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Adoption of Post-Harvest Practices Implemented by Fruit Farmers in Johor

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Abstract. The post-harvest practice is important to maintain and prolong the shelf life of fruits and vegetable. However, farmer's adoption towards agriculture practices is still low. This research aims to determine post-harvest adoption among fruit farmers in Johor. The study employs a Unified Theory of Acceptance and Use of Technology (UTAUT) and Theory Planned Behaviour (TPB) to evaluate the factors that influencing post-harvest practice adoption. 150 fruit farmers in Johor were chosen by using a simple random sampling technique. This study indicates that the level of performance expectations (M=4.27), effort expectations (M=4.36), facilitating conditions (M=3.95), attitude (M=4.09) and post-harvest practices adoption (M=4.33) have a high mean score. This study emphasises the importance of post-harvest practices adoption in improving and maintaining the quality of fruits. Post-harvest practices adoption could help to enhance the per capita availability of fruits because the adoption of post-harvest practises and technologies will affect the reduction in fruits losses, thus increasing the availability of fruits products.

1. Introduction

Malaysia is a tropical country that has more than 50 varieties of fruit crops with 198,435 hectares of the planted area. Tropical fruits are beneficial for human health as they contain micronutrients, vitamins, minerals and fibre that is good for improving digestion, building a strong immune system and maintaining a healthy body [1]. In 2018, agriculture remained as an important sector of Malaysia economy that contributed 8.2 % or RM96 billion to the Malaysian Gross Domestic Product (GDP) [2]. Per capita consumption of fruits in Malaysia was 62.18 kg, and the self-sufficiency ratio of fruits was 80.24%, in 2018. Doa [3] reported that Malaysia had exported fruits with the amount of 1188.65 million Ringgit Malaysia but still need to import about 3899.40 million Ringgit Malaysia in 2018. A study has indicated that fruits production in Malaysia is still not equivalent to domestic consumption. Malaysia needs to increase its fruit production and export volume to meet the food supply and food safety under the National Agro-Food Policy (2011-2020). However it is crucial to maintain the quality of fresh fruits after they are harvested. Post-harvest activities usually occur after the harvest season until the delivery of the food product to the consumers [4].

Post-harvest technologies are important to maintain the quality of the product and extension of the fruits' shelf life [5] and reduce post-harvest losses [6]. Post-harvest losses for fruit in Southeast Asia are reported to be around 42% [1], and Malaysia itself is around 20% [7]. Lacking proper handling, knowledge and infrastructure towards post-harvest were some of the main causes of crops losses [8]. As mentioned by Olayemi et al. [9], inadequate post-harvest handling and non-adoption of post-harvest technologies have affected the losses during post-harvest handling. However, practices and technologies adoption level among farmers in agriculture is still low [10]. Elemasho et al. [11] also agreed that many farmers are still using conventional method and poorly adapting agricultural technologies or practices. Therefore, this study aims to evaluate the adoption of post-harvest practice among fruit farmers in Johor. This study will help to support a better post-harvest technologies and practices adoption and to plan a strategic direction for the fruit industry in Malaysia, as well as to extend the shelf life of fresh fruits without deteriorating fruit quality.

2. Literature Review

The climate of Malaysia is very favourable to produce a variety of fruits, especially for seasonal and non-seasonal fruits. DOA [3] recorded that, 10 most popular fruits that are grown in Malaysia are durian (73, 739 ha), banana (30,455 ha), rambutan (16,580 ha), pineapple (14,046 ha), watermelon (10,430 ha), cempedak (7,193 ha), mango (6,360 ha), duku (5,508 ha), jackfruit (4,895 ha) and dokong (4,894 ha). Durian, pineapple, mangoes, papayas, pineapples, and bananas are some of the major fruits that have been exported from Malaysia to the rest of the world [3]. However, exporting fresh fruits to international markets is quite challenging as mandatory government regulations are needed to face stringent regulations concerning the use of agrochemicals and their maximum residue levels [12]. This causes the export volume of fruits to fall behind other major fruit-producing regions.

Technology or practices adoption is referred to as a process or period of trying a new technology into existing practice [13]. There are many theories including the Theory of Reasoned Action, Technology Acceptance Model (TAM), Diffusion Theory, Motivational Model and Social Cognitive Theory that have been developed to explain the intention and use of new technologies and practices [14]. In order to analyse the research objectives, this study has combined the Unified Theory of Acceptance and Use of Technology (UTAUT) [15] and Theory Planned Behaviour (TPB) [16]. UTAUT is the best theory for explaining technology and practices adoption [17] as it can explain as much as 70% of the variance in intention [15; 16]. Besides, attitude present in TPB, directs the complete evaluation of the specific behaviour in the perspective of the farmer's intention towards the technology adoption [18]. Supported by Kabaci [19], attitude is an important variable of behavioural intention, especially in technology adoption.

