Factors Influencing Small-Holder Food Crops Farmers' Adoption Intention Behaviour on Modern Agricultural Technology among the Non-Adopter in Sarawak's Rural Areas

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Abstract
Despite the government placing a strong emphasis on the agriculture development, Malaysia still continue to have low level of self-sufficiency in its various major food crops. It is widely acknowledge that the use of modern technology can greatly increase the productivity and quality level of the agriculture products. Thus, this paper is timely as it investigate the factors that influence the farmers' intention to adopt the modern agricultural technology. By examining the issues from the small-holder food crop farmers' perspective, a better understanding of the issues can be derived. This can ensure the development of relevant strategies to counter the problems identified. To achieve this objective, the study was conducted within the largest state in Malaysia that is Sarawak, by focusing on the rural small-holder food crop farmers across its central, northern and southern regions. A total of 108 of respondents have participated in this researcher-administered survey, who have been chosen based on purposive sampling method. The data obtained were analysed using Covariance-based Structural Equation Model (CB-SEM). The findings shows that the farmers' age and voluntariness posed significant moderating effect on their intention to adopt modern agricultural technology. Moreover, farmers' gender and past experience have not moderated farmers' adoption intention. The finding also revealed that social influences did not have strong influence on farmer intention to adopt the technology. The implication of this findings shows the importance of increasing farmers' awareness on the importance of technology in their farming methods, the increased focus on youths to join the agricultural activities and also more training programs to the farmers that are located in the rural areas.
Keywords: Adoption Intention, Small-Holder, Food Crops, Modern Agricultural Technology, Rural Farming.

Introduction

Since the introduction of the New Economic Policy (NEP), the agricultural sector has been given attention to ensure that it develops in line with the government's aspiration to ensure a balanced distribution of national income. The agricultural sector remains one of the significant contributors to the country's economy, in which in 2020 it contributes as much as 7.4% to the country's GDP (Jabatan Perangkaan Negara, 2021). Although Malaysia is a relatively active country in the agricultural sector, the country still experiences a low food self-sufficiency ratio as a result of low productivity especially for food crops. One of the cause of this problem stems from the lack of efficiency in food crop farming methods which are mostly practiced by traditional smallholders who are less receptive to modern agricultural technology (Mat Lazim et al., 2020; Dung & Hiep, 2017).

There is a lot of evidence showing how the use of modern technology in agriculture can increase productivity more efficiently and cost effectively (Nukala et al., 2016). However, efforts to improve the productivity of the agricultural sector through the adoption of modern technology depend a lot on the willingness and commitment of the farmers themselves. Unfortunately in most scenario, farmers' lack of acceptance to adopt to modern agricultural technologies have contributed to lower productivity (Akundu et. al., 2012). Unfortunately, despite great emphasize given by government on the development of agricultural sector, Malaysia still experiencing low self-sufficiency ratio for several major food crops, which one of the causes is lack of adoption of new technology and innovation in the sector (Kementerian Kewangan Malaysia, 2020). Meanwhile in Sarawak, very low adoption rate of modern agricultural technology has forced Sarawak's Ministry of Food Industry, Commodity and Regional Development implement various initiatives to encourage the adoption of the technologies among state's farmers (UKAS, 2023).

Despite of being regarded as one of the major issues in agriculture industry in Malaysia, comprehensive research that study on the factors contributing to the lack of acceptance to adopt modern farming technology are still limited especially focusing on Sarawak. Most of the existing studies focusing on assessing the rate of adoption of modern agricultural technology in certain agricultural activities and if it even touch on the cause of farmers' non-involvement in modern agricultural technology, it was only touched superficially because it was not the main objective of the aforesaid studies. Furthermore, most of the studies solely focused on cultivation of paddy and conducted in northern states in Peninsular Malaysia (Harun et al., 2015; Mohd. Nawi et al., 2021). Meanwhile, the research conducted Zainol Abidin et al. (2022) focused on sociological aspect of paddy farmers specifically in Batang Lupar, Sarawak and Kota Belud, Sabah only. Similarly, the research conducted by Muhammad et al. (2017) is mostly a benchmarking analysis of technology adoption between melon farmers in Sabah and Sarawak. Furthermore, there are quite a number of researches pertaining adoption of modern technology in various type of agricultural sub-sectors such as forestry, livestock, fishery and commodity crops but most of it were conducted abroad.

