

Adoption of IoT in Agriculture

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Abstract

One of Malaysia's top dairy companies, Farm Fresh, has harnessed the Internet of Things (IoT) to improve efficiency and streamline its agricultural operations. Farm Fresh desires to raise the bar for sustainable and effective dairy production by incorporating IoT technology into every facet of farming, from animal management to crop monitoring. Farm Fresh has been able to maximize resource use, save waste, and boost productivity throughout its operations thanks to the implementation of IoT. The firm has been able to provide consumers with high-quality dairy products while also promoting sustainable agricultural techniques through the utilization of data and technology. IoT-powered smart agricultural solutions will be essential to supplying the growing worldwide need for food while fostering environmental sustainability as the world's population continues to rise. Other farming businesses hoping to embrace the future of farming and spur innovation in the sector might learn from Farm Fresh's effective IoT integration.

1. Introduction

In line with the emergence of new technologies, it is important for the city citizens to live in a resilient and sustainable environment (Wolfert *et al.*, 2017). The Internet of Things (IoT) is a system of interconnected devices that exchange data without human intervention, posing potential regulatory, privacy, and data security challenges for government (Allmendinger, 2020). Urban agriculture offers a promising opportunity for critical geographers to explore sustainability, health, and alternative urban life models, while addressing key questions in urban planning, landscape, and cultural studies (Tornaghi, 2014). IoT has brought significant changes to the agricultural sector, enabling smart farming practices that increase productivity, reduce waste, and optimize resource utilization (Xu *et al.*, 2022). Agriculture is integrating the (IoT) to increase production, sustainability, and efficiency. It entails gathering data in real time on crop health, weather patterns, animal monitoring and soil characteristics. Farmers are able to increase crop yields, minimize waste, maximize resources consumption, and make well-informed decisions thanks to these data-driven insights. Adoption of IoT also makes precision agricultural methods possible, enabling farmers to automate chores, apply targeted inputs, and monitor and manage their farms with accuracy. The use of intelligent agricultural techniques optimizes processes, minimize human effort and boosts output in an environmentally friendly way. The demand for enhanced decision-making procedures, more effective agricultural techniques, and environmental flexibility is what's driving the adoption. By integrating sensors, connectivity, and data analytics, IoT systems can monitor various aspects of farming, such as soil conditions, crop growth, livestock health, and weather patterns (Dhanaraju *et al.*, 2022). Urban farming is the practice of cultivating plants surrounding cities to provide food for the local people, according to Kulak *et al.* (2013). In low-income areas, urban agricultural operations can increase food security (Rurangwa & Verdegem, 2014). Smart Farming Technologies in Malaysia can boost crop and livestock production, improve quality, control

resource usage, and ensure sustainability, but require further research to connect technologies and data for automated decision-making strategies (FAMA, n.d.). In 2010, Loi Tuan Ee established Farm Fresh Sdn. Bhd., a dairy firm based in Malaysia. The firm makes fresh milk-based goods free of artificial coloring and preservatives. After first encountering difficulties such as blood parasites in cows and logistical problems, the firm grew by purchasing two dairy farms and a processing facility in Australia. Because of this, the firm was able to launch new brands like Henry Jones and Yarra and manufacture milk of the highest caliber. Distributing Farm Fresh products across local communities is made possible by the Farm Fresh Home Dealer Network, an inventive distribution strategy that gives micro-entrepreneurs many of whom are women more authority. In order to guarantee the highest standards of food safety and animal welfare, the firm has obtained certifications such as Certified Humane Raised and Handled, myGAP, GMP, and HACCP. The core values of the business include generating naturally nutritious dairy products, stressing the value of healthy cows, protecting the environment, and offering the finest dairy to clients (Farm Fresh Malaysia, n.d.).