In the post-harvest industry, adoption of practices and technologies is significant to maintain and prolong the shelf life of crops [20], and it can reduce post-harvest losses [21]. Proven by Olayemi et al. [9], more than 50-70% losses during post-harvest handling is caused by poor post-harvest handling and non-adoption of post-harvest technologies. Even though the adoption of post-harvest practices is important to maintain the quality of fruit crops, farmers are poorly adapting the agriculture practices and technologies [12]. Most of the farmers are lacking in post-harvest management knowledge and still practising post-harvest activities with the traditional method [22].

3. Methodology

The study was conducted in Johor as it is one of the highest fruit producers in Malaysia with 46,032 hectare planting area [3]. A survey method through structured questionnaires with seven sections, including demographic profile, post-harvest practices adoption, effort expectations, performance expectations, social influence and facilitating conditions and attitude was conducted for data collection. This study was conducted using five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) because it could reduce some inconvenience such as weakness from responding which may produce large missing values [23]. 150 fruit farmers were selected randomly based on the list of fruit farmers from the Department of Agriculture (DOA) and Malaysia Pineapple Board in

Johor. Only fruit farmers that are involved with post-harvest activities were considered in the sample frame. The population of fruit farmers in Johor is 43, 259 [3]. However, only 150 respondents were chosen according to the sample size. The sample size must be more than 30 and below than 500 [24] because the sample size that is below than 30 respondents will give inaccurate result [25]. Completed data from the questionnaires were analysed using SPSS Software Version 21.0. Descriptive analysis such as percentage, sum, and mean were used to describe characteristics of respondent background and level of post-harvest practices adoption, performance expectations, effort expectations, facilitating conditions and attitude.

4. Result and discussion

4.1 Demographic characteristics of the respondents

Socio-economic variables like age, education qualification, experience and farm size are the variables utilised to explain the decision of farmers towards technology or practices adoption [26]. Table 1 indicates that only 28.6% of youth or young farmers were involved in post-harvest practices in this study. It shows that elderly farmer with the age of more than 41 is loyal to post-harvest practices in the fruit industry. In contrast to Ye et al. [27], young people are more curious, and their learning skill is better than older people. This study shows that 83.3% of respondents were men, indicating that men have dominated post-harvest activities in the study area. The majority (46.7%) of respondents had attempted secondary schools, and 33.45% attended primary schools and also have no formal education. People with a higher education level should have a more positive attitude to accept and use technology [27]. Moreover, most farmers have farming experience for more than 6 years (78%), which indicates that the respondents were highly experienced in the fruit industry [28]. Most farmers (48.7%) have a bigger farm size of around 6 to 10 acres meaning that farm size has positive relation towards the adoption of agricultural technology [29]. Supported by Walisinghe et al., [26] farm size and education level are considered as one of the most important determinants of technology adoption.

Table 1. Demographic Characteristics of Respondents

Variables	Frequency	Percentages (%)
Gender		
Male	125	83.3
Female	25	16.7
Age		
21-30 years old	11	7.3
31-40 years old	32	21.3
41-50 years old	36	24.0
51-60 years old	31	20.7
61-70 years old	28	18.7
>71 years old	12	8.0
Size Farming		
<5 acre	50	33.3
6-10 acre	73	48.7
11-15 acre	9	6.0
16-20 acre	8	5.3
>21 acre	10	6.7
Education Level		
Not school	31	20.7
UPSR	19	12.7
PMR	4	2.7
SPM	70	46.7
Certificate	12	8.0
Diploma	9	6.0
Degree	5	3.3
Experiences in Fruit Industry		
<5 years	33	22.0
6-10 years	57	38.0