One the most obvious gap that lead towards the need to conduct this study is the lack research that conducts in-depth investigation on the factors influencing farmers' adoption intention behaviour among non-adopters of modern agricultural technology using popular theories that are often used in other sectors such as the Theory of Resistance, Diffusion of innovation, Theory of Reasoned Actions (TRA), Theory of Planned Behaviour (TRB), Theory of Technology Acceptance and so on to portray a clear picture of the reasons for a person's acceptance and rejection of new technologies including among individual farmers in the

agricultural industry. Therefore, there is a need to carry out a comprehensive study to accommodate the gaps that have described above to provide an in-depth understanding of the real reason why the level of adoption of modern agricultural technology is still at a low level among small holder farmers who also consist of traditional farmers despite various efforts made by the government.

As food crop farming by small-holder farmers tend to be conducted in rural areas in Sarawak, the general objective of this study is to investigate the factors influencing small-holders crop farmers' intention to adopt modern agricultural technology among non-adopters in Sarawak's rural areas. With regards to the aforementioned problems, this study seeks to achieve the following specific objectives:

- To examine the direct and moderating impacts of various factors stated in the renowned technology acceptance theories on farmers' intention to adopt modern agricultural technology in rural areas of Sarawak.
- To recommend how efforts can be tailored to increase the rate of adoption of modern agriculture technology among small-holder farmers in Sarawak's rural areas based on the research findings.

Literature Review

Sarawak's agricultural sector remains to be one of the main contributors to the Gross Domestic Product. According to a report in the Sarawak Voice news portal (2020), the State Minister of Agriculture Modernization has stated that the sector has contributed as much as 2.1% or RM16.5 billion to Sarawak's GDP and recorded a trade surplus of RM6.9 billion in the same year. Meanwhile, Sarawak Socioeconomic Report 2019 has shown that Sarawak's agricultural sector value added of RM16.5 billion is the largest contributor to the agricultural sector in Malaysia which is 16.3% (Jabatan Perangkaan Malaysia, 2020). Out of the value, RM12,515 million is the contribution of the crop farming sub-sector. According to the same data, the increase in the crop agriculture sub-sector has also been driven by food crops, especially pepper crops in which Sarawak is the largest producer of the crop.

However, Sarawak only achieved a 38% food self-sufficiency level, far from the target of 60%. Commenting on the figure, the Minister of Food Industry, Commodity and Regional Development, Dato Sri Dr. Stephen Rundi Utom explained that the state of Sarawak should undergo a holistic transformation in the agricultural sector through cooperation with countries that are more advanced in the field of agriculture (TVS, 2022). However, the adoption rate of modern technology in the food crop sub-sector is relatively low in Sabah and Sarawak (Muhammad et al. 2017). Therefore, Dato Sri Dr. Stephen Rundi Utom emphasized that the state government always welcomes foreign investors to bring in modern agricultural technology to transform the agricultural sector in the state (Linch, 2022).

Undeniably, the lack of use of modern technology in farming is one of the causes of the slow growth of the agricultural sector (Dung & Hiep, 2017). The use of modern technology in the agricultural sector is widely considered as the solution to agricultural problems such as lack of water supply, labour force, usable land and climate change (Liaghat & Balasundram, 2010). The adoption of modern technology in farming or often being referred as smart farming which is one of the effects of the industrial revolution 4.0 (Mat Lazim et al. (2020).

In Malaysia, there are lots of evidences that show the benefits enjoyed by farmers as a result of the adoption of modern technology in their farming activities which has enabled

the farmers to enjoy significant increase in productivity as well as increase in their income and standard of living (Awang et al., 2016). Additionally, the adoption of modern agricultural technology have led to the development of sustainable competitive advantage for the farmers (Harun et al., 2015). The author highlighted that farming of paddy is one of the most active sector in the application of modern technology in Malaysia apart from oil palm farming through the use of modern machinery for the purpose of sowing and harvesting.

Furthermore, the presence of financial assistance is also a determining factor as to whether farmers will adopt modern agricultural technology in Malaysia (Saifan et al., 2021). This is due to the fact that modern agricultural technology usually requires relatively large costs but most small-holder farmers do not have strong financial capabilities.