In developed nations, IoT technology offers numerous applications in lifesaving, smart cities, agricultural, and industrial fields, but faces challenges in security and protocol development (Balaji, Nathani & Santhakumar, 2019). Additionally, IoT may aid in the transformation of the agriculture sector and assist farmers overcome obstacles like a lack of water, a paucity of available land, and easily managed crops. With sophisticated industries and smart cities, the benefits of IoT can impact global living (Halgamuge *et al.*, 2019). IoT smart agriculture tools applied to farming practices use AI to regulate resources used such as water, pesticides and fertilizers, and reduce on diseases affecting crops and pests affecting crops (Qazi, Khawaja, & Farooq, 2022). An estimated 60% of Malaysia's food is imported, and the country's population has been facing a decline in standard of living owing to the weakening ringgit and rising food costs brought on by interruptions in the global supply chain. This is particularly noticeable when it comes to the increased cost of necessities. Food imports into Malaysia reached a value of over 75.71 billion Malaysian ringgit in 2022, up from 63.65 billion the year before. Despite a fall in 2018, the value of food imports has been rising consistently since 2012 (Govind, 2023). Malaysia has always been dependent on imported vegetables and fruits because our own production cannot fulfill the needs of the local market (Food Security and Unsustainable Agriculture in Malaysia, n.d., 2022). Farm Fresh gross profit margin decreased by 3.4 percentage points, from 27.2% in FY2022 to 23.8% in FY2023, even though gross profit climbed by 10%, from RM136.3 million in FY2022 to RM149.7 million in FY2023. Reduced gross profit margins were caused by a number of external variables, such as rising labor, agricultural, and raw material expenses as well as the devaluation of the ringgit relative to the US dollar (The Farm Fresh- Integrated Annual Report, 2023).

The current research is motivated by two objectives, which is to examine the level of intention towards IoT adoption in agriculture sector and to identify the relationship between the influencing factors and IoT intention of adoption in agriculture sector. The target sample for this research is the people that work in Farm Fresh in Desaru, Johor Bahru because they have the biggest farm in Malaysia and most technology use. Hence, this research is to determine relationship between the influencing factors and IoT intention of adoption in urban farming. The respondents of survey targeted in this research are the people working with the IoT in the Farm Fresh. The government, in particular, should take note of this study's important recommendations for encouraging and supporting urban farming in Malaysia. Secondly, this research will encourage farmers to employ modern agricultural techniques. Furthermore, it makes it easier for future researchers to learn more about the significance of cultivation and current technology, and it may also be put into practice. Additionally, this work has the potential to become an invaluable reference for scholars.

2. Literature Review

2.1 Internet of Things (IoT)

Research on the Internet of Things (IoT) is ongoing, making it one of the fastest-growing fields in the world (Othman Mohammed Salih *et al.*, 2022). The Internet of Things is a computing concept that connects computer networks (Singh, 2020). Through the integration of the physical and digital realms, the Internet of Things (IoT) transforms routine activities and routines. It does housework, increases safety, and keeps an eye on senior citizens. IoT applications improve efficiency and style in a variety of industries, including industrial, environmental, healthcare, infrastructure, resource management, and energy use (Munoth *et al.*, 2022). By connecting items to the internet, the Internet of Things (IoT) allows them to interact with one another and react to changes in their surroundings. The seamless integration of digital and physical interactions has been made possible by advancements in communication technologies, sensing devices, and microcontrollers (Khelloufi *et al.*, 2023). According to Villamil, Hernández, and Tarazona (2020), the internet of things technology offers potential security, processing capacity, and data mobility, all of which contribute to improved corporate and industrial performance as well as an improved quality of life.