11-15 years	24	16.0
16-20 years	14	9.3
>21 years	22	14.7

4.2 Level of Factors that Influencing Post-Harvest Practices Adoption

Table 2 indicates that post-harvest practices adoption level has the highest mean score (M = 4.33), which implies that respondents have adopted post-harvest practices. Farmers that have high awareness and knowledge about technology and practices tend to adopt post-harvest practices [30]. However, it is opposite to a past study that reveals that farmers were poorly adopting post-harvest technologies [11]. The result from this study demonstrates that all actual scores for each factor influencing post-harvest practices adoption have a high mean score. The effort expectancy (EE) demonstrates the highest mean score (M = 4. 36). The previous study has reported that EE has a strong influence on the users' intention to new technologies adoption and acceptance [31]. Knowledge and understanding of new technologies or practice is an important factor that contributes to the willingness of practices adoption. Supported by Azman et al. [32], adequate knowledge about contract farming will enhance good agriculture practices in their cultivation of crops among contract farmers. Based on this study, adequate knowledge and skill about post-harvest practices can encourage farmers to adopt post-harvest activities. Based on the finding of this study, performance expectancy (PE) has a high mean score (M =4.27); thus it can be considered as the strongest determinant of a user's behavioural intention to adopt post-harvest practices [15]. In accordance with the past study, PE in information technology for farmers will have a positive impact on behavioural intention [33]. Past study has reported that attitude can contribute to post-harvest losses of fruits and vegetables [34]. Consistently with the findings for the attitude that has a high mean score (M = 4.09), Barua et al. [35] also agreed that farmers have positive attitudes towards post-harvest management practices. Supported by past study, the farmer's attitude can influence the adoption of agriculture technologies [36] and has a positive impact on agriculture practices adoption [37]. Social influence (SI) is quite similar to the subjective norm within the Theory Planned Behaviour [16] that has reflected on the influencing of external factors on attitudes and behavioural intention. Swinerd and Mcnaught [38] stated, SI play an important adoption role as a factor and potentially influences the individual's attitudes. With a high mean score (M = 4.02) recorded, this study has also agreed that SI can influence the adoption of post-harvest practices. Farmers in this study have agreed that government, extension agent, friends and family are all encouraging them to adopt the post-harvest practice. However, it is contrasted with Taufiq [41] study, that mention farmers in Malaysia refuse to implement technology and post-harvest handling practices because of less enforcement by the government. Other than that, in contrast with Barua et al., [35] high cost of technology has caused the poor adoption of post-harvest technology. Still, farmers in this study area mentioned that cost of post-harvest practices is cheaper. Reflecting Taufiq [39] study, the Malaysia government have given many incentives and provide many post-harvest infrastructure and facilities to help farmers maintain their fruit quantity. Financial support, necessary knowledge, resources, training and facilities were used as a factor for facilitating conditions (FC) that has the potential of influencing the new technology or practices adoption [40]. This study shows that FC has a high mean score (M = 3.95), indicating that fruit farmers in Johor agree that FC has influenced them to adopt post-harvest practices. Contradict with past study, even though many post-harvest facilities have been provided by government agencies like Federal Agricultural Marketing Authority (FAMA) to reduce post-harvest losses, post-harvest practices in Malaysia are still lacking [39].

Table 2. Factors that Influencing Post-Harvest Practices Adoption

Variables	Frequency	Percentage	Mean	SD
Post-Harvest Practices Adoption			4.33	.493
Low (1.00 – 2.33)	1	0.7		
Medium (2.34 – 3.66)	2	1.3		
High (3.67 – 5.00)	147	98.0		
Performance Expectancy			4.27	.415
Low (1.00 – 2.33)	0	0.0		
Medium (2.34 – 3.66)	3	2.0		
High (3.67 – 5.00)	147	98.0		
Effort Expectancy			4.36	.470
Low (1.00 – 2.33)	0	0.0		
Medium (2.34 – 3.66)	5	3.3		
High (3.67 – 5.00)	145	96.7		
Social Influence			4.02	.408
Low (1.00 – 2.33)	0	0.0		
Medium (2.34 – 3.66)	20	13.3		
High (3.67 – 5.00)	130	86.7		
Facilitating Conditions			3.95	.297
Low (1.00 – 2.33)	1	0.7		
Medium (2.34 – 3.66)	17	11.3		
High (3.67 – 5.00)	132	88.0		
Attitude			4.09	.334
Low (1.00 – 2.33)	0	0.0		
Medium (2.34 – 3.66)	8	5.3		
High (3.67 – 5.00)	142	94.7		

5. Conclusion

The main objective of this study is to identify post-harvest practices adoption among fruit farmers in Johor, Malaysia. The finding shows that fruit farmers in Johor have adopted post-harvest practices. Nonetheless, the Malaysia government should encourage fruit farmers to adopt more post-harvest technologies or practices because the fruit industry has the potential to grow further and contribute to the expansion of the agricultural sector. This study has contributed to the literature of factors influencing post-harvest practices adoption in Johor. Nevertheless, there are some limitations that need to be highlighted as it could provide a better understanding of future research. Even though the UTAUT and TPB have explained the adoption of the post-harvest practice in Johor, the future study could be conducted at other states or countries. Other than that, future research should cover stage and types of post-harvest practices that have been adopted among fruit farmers to ensure that this study can explain more on the level of adoption.