Conceptual Framework

Research in uses multi-dimensional methods to study the factors of rejection of small-holder farmers towards modern agricultural technology. In order to get a comprehensive picture of the factors contributing to acceptance or rejection of the adoption of modern agricultural technology among small-holder farmers in rural areas in Sarawak, the Unified Theory of Acceptance and Use of Technology (UTAUT) formulated by Vankatesh et al. (2003) has been used as a theoretical framework to develop a research framework for this research. The UTAUT integrates several main constructs in order to predict individual's intention and use of certain new technolgy. Basically, this theory opined that behavioural intention may influence one's decision to use a new technology. Here, the propensity that an individual to accept a new technology rely on the direct effect of four main constructs (performance expectancy, effort expectancy, social influence and facilitating conditions) (Marikyan & Papagiannidis, 2021; Venkatesh et al., 2003). Furthermore, the direct effect will be moderated by age, gender and voluntariness of use (Venkatesh et al., 2003).

As this study only focusing on the non-adopter of modern agricultural technology in rural areas in Sarawak, the conceptual framework of this study was only covering partial parts of the theoretical framework developed Marikyan and Papagiannidis (2021) as shown in Figure 2.1. Hence, to ensure only relevant variables are tested, the following research framework was developed:
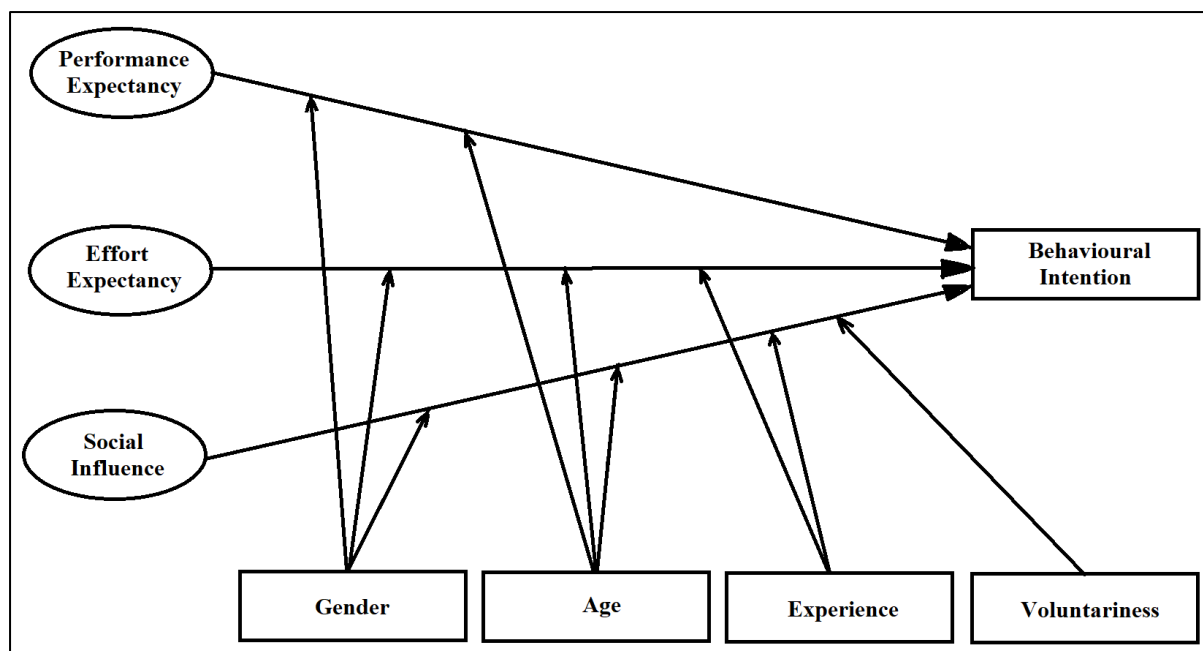
Figure 2.1: The Conceptual Framework

Performance expectancy

It refers to one's belief that the new technology will enhance his or her performance (Venkatesh et al., 2003). In the context of small-holder farming, we may infer that once the farmer have no belief that the adoption of the new technology will contribute to better productivity and efficiency, the farmer will reject the new farming technology. The research finding from a research conducted by Crentil et al. (2018) on aquaculture farmers in Ghana has shown that despite being regarded as new among the farmers, once the new technology being perceived as a 'risk-reducing' innovation by the farmers, the adoption rate will escalate as they believed that the new technology brings benefits to them especially in term of productivity and pest control. The aforesaid research also highlighted the importance of providing an effective way to educate the farmers regarding the benefits of new technology to reduce the ambiguity and anxiety over the possible risks. Despite vast assertions regarding the benefits of the adoption modern agricultural technology for farmers, existing studies have yielded mixed results regarding its influence on farmers' adoption behaviour. A research conducted in Kenya by Eidt et al. (2012) has found that farmers' lack of confidence that the modern agricultural technology will contribute to better farming performance has led to low adoption rate on the technology.