2.2 Internet of Things (IoT) and Agriculture

The Internet of Things (IoT) is a network of interconnected computing devices that computerize devices equipped with unique IDs and the ability to share data throughout an organization without requiring human intervention (Halgamuge *et al.*, 2019). To meet food security goals and objectives and promote social and economic development, Malaysia should coordinate its agricultural and food security policies (Sani, Osman, Saari & Idrus, 2022). By making objects into intelligent gadgets and giving end users rapid updates, the Internet of Things has had a huge impact on precision agriculture (Khanna & Kaur, 2019). By enhancing production efficiency and product quality, Internet of Things technology in modern agriculture eventually helps farmers and advances intelligent, scientific, and effective agriculture (Chen & Yang, 2019). According to laws and regulations, land usage for agricultural production, research, training, and infrastructure installation are all included in the broad and narrow definitions of agriculture (Stefan, 2018). In order to meet population demands and maintain environmental sustainability as well as food security, sustainable agricultural methods are crucial. They place a strong emphasis on organic, holistic, and environmentally friendly farming practices (Arora, 2018). Information technology is used in agriculture (IoT) to gather data, enhance precision agriculture, and improve agricultural methods (Abbasi, Yaghmaee, & Rahnama, 2019). Using blockchain technology, IoT in agriculture improves sustainability and product quality while monitoring soil, environment, and crops. It also provides prescription maps for automated device and equipment operation (Vieri *et al.*, 2020). Pricing value, trust, hedonic motivation, government support, effort and performance expectations, facilitating conditions, and price are some of the elements that affect the adoption of IoT in agriculture (Shi *et al.*, 2022).

2.3 Behavioral Intention to Adopt

Research on the purpose of IoT in urban farming has been done infrequently. A few things, particularly the social effect, will affect how widely adopted the internet of things becomes. Social impact is crucial in the early stages of the adoption process for the internet of things. Trust (2018) posits that the intention to adopt the internet of things may be influenced by elements related to perceived usefulness and simplicity of use. Subjective norms, perceived utility, perceived behavioural control, and attitude toward adoption are the primary elements influencing adoption intentions, according to Jurkenbeck *et al.* (2019).

2.4 Perceived Usefulness and Adoption Intention

Perceived usefulness, according to (Ambalov, 2021), is a multidimensional construct that accurately captures the complexity of contemporary IT systems, enabling more precise explanations and predictions of IT usage. IoT platforms and big data sets can be used to create a smart decision-making system that enhances real-time farming decisions while minimizing environmental impact (Cambra-Baseca *et al.*, 2019). By monitoring important data like humidity, soil quality, and air temperature and supporting efficient planning and irrigation, IoT adoption in agriculture increases yields, efficiency, and sustainability (Sekharamantray *et al.*, 2022). IoT applications in smart agriculture have the potential to boost efficiency and production, which will boost the sector's economy (Kaushik & Prakash, 2021).

H1: There is significant relationship between perceived usefulness and behavioral intention to adopt.

2.5 Perceived Behavioral and Adoption Intention

According to the study, one of the main factors impacting farmers' intentions to use IoT technologies for vegetable farming is perceived behavioral control, which is defined as their level of information technology knowledge, expertise, and experience. Farmers who feel more in control of their conduct are more likely to plan to use IoT technologies in agriculture (Li *et al.*, 2024). According to the study, farmers' intentions to employ IoT in agriculture are highly influenced by their perception of behavioral control. Perceived behavioral control is the second most important predictor behind attitude, suggesting that farmers' perceptions of the ease or difficulty of adopting ICTs have a major impact (Ali *et al.*, 2020).

H2: There is significant relationship between perceived behavioral and behavioral intention to adopt.

2.6 Attitude Toward Adoption and Adoption Intention

An individual's goals, feelings, and beliefs about a certain object, person, or situation are characterized by their attitude. It has a big influence on people's decisions, deeds, and intentions when it comes to accepting new technology like the Internet of Things. Understanding attitudes is essential for researchers, governments, and businesses to develop strategies that address user concerns, boost confidence, and promote widespread Internet of Things use (Lafontaine *et al.*, 2021). The study found that the intention of vegetable farmers to use IoT

technology is a strong predictor of their actual adoption behavior, further supporting the relationship between attitude and behavioral intention (Li *et al.*, 2024).

H3: There is a significant relationship between attitude toward adoption and behavioral intention to adopt.

2.7 Research Framework

The study of Jurkenbeck *et al.* (2019) has an impact on the process of conceptualizing the research framework and factors that lead to intention of adoption. The elements that influence vertical farming's inclination to adopt new technologies have been covered in their study. Jurkenbeck *et al.* (2019) have embraced TAM and TPB theory to explain this situation. In this study, TAM will be utilized to elucidate the perceived utility of technology. In this study, however, the attitude toward adoption and perceived behavior control will be explained by TPB. The research framework's (refer Fig. 1) primary goal is to illustrate its key elements, which include the study's independent and dependent variables. This study has one dependent variable which is intention to adopt and three independent variables which are perceived usefulness, perceived behavior control and attitude toward adopt will be further elaborated.

