding is consistent with other studies like Gao et al. (2015a), Gao et al. (2015b), and Choudrie et al. (2014). The use of latest 4IRT technology in FPOs will not require higher effort to implement or adopt these technologies.

Behavioural intention strongly and significantly influences adoption, adoption construct, it contributes to the value chain performance and FPO performance which shows the positive impact that this adoption is significant with FPO performance. It explains that they will produce higher quality of product which will eventually be promoted to higher scales. Hence, the result perceived usefulness and effort expectancy are significant to the behavioural intention, which means that the FPOs are willing to use the technology, but they are not fully into it. But performance expectancy and compatibility are indirectly supports the FPOs to adopt the technology, which will eventually increase the chances of using 4IRT. But perceived enjoyment is not supported because, people are not enjoying the new technology, as they want to upgrade themselves in the FPOs level. Observability and price value are being affected because of the lack of opportunities the FPO find to adopt and because of that they are not willing to pay higher price for technology to use. Figure 4 depicts the detail model mentioning the loadings of the item-linkages with the constructs.

MODERATION: MULTI GROUP ANALYSIS

Henseler et al. (2016) and Hair et al. (2017) recommended doing a measurement invariance test before conducting Multi Group Analysis (MGA) when employing SEM analysis. Henseler et al. (2016) suggested using composite measurement invariance for PLS-SEM (Measurement Invariance Assessment-MICOM). Because MICOM is a composite-based analytic tool, it is a better fit for PLS-SEM. Invariance measurement testing is required for comparing and evaluating group-specific differences. With the use of SmartPLS for multi group analysis, the measurement of invariance was done by applying MGA outer loadings factor as the data here used is reflective factors. With the use of PLS-MGA, which shows the outer loading differences, with the help of these difference, we see the p-values which should be more than 0.05. And if some variables have less than 0.05, then it will be deleted in order to load the MGA. So, in the study we have removed 4 variables from the model in order to analysis MGA. Those outer loadings differences are in negative, and their p-values are less than 0.05, which has to higher than 0.05, in order to perform the multi group analysis. Henseler's MGA compares each of the bootstrap samples' group-specific bootstrap estimates. In Henseler's MGA approach, a p-value of less than 0.05 or greater than 0.95

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indicates significant differences in specific route coefficients between two groups at the 5% level (Henseler et al., 2009; Sarstedt et al., 2011) Table 6.

Table 6
OUTER LOADINGS-DIFFERENCE AND P-VALUE

Variables Relationships	Outer Loadings-diff	p-Value new
PC4 <- Compatibility	-1.74	0.003
PQ1 <- Value Chain	-0.187	0.017
PQ6 <- Value Chain	-0.187	0.038
PQ4 <- Value Chain	-0.148	0.041

Table 5 indicates which components are significant in its regional impact and which are not. The results revealed that four factors are significant across India and rest of the factors are not significant. Perceived Usefulness -> Behavioral Intention, Social Influence -> Behavioral Intention, Adoption -> Value Chain, Behavioral Intention -> Adoption are significant with p-values less than 0.05, which implies that region has effect on 4IRT implementation among FPOs Table 7.

TABLE 7
PATH COEFFICIENTS -DIFFERENCE AND P-VALUE

Variables Relationships	Path Coefficients-diff	p-Value new
Perceived Usefulness -> Behavioral Intention	0.565	0.015
Social Influence-> Behavioral Intention	-0.787	0.015
Adoption -> Value Chain Performance	0.6	0.021
Behavioral Intention -> Adoption	0.479	0.031
Effort Expectancy -> Behavioral Intention	-0.43	0.059
Compatibility -> Perceived Usefulness	0.608	0.082
Value Chain -> Business Performance	-0.245	0.297
Performance Expectancy -> Perceived Usefulness	-0.254	0.352
Observability -> Behavioral Intention	0.185	0.413
Price value -> Behavioral Intention	0.17	0.479
Price value -> Perceived Usefulness	-0.143	0.499
Enjoyment -> Perceived Usefulness	-0.156	0.644

Karnataka is one of India's developed states with technology as a prime focus. Its capital Bangalore is also known as the Silicon Valley of India. So, for FPOs in and around Karnataka would find technology adoption easy and find technology skilled labour. FPOs may find it useful in various aspects such as reducing middleman or introduce traceability and many more. Assam is still a developing state and known for its tea production. While they could implement 4IRT in agriculture, they might have constraints due to geography specifically terrain and adequate manpower. FPOs need to understand the macro environment before their decision to adopt 4IRT implementation through their organisation.

CONCLUSION AND MANAGERIAL IMPLICATIONS

This study was successful in establishing the perfect model for FPOs to adapt and embrace 4IRT. Moreover, the study has clarified FPO factors that aid in understanding the FPO's attitude toward the adoption of FIRT and, as a result, influence the FPO's business performance.

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Performance Expectancy, Perceived Enjoyment, and Compatibility as Perceived Usefulness components; Price Value, Effort Expectancy, and Observability for determining their influence on behavioural intentions; and finally, adoption. Perceived Usefulness has a precursor in the form of Price Value. For these factors, the study presents a standardised set of instruments. After a thorough examination of each variable with behavioural aim, hypotheses were proposed. As a result, the study provides a validated and comprehensive list of references that can be used in future studies and serve as a solid foundation for research. The report includes a list of various technology adoption models and their expansions, which can help researchers to understand the topic. Managers can be benefitted from the study with the followings - Most FPOs want to continue or proactively use 4IRT technology in their operations. Price, member likeliness to use technology i.e., most of the FPO's members are farmers who find it difficult to understand the latest technology, so the managers who knows about the technology need to educate FPO's members. This can be done using easy to understand live demonstration of the use of technology.

In the same way, most of the FPOs are want to upgrade their technology but they have little knowledge on the latest technology, here managers from the technological companies should addresses the FPOs who are in need to upgrade and they should provide constant support to the FPOs till the technology is fully operated by the FPO's employees. Most of the FPOs believe that 4IRT helps them in successfully operates the operations in their organisation. Therefore, the managers from technological companies should address what type of operation in FPOs being carried out, which will be easily sorted out by the current technology. Mostly the technology should be useful to the FPO in one or another way, by means of addressing their needs. By giving them training and trail version of the technology, they can be habitual with the technology and once, they are master in that, they can adopt in all the operations needed.

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