Effort Expectancy

It refers to the magnitude of difficulty to utilise the new technology (Venkatesh et al., 2003). To put this assertion in the context of farming, small-holder farmers might reject the technology if they perceived that the technology is difficulty to be applied on their farming activities. It also may refers to whether the farmer has knowledge or skill to operate the new technology. To support the aforesaid notion, the lack of ability and competency among farmers to understand and to use technology correctly are also the main reasons for the low adoption rate of modern agricultural technology because the farmers were not getting the results they hope for through the use of aforesaid technology (Zainol Abidin et al., 2022). This finding may serve as an indicator that there may be loopholes in the government's efforts so

far to empower the adoption of modern agricultural technology by farmers. Additionally, other than lack of sensitivity to modern technology, the lack of courage to practice modern agricultural technology is a factor that causes the productivity of the Malaysia's paddy industry to be quite far behind compared to Thailand and Vietnam (Kar & Chamhuri, 2018). New technology tend to pose huge risks especially financially to farmers as well as ambiguity due to their lack of familiarity on the technology (Foster & Rosenzweig, 2010). Meanwhile, Senunuga et al. (2020) asserted that highly knowledgeable farmers are more open to accept new modern technology.

Social influence

It refers to one's perception on the beliefs of other significant individuals whether he or she should adopt the new technology (Venkatesh et al., 2003). From the context of this research, social influence may exist in the form point of view of the socially-close individuals with the farmer whether they should adopt to new farming technology or not. In general, resistance to change is widely perceived as normal response against probable threats associated to the change due to various factors which include individual factor (loss of control and face) and group (cohesiveness and social norms) factors (Mabin et al., 2001). Most small-holder farmers in Malaysia engage in agricultural activities on their own lands which resulted to lack of urgency and commitment to adopt modern agricultural technology. The aforesaid customary practice is highly contrasted the adoption rate of modern technology for the paddy farming sector in Vietnam which is much higher due to the fact that farmers work on farming activities on government-owned lands and are required to abide strictly to all the guidelines of planting practices set by the government or risking having their rights to carry out agricultural activities on government-owned land being revoked and may subsequently cause the loss of sources of income (Harun et al., 2015). Social factors have been subjected to debates over its influence over farmers' adoption behaviour on modern agricultural technology. For instance, Gao et al. (2022) in their literature reviews emphasized that social factors offer non-conclusive effect on farmers' adoption behaviour on modern agricultural technology despite mentioning social factors' negative relationship with farmers' adoption behaviour as opined by Feder and Umali (1993). Similarly, a study conducted by Han et al. (2022) has concluded that farmers' social capital which refers to the enabling relationship linkages among farmers in a certain community has shown mixed impacts on farmers' willingness to adopt modern agricultural technology depending to specific zones in China. Furthermore, Fellow farmers have been described as significant factors influencing farmers to adopt modern technology in the forms of source of information, advice, and knowledge sharing especially from those who are more knowledgeable and skilful farmers (Ramirez, 2013). The same study also highlighted the significant of close family members in providing word-of-advise. Meanwhile, a study conducted by Huawei et al. (2022) has supported the notion that social network and norms shared among the farmers' local communities has resulted on significant effect on farmers' decision to adopt modern technologies.

The Influence of Farmers' Age

Research conducted by Harun et al. (2015) indicated that the main reasons of farmers' rejection of modern farming technology are maintaining status-quo among elderlies as well as lack of awareness and interest on the technology. Eldest farmers also have been described to be afraid to take risk to adopt modern agricultural technology compared to younger

generation of farmers (Mwangi & Kariuki, 2015; Sennuga et al., 2020). However, although age factor has been claimed to be one of the factor that lead to rejection of new technology, various has shown that age factor did not bear significant effect on technology adoption in agriculture sector (Akundu et al., 2012). Therefore, based on aforementioned assertions the following hypothesis is developed:

H1: Farmer's age moderate the effect of performance expectancy, effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.