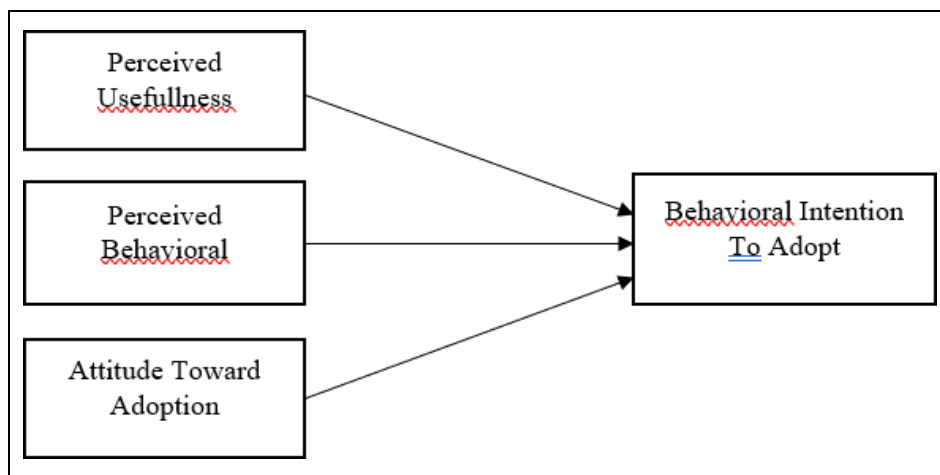


Fig. 1 Research Framework

3. Research Methodology

This research aims to examine the level of intention towards IoT adoption in agriculture sector. In order to determine the degree of intention for IoT adoption in the agriculture sector and analyze the link between influencing variables and IoT intention of adoption, quantitative approaches were employed in this study. When employing quantitative methods, the objective is to gather numerical data from a sizable sample in order to apply statistical techniques to identify trends, linkages, or patterns. In order to ensure that the respondents have the necessary knowledge and insights, this method involved gathering data from Farm Fresh personnel who have direct experience with IoT. Determining how technological advancements impact operational metrics and general workplace dynamics is the main goal. The research process is shown in Figure 2. The technique used to obtain and compile research data is called instrument study. One of the quantitative method's instruments for obtaining structured data from respondents is the questionnaire. The structure of the questionnaire that was given to the respondents is closed-ended. There are two sections on the questionnaire: section A and section B. The respondents' backgrounds will be discussed in Section A. The question on adoption intention will be posed in Section B. The act of gathering data and arranging it into the appropriate information in order to determine the appropriate information is known as data collection. The information that the researcher gathers in order to address every query is known as data. Primary and secondary data are the two categories of data that are gathered during the procedure. Primary data are those that are directly gained or gathered through surveys, observations, or interviews. In order to get information from respondents, this study uses observations and questionnaires as its major data sources. Employees at Farm Fresh who utilize and collaborate with IoT were asked to complete questionnaires. All of the questionnaire's questions must be answered by respondents using their own experiences. Additionally, the researcher observed how employees at the Farm Fresh facility interacted with IoT. Data gathered from sources other than primary research is referred to as secondary data. One can find secondary data from a number of sources, including books, journals, articles, and websites. In order to get pertinent support for the research being conducted, the researcher employed a number of publications, journals, and websites in this study. IBM SPSS statistics version 27 has been used to examine all findings and accessible data. Only users

with prior IoT work experience were included in the surveys given to Farm Fresh employees, and no other data was collected. To get correct findings, the researcher employed regression analysis, correlation analysis, normality testing, descriptive analysis, and reliability analysis.