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References

[1] Kusumaningrum, D., Lee, S. H., Lee, W. H., Mo, C., & Cho, B. K. 2015. A review of technologies to prolong the shelf life of fresh tropical fruits in Southeast Asia. *Journal of Biosystems Engineering*, ***40***, 345-358.
[2] DOS. 2018. Selected Agricultural Indicators, Malaysia, 2018
[3] DOA. 2018. Statistik Tanaman (Sub-Sektor Tanaman Makanan 2018

[4] Gardas, B. B., Raut, R. D., & Narkhede, B. 2018. Evaluating critical causal factors for post-harvest losses (PHL) in the fruit and vegetables supply chain in India using the DEMATEL approach. *Journal of cleaner production*, **199**, 47-61.
[5] Singh, V., Md. Hedayetullah, P. Zaman and J. Meher. 2014. Postharvest technology of fruits and vegetables: An Overview. *Journal of Postharvest Technology* **2:** 124-135.
[6] Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. 2015. Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis. *World Development*, **66**, 49-68
[7] Tengku, M., & Mohamed, M. 2017. An *Unsung Solution for Food Security* (Selangor: Universiti Putra Malaysia Press) p 84
[8] Raut, R. D., Gardas, B. B., Kharat, M., & Narkhede, B. 2018. Modeling the drivers of post-harvest losses–MCDM approach. *Computers and Electronics in Agriculture*, **154**, 426-433.
[9] Olayemi, F.F., Adegbola, J.A., Bamishaiye, E.I. and Awagu, E.F. 2012. Assessment of Postharvest losses of some selected crops in eight local government areas of Rivers State, Nigeria. *Asian J. Rural Dev.* **2** : 13-23.
[10] Dhraief, M. Z., Bedhiaf-Romdhania, S., Dhehibib, B., Oueslati-Zlaouia, M., Jebali, O., & Ben Youssef, S. 2018. *Factors Affecting the Adoption of Innovative Technologies by Livestock Farmers in Arid Area of Tunisia*, **3**,22. FARA Research Report.
[11] Elemasho, M. K., Alfred, S. D. Y., Aneke, C. C., Chugali, A. J. C., & Ajiboye, O. 2017. Farmers' perception of adoption of postharvest technologies of selected food crops in rivers state, Nigeria. *International Journal of Agricultural Research, Innovation and Technology*, **7**, 22-26.
[12] UNCTAD. 2007. Food-safety and Environmental Requirements in Export markets – Friend or Foe for Producers of Fruit and Vegetables in Asian Developing Countries. Available at: www.unctad.org.
[13] Loevinsohn, M., Sumberg, J., Diagne, A., & Whitfield, S. 2013. Under what circumstances and conditions does adoption of technology result in increased agricultural productivity. A Systematic Review
[14] Hoque, R., & Sorwar, G. 2017. Understanding factors influencing the adoption of mHealth by the elderly: An extension of the UTAUT model. *International journal of medical informatics*, **101**, 75-84.
[15] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.
[16] Ajzen, I. 1991. The theory of planned behaviour. *Organizational behavior and human decision processes*, **50**, 179-211.
[17] Shaper, L. K., & Pervan, G. P. 2007. ICT and OTS a model of information and communication technology acceptance and utilizations by occupational therapist. *Int. J. Med. Inform*, **76**, 212-221.
[18] Mastrangelo, M. E., Gavin, M. C., Laterra, P., Linklater, W. L., & Milfont, T. L. 2014. Psycho-social factors influencing forest conservation intentions on the agricultural frontier. *Conservation Letters*, **7**, 103-110.
[19] Kabaci, M. J. (2014). Family and consumer sciences graduate research productivity in 2013. *Family and Consumer Sciences Research Journal*, **43**(2), 107-115.
[20] Arah, I. K., Ahorbo, G. K., Anku, E. K., Kumah, E. K., & Amaglo, H. 2016. Postharvest Handling Practices and Treatment Methods for Tomato Handlers in Developing Countries: A Mini Review. *Advances in Agriculture*, *2016*.
[21] Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. 2015. Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis. *World Development*, **66,** 49-68.