The Influence of Farmers' Gender

There studies that have indicated that male farmers are bolder in taking risk to adopt modern technology (Lavinson, 2013; Sennuga et al., 2020). However, the study conducted by Bonabana-Wabbi (2002) has found that the influence of gender on technology adoption in agricultural sector has indicated mixed results and this finding has been emphasized in recent studies (Mwangi & Kariuki, 2015). Hence, according to the brief information above, the following hypothesis has been initiated:

H2: Farmer's gender moderates the effect of performance expectancy, effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.

The Influence of Farmers' Past Experience

Sunnuga et al. (2020) have opined that farmers that vast experience in using previous technologies tend to have high propensity to adopt newer technology. The aforesaid finding is reiteration of previous finding made by Karunathilaka and Thayaparan (2016). Thus, based on such limited information, the following hypothesis has been derived:

H3: Farmer's past experience moderate the effect of effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.

The Influence of Farmers' Voluntariness

In research conducted on farmers in China, Liu (2013) found out that the stronger the magnitude of farmer's disinclination against the possible risks associated to the new technology, the longer the adoption time would be. This assertion is supported by a research conducted by Karunathilaka and Thayaparan (2016) has opined that farmers' voluntariness tend to increase to adopt modern technology when they have complete information about the technology. The aforesaid assertion has confirmed the finding that opined lack of information and knowledge regarding the new technology significantly reduced farmers' willingness to adopt new technology (Chandrasiri, 2013). Finally, by referring to the past studies regarding the influence of farmers' voluntariness and willingness to adopt new technology, the following hypothesis is established:

H4: Farmer's voluntariness moderates the effect of social influence on farmers' adoption intention on modern agricultural technology.

Research Methodology

In this research, respondents have been selected from the population using a non-probability method, which is through purposive sampling. This is to ensure that only small-holder farmers will be selected in selected rural areas in this research to study the factors that affect whether they intended to adopt modern agricultural technology or not in their farming activities.

For the purpose of data collection, the finalised instrument which is the structured-questionnaire that consists of open-ended and close-ended questions has been used administered by selected enumerators who are capable of conducting interviews with respondents. Prior the finalisation of the instrument, the face-to-face interviews have been carried been with 30 selected small-holders food crops farmer in rural areas in Kuching and Kota Samarahan divisions in which the outcomes of the interviews have validated the initial instrument to be used for exact data collection method.

In general, the first part of the questionnaire has been used for the purpose of collecting information related to the respondent's demographic information while the next part has been used for the specific purposes of this study such as the farmers' performance expectancy on the current modern technology if it were adopted on their farming activities, their effort expectancy regarding the adoption of the technology, the social influences affecting their adoption intention, their intention in adopting the technology in the near future, as well as their comments and recommendations on how the adoption rate of modern agricultural technology among themselves can be enhance. Questions related to factors influencing behavioural intention adopt modern farming technology have been developed based on UTAUT (Venkatesh et al., 2003) to provide comprehensive information that will help us to understand farmers' intention to adopt or reject modern technology in their farming activities.

Since this research involves several variables, regression analysis has been implemented to assess the relationship between dependent variables (the behavioural intention to either to adopt the modern agricultural technology) and independent variables (factors influencing farmers behavioural intention to adopt modern agricultural technology) as well as moderating variables that moderating the relationship between both aforesaid variables. The implementation of this regression analysis is in line with the recommendations of Malhotra (2007) who describes it as the most suitable and flexible approach to evaluate the relationship between the dependent variable and multiple independent variables. As a result, all reliability and validity tests such as Confirmatory Factor Analysis (CFA), Goodness-of-Fit of the model's constructs as well as hypotheses tests have been carried out using the Covariance-based Structural Equation Model (CB-SEM) method through SPSS AMOS software as this research aimed to study the factors influencing small-holder food crops farmers non-adoption behaviour on modern agricultural technology in Sarawak's rural areas based on the well-established theoretical framework developed by Marikyan & Papagiannidis (2021).

Analysis And Findings
Demographic Profiles
Table 1 portrays the demographic statistics of the small-holder food crops farmers that has been participated as the respondents for this study. A total of 108 small-holder crops farmers in rural area across Sarawak participated as respondents this study. Male farmers constitute the larger portion of the respondents. Although the majority of the respondents are those in the age range of 50-59 year old with 25.9%, those in the ranges of 30-40 and 40-49 year old recorded almost the same percentage.