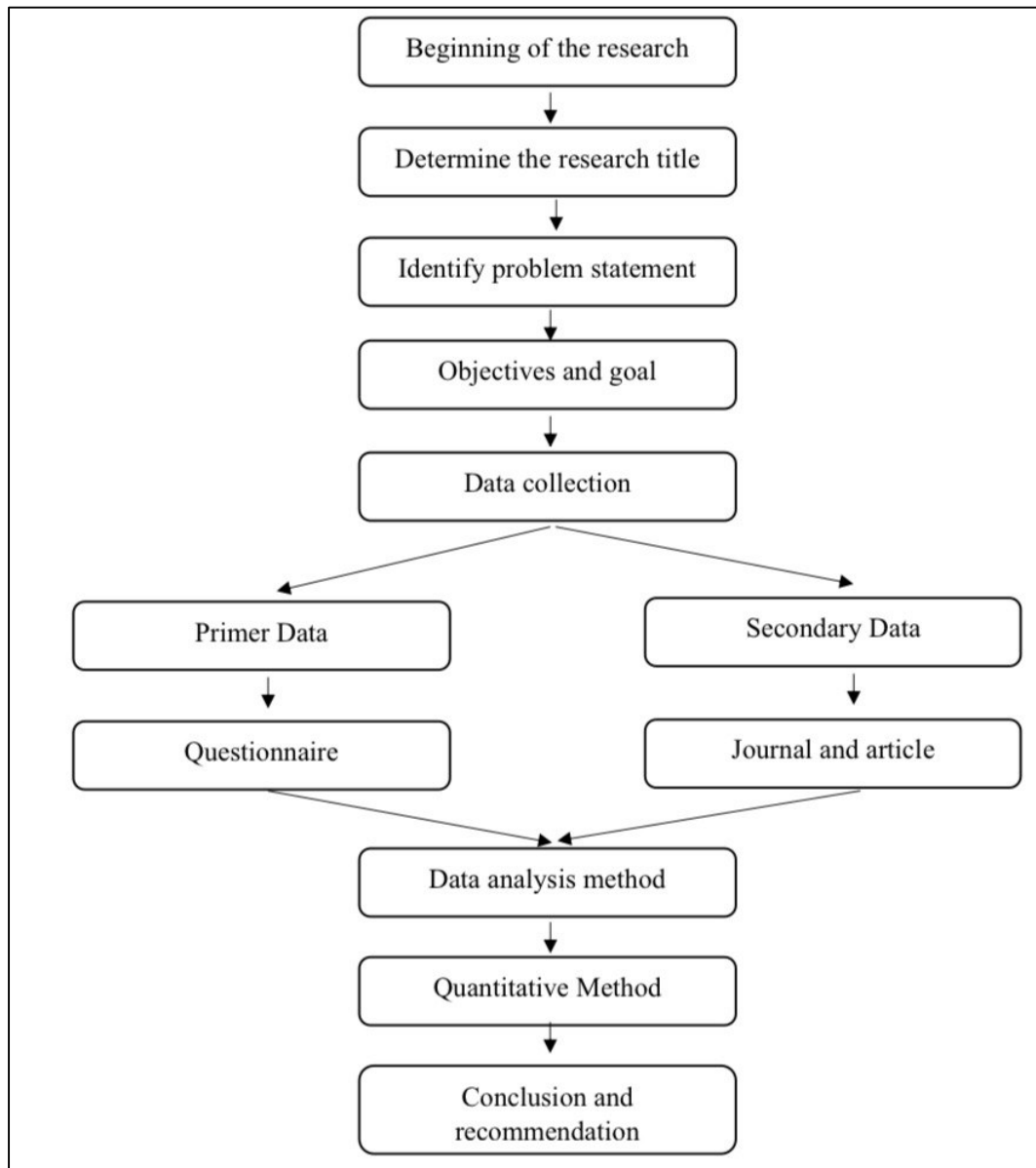


Fig. 2 Research Flowchart

4. Results and Discussion

4.1 Response Rate

The research focuses on case study analysis of the extent of use of IoT technologies in the agricultural industry as practiced at Farm Fresh Desaru in Johor Bahru, Malaysia. The study objectives are to identify IoT usage drivers that will make employees in the IoT department to use IoT as intended regarding perceived usefulness, perceived behavioral control and perceived attitude toward IoT usage. Out of 150 employees to whom the structured questionnaire was administered, a response rate of 71.33% was received (refer Table 1). The survey conducted provided useful information which was analyzed using SPSS software in order to realize change in the agricultural environment. To this end, the study seeks to establish the experience, challenges, successes and prospects of Internet of Things (IoT) in agriculture.