[22] Mollah, M. A. H., Hawlader, A. J., Ali, M. R., Khatun, R., Ahmed, S., Mahmud, M. S., & Hasan, M. A. 2018. Assessment of Technological Knowledge on Pre-and Post-harvest Agricultural Management System and its Economic Impacts in Bangladesh. *Univ. J. Agric. Res*, **6**, 79-90.
[23] Lehmann, D. and Hulbert, J. 1972, "Are three-point scales always good enough?", *Journal of Marketing Research*, **9**(4), pp. 444-446.
[24] Roscoe, J.T. 1975. *Fundamental Research Statistics for the Behavioral Sciences*. New York: Holt, Rinehart and Winston
[25] Sekaran, U. 2003. *Research methods for business: A skill building approach*. Hoboken, NJ: John Wiley & Sons.
[26] Walisinghe, B. R., Ratnasiri, S., Rohde, N., & Guest, R. 2017. Does agricultural extension promote technology adoption in Sri Lanka. *International Journal of Social Economics*, **44**(12), 2173-2186.
[27] Ye, J., Zheng, J., & Yi, F. 2020. A study on users' willingness to accept mobility as a service based on UTAUT model. *Technological Forecasting and Social Change*, **157,** 120066.
[28] Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. 2014. The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). *International Journal of Information Management*, **34**(2), 151-166.
[29] Davidson, D. J., Rollins, C., Lefsrud, L., Anders, S., & Hamann, A. 2019. Just don't call it climate change: climate-skeptic farmer adoption of climate-mitigative practices. *Environmental Research Letters*, **14**(3), 034015.
[30] Mwaijande, F. 2017. Farmers' adoption and willingness to pay for post-harvest technologies in Tanzania: policy implication for enhancing food security. *Journal of Postharvest Technology*, **5**(1), 1-6.
[31] Sun, Y., Wang, N., Guo, X., Peng, Z., 2013. Understanding the acceptance of mobile health services: a comparison and integration of alternative models. J. Electron. Commerce Res. **14**, 183.
[32] Azman, A., D'Silva, J. L., Samah, B. A., Man, N., & Shaffril, H. A. M. 2012. Comparative study on sustainable agriculture knowledge among Malaysian contract farmers. *American Journal of Applied Science*, **9**(5), 673-67.
[33] Chiemeke, S. C., & Evwiekpaefe, A. E. 2011. A conceptual framework of a modified unified theory of acceptance and use of technology (UTAUT) Model with Nigerian factors in E-commerce adoption. *Educational Research*, **2**(12), 1719-1726
[34] Rose, D. C., Sutherland, W. J., Parker, C., Lobley, M., Winter, M., Morris, C. & Dicks, L. V. 2016. Decision support tools for agriculture: Towards effective design and delivery. *Agricultural systems*, **149**, 165-174.
[35] Barua, S., Singh, P., Mridiula, D., Gupta, R. K., Satyapriya, & Tomar, B. S. 2017. Attitude Assessment of Farmers Towards Post-harvest Technologies and Value Addition of Horticultural Crops in Punjab. *Journal of Human Ecology*, **59**(2-3), 164-168.
[36] Bagheri, A., Bondori, A., & Damalas, C. A. 2019. Modeling cereal farmers' intended and actual adoption of integrated crop management (ICM) practices. *Journal of Rural Studies*, **70**, 58-65.
[37] Tang, Y., & Yang, C. (2019, July). Which Factors Influence Chinese Farmers to Adopt Formulated Fertilization Technology In *IOP Conference Series: Earth and Environmental Science* **295**(2) 012039.
[38] Swinerd, C., Mcnaught, K.R., 2015. Comparing a simulation model with various analytic models of the international diffusion of consumer technology. Technol. Forecast. Soc. Chang. **100** (1), 330–343.

[39] Taufiq bin Sabuddin, A. 2017. Postharvest handling practices on vegetable crops at different stages of the distribution chain: a case study in Selangor, Malaysia (Master's dissertation, Wageningen University and Research). https://edepot.wur.nl/419321

[40] Li, W., Clark, B., Taylor, J. A., Kendall, H., Jones, G., Li, Z., & Cheng, X. 2020. A hybrid modelling approach to understanding adoption of precision agriculture technologies in Chinese cropping systems. *Computers and Electronics in Agriculture*, **172**, 105305.