Table 1 Response Rate

Sample	Questionnaire Distributed	Questionnaire Returned	Percentage (%)
150	150	107	71.33 %

4.2 Reliability Analysis

In the reliability test done for the study on the adoption of IoT in agriculture at Farm Fresh Desaru, Johor Bahru, 107 respondents were estimated depending on Cronbach’s Alpha coefficient. The results proved a high reliability in the independent factors where Cronbach alpha value of Perceived Usefulness and Perceived Behavioral Control were 0.960 and 0.975 respectively, and the Attitude Towards Adoption had the value of 0.967. These results are above the acceptable limit of 0.70 thus making the items in the questionnaire relevant and aligned to the research objectives of the study. Also, on the reliability test, the dependent variable, Intention to Adopt, gave a good result of 0.947, which gives more validity to the measurement instruments that were used in this study. Therefore, the outcome of the reliability analysis supports the application of the survey items in determining the perception of the respondents concerning IoT adoption in agriculture.

4.3 Demographic Analysis

Socio-demographic data was collected through questionnaires from 107 participants in Farm Fresh Desaru and in relation to a broad range of factors that could impact on the adoption of IoT in agriculture. These includes gender, age, race and working experience as part of the analysis done in this study. The gender distribution of participants was also slightly more female with 43% of respondent male and 57% female. From the respondents’ age distribution, the majority of respondents fall within age bracket of 26-35 years and 36-45 years, both of which accounted for 28% of the total respondents. The racial distribution revealed the percentage whereby the largest group was Chinese 43.9%, followed by Malay 31.8%, Indian 24.3%. In this study working experience of the respondents was middle: 37.4% of respondents had working experience between 1-5 years while 36.4% had working experience between 6-10 years and only 26.2% had working experience between 11-15 years. Based on the findings described in this demographic profile, some assumptions have been made relating to the respondents’ views and perceptions towards the adoption of IoT in agriculture hence their background plays an important role in their response to the survey.

4.4 Normality Test

The normality test carried out in the study intended to check the nature of data regarding the usage of IoT in farming at Farm Fresh Desaru. Shapiro-Wilk test and Kolmogorov-Smirnov (refer Table 2) test were used and results showed that both Perceived Usefulness and Perceived Behavioral Control, Attitude Towards Adoption, and Intention to adopt were also insignificant at 0.05 level, thus confirming that the samples do not follow normal distribution. Furthermore in Table 3, the obtained means of skewness were negative for all the elements, which pointed to the leftward skewing of the distribution and the obtained means of kurtosis pointed to flatter distribution with lighter tale. Due to this non normality, the study proceeded to use the Spearman correlation approach to help analyze the inter-variable relativity. This assessment shows the importance of translating the choice of methods for analyzing most of the data to call for precaution.

Table 2 Kolmogorov-Smirnov and Shapiro-Wilk test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Perceived Usefulness	.381	107	<.001	.651	107	<.001
Perceived Behavioral Control	.312	107	<.001	.751	107	<.001
Attitude Towards Adoption	.407	107	<.001	.660	107	<.001
Intention to Adopt	.431	107	<.001	.608	107	<.001

Table 3 Skewness and Kurtosis test

	Skewness		Kurtosis	
	Statistics	Std. Error	Statistics	Std. Error
Perceived Usefulness	-1.241	.234	-.171	.463
Perceived Behavioral Control	-1.027	.234	-.523	.463
Attitude Towards Adoption	-1.210	.234	-.252	.463
Intention to Adopt	-1.202	.234	-.313	.463

4.5 Descriptive Analysis

The descriptive analysis done (refer Table 4) in the study offered an understanding of the perception that the respondents had about the usage of IoT in agriculture. When respondents' answers were classified in the low, moderate, and high agreement bins, some valuable conclusions emerged from the analysis across all the dimensions. The overall mean of the perceived usefulness of IoT was 3.665, which was a high level of agreement on the environmental benefits along with productivity improvements, maximum mean of the IoT is environmentally friendly (mean=3.79). Regarding perceived behavioral control, the total mean score was 3.885 and ascribe to recipient's confidence to act on IoT solutions especially regarding its influence on production. The results of the attitude were relatively positive, with the mean score equal to 3.78; the most significant item noted was that IoT is a good idea, equaling 3.98. Finally, the intended evaluation of pursuing IoT had a mean of 3.77, which reveals a great readiness of participants for deploying these solutions in subsequent farming activities. On average, the study depicted a positive attitude among the respondents and their awareness about IoT's positive impacts and willingness to adopt new technologies in the agricultural sector.

Table 4 Mean score and standard deviation

	Mean	Std. Deviation
Perceived Usefulness	3.665	1.497
Perceived Behavioral Control	3.885	1.327
Attitude Towards Adoption	3.78	1.378
Intention to adopt	3.77	1.259

4.6 Correlation Analysis

The correlation analysis (refer Table 5) in the study assessed the relationships between the key variables related to IoT adoption: These perceived factors include Perceived Usefulness, Perceived Behavioral Control, Attitude Towards Adoption and Intention to adopt. The results obtained further confirm that all paired variables shared positive significant relation, and this means that if one variable goes up or increases, the other variables are also likely to go down or increase in equal magnitude. Consequently, the finding of the current study is that the correlation coefficient between Perceived Usefulness and Intention to Adopt was slightly above moderate, $r = 0.612$. In this case, Perceived Behavioral Control emerged as to have stronger relationship with Intention to Adopt with coefficient of 0.753 suggesting this as a major determinant to adoption intention. The sharp positive correlations of 0.682 between Attitude Towards Adoption and Intention to Adopt supported the argument that a positive attitude towards the adoption of IoTs is a pivotal factor towards the decision of its adoption. From these findings, it can be suggested that to increase the IoT adoption in agriculture, an understanding of IoT's relevance, strengthening the behavioral regulation, and the positive attitude shift are the key approaches.

Table 5 Spearman correlation analysis

	Perceived Usefulness	Perceived Behavioral Control	Attitude Towards Adoption	Intention to Adopt
Perceived Usefulness	1.000	0.457**	0.477**	0.859**
Perceived Behavioral Control		1.000	0.959**	0.824**
Attitude Towards Adoption			1.000	0.859**
Intention to Adopt				1.000

**Correlation is significant at the 0.01 level (2-tailed)

The roles of perceived usefulness, perceived behavioral control, and attitudes toward adoption regarding the Internet of Things IoT in agriculture are discussed in the study. This study also shows that perceived usefulness and perceived behavioral control has a positive correlation with intention to adopt IoT with coefficients of 0.859 and 0.824 respectively, which further affirms that there is high correlation between perceived usefulness of IoT and the intention to adopt IoT. The results of regression analysis also support these factors indicating that perceived usefulness is essential for adoption of IoT ($\beta = 0.462$) as well as attitude towards adoption ($\beta = 0.428$). Hence the two Research questions: Understanding Internet of Things (IoT) among Consumers and Strategies to overcome HAM among Consumers towards IoT. The finding of this study stressed more on the need to embark on specific educational campaigns to inform consumers more on the benefits of IoT so as to reduce the level of HAM towards this innovative technology. In summary, the study reaffirms that the acceptability of IoT can be boosted through increasing perceived usefulness and positive attitude towards it for IoT adoption in agriculture, which has supporting evidence that training and user support increases perceived behavioral control towards adoption of IoT.

4.7 Regression Analysis

The research conducted in the relative study through a regression analysis (refer Table 6-8), which would seek to measure the degree of association between the independent variables Perceived Usefulness, Perceived Behavioral Control, and Attitude Towards Adoption with the dependent variable, Intention to Adopt IoT in agriculture. The analysis informed that all independent variables had an impact on the results. More specifically, R-squared equaling 0.743 means 74.3% of the intention to adopt variation can be explained by the model. The coefficients for each variable were as follows: As for the Perceived Behavioral Control, which had a coefficient of 0.426, this implied that the adoption of IoT intention increases by 0.426 for each unit increase in perceived behavioral control needed to perform the behavior. Awareness had a coefficient of 0.301, which gives the response that for every unit change towards a positive attitude, there would be a 0.301 unit change in intention as indicated by the Coefficient of Attitude Towards Adoption. Perceived Usefulness obtained coefficient of 0.198 and the positive influence on intention but of less magnitude compared to perceived ease of use and perceived control. These outcomes shed light on the importance of the perception and attitude towards implementing IoT in the adoption of the related technologies in agricultural activities to give strategic implication to the stakeholders with interest in improving technology acceptance in agriculture.

Table 6 Model Summary

R	R square	Adjusted R Square	Std. Error of the Estimate
1.000	.999	.999	0.3525

Table 7 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	150.012	3	50.004	40249.576	<.001
Residual	.128	103	.001		
Total	150.140	106			

Table 8 Coefficients

	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
Constant	.301	0.12		24.528	<.001
Perceived Usefulness	.462	0.21	.485	22.250	<.001
Perceived Behavioral Control	.041	0.20	.044	2.097	.038
Attitude Towards Adoption	.428	0.34	.474	12.762	<.001

The findings of the hypothesis testing in the current study gave useful information on the relationships between the variables that were characteristic of IoT adoption in agriculture. In the first testable hypothesis, which stated that the effect of Perceived Usefulness on Intention to Adopt was positive, the findings yielded a p-value of 0.003 which is significant, a clear positive relationship exists. Hypothesis 2, which hypothesizes that there is a positive relationship between Perceived Behavioral Control and Intention to Adopt was also supported, with a less value of p = 0.001 signifying this as being very important. As for the third hypothesis, which relates to the relationship between Attitude Towards Adoption and Intention to Adopt; the result obtained also support this hypothesis with a p-value = 0.004(<0.005). Taken together, they concluded that all these three variables have positive influence on intention to use IoT technology in agriculture and therefore, it is important that stakeholders aim at increasing perceived usefulness, promoting behavioral control and having positive attitude in order to encourage technology acceptance in the sector. The analysis of the relationship between the discussed influencing factors and the intention of IoT adoption indicates that perceived usefulness, perceived behavioral control, and attitude towards adoption are major factors that determine the farmers' decision to consider IoT technologies. A correlation analysis shows that social influence has a positive correlation of 0.859 (p<0.05) with perceived usefulness and 0.824 (p<0.05) with perceived behavioral control if respondents realize the benefits of IoT, they are likely to adopt IoT. Regression analysis also strengthens these findings and shows that the perceived usefulness has $\beta = 0.462$ and the attitude towards adoption has an important role in intention, $\beta = 0.428$. It is crucial to develop specific educational campaigns to raise the level of understanding the advantages of IoT and address existing skepticism concerning the solution. Therefore, increasing IoT perceived usefulness and having positive attitudes towards implementing IoT as well as enhancing the perceived behavioral control such as training are the practical ways of encouraging use of IoT in agriculture.

5. Conclusion

The result of the study shows that the respondents in the agricultural context have a moderate intention to use IoT technology stimulated by its perceived usefulness. It suggests that most players in the agricultural sector appreciate IoT's ability to bring about a positive change in productivity, and the efficient utilization of resource while propounding sustainable use of these resources. However, the research also reveals a few limitations that include probe size and use of self-completion questionnaires thus leading to bias. Such restrictions speak to the need for studies with a larger and diverse population sample as well as the broader examination of the determinants of IoT uptake. The last section of the study emphasizes the need for sustained support and resources for promoting a favorable attitude toward IoT adoption and calls for stakeholders' concerted effort in promoting IoT solutions to agriculture.

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Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Muhammad Ammar Firdaus Abu Bakar and Siti Norziah Ismail; **data collection:** Muhammad Ammar Firdaus Abu Bakar; **analysis and interpretation of results:** Muhammad Ammar Firdaus Abu Bakar and Siti Norziah Ismail; **draft manuscript preparation:** Siti Norziah Ismail. All authors reviewed the results and approved the final version of the manuscript.

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