Table 1:
Respondents' Demographic Profile

Item	Category	Frequency	%	Item	Category	Frequency	%
Region	Southern	40	37.0	**Age**	20 - 29	17	15.7
	Central	33	30.6	(Years)	30 - 39	26	24.1
	Northern	35	32.4		40 - 49	26	24.1
					50 - 59	28	25.9
Gender	Male	69	63.9		60 - 69	10	9.3
	Female	39	36.1		70 - 79	1	.9

Confirmatory Factor Analysis (CFA)

Based on the result of CFA, unidimensionality is reached in which all measuring items that scored lower than the ideal value of 0.7 were deleted in accordance to the assertion made by Heir et al. (2014). Table 2 demonstrates the CFA of latent variables involved in this study:

Table 2:
Factor Loadings for Each Measurement Item

Item		Coding	Loading	Status
Performance Expectancy				
1.	Expect modern farming technologies will increase farming quantity output.	PF1	0.92	Proceed
2.	Expect modern farming technologies will ease routine farming activities.	PF2	0.97	Proceed
3.	Expect modern farming technologies will lead to time-saving.	PF3	0.97	Proceed
4.	Expect modern farming technology to be more cost-effective.	PF4	0.78	Proceed
5.	Expect modern farming technologies will improve farming output quality.	PF5	0.97	Proceed
6.	Expect modern farming technologies to improve effectiveness of crop-care activities e.g. fertilization, pest control etc.	PF6	0.93	Proceed
Effort Expectancy				
1.	Expect to have sufficient knowledge on how to basically operate the relevant modern agricultural technology.	EF1	0.85	Proceed

2.	Expect to have sufficient knowledge on all functions and features of the relevant modern agricultural technology.	EF2	0.96	Proceed
3.	Expect to have sufficient skills on how to effectively operate the relevant modern agricultural technology.	EF3	0.95	Proceed
4.	Expect the currently available modern farming technologies would be easy to apply on current/planned crops.	EF4	-0.01	Deleted
5.	Expect the relevant modern farming technology would be easier to be operated compared to the conventional one.	EF5	0.11	Deleted

Social Influences

1.	Immediate family members influence on decision to adopt modern farming technology.	SI1	0.78	Proceed
2.	Relatives influence on decision to adopt modern farming technology.	SI2	0.88	Proceed
3.	Friends influence on decision to adopt modern farming technology.	SI3	0.91	Proceed
4.	Others local famers' actions influence on decision to adopt modern farming technology.	SI4	0.9	Proceed
5.	Close-suppliers influence on decision to adopt modern farming technology.	SI5	0.73	Proceed

Upon deletion of individual measurement items that score the factor loading value below 0.70, the remaining measurement items were further analysed reliability and validity assessments via pooled-CFA. The result of pooled-CFA on all three latent variables involved in this study has generated the following result:

Table 3:
Goodness-of-Fit (GOF) of Modified Model (Pooled-CFA)

Goodness-of-Fit (GOF) Indices				
x^2/df	GFI	CFI	TLI	RMSEA
1.592	0.871	0.976	0.970	0.074

From the above table, the model has exceeded GOF minimum values for almost of major indices stated in the table, except for GFI which did not reaching the threshold value of 0.9 (Hair et al, 2010; Zainudin, 2012). However, since that all other indices have indicated excellent values, GFI value lesser than 0.9 still can be accepted especially for a study that involving large sample (Hair et al., 2010).

Reliability and Validity

Once the measurement model has achieved unidimensionality, reliability and validity tests were conducted. From the previous CFA on the modified measurement model, the following detailed results have been obtained:

Table 4:
CFA Result for the Final Measurement Model

Construct	Item	Factor Loading	Cronbach's Alpha (≥0.7)	CR (≥0.6)	AVE (≥0.5)
Performance Expectancy	PF1	0.92	0.97	0.97	0.86
	PF2	0.97			
	PF3	0.97			
	PF4	0.78			
	PF5	0.97			
	PF6	0.93			
Effort Expectancy	EF1	0.86	0.94	0.95	0.85
	EF2	0.96			
	EF3	0.95			
Social Influence	SI1	0.79	0.92	0.93	0.71
	SI2	0.89			
	SI3	0.90			
	SI4	0.90			
	SI5	0.73			

The above table (Table 4) has shown that all constructs and measurement items have exceeding acceptable values for all indicators which indicates the modified measurement model has achieved construct validity as the correlations among all variables are well below the AVE values. Meanwhile, the following table (Table 5) has shown that the model has achieved discriminant validity.

Table 5:
Discriminant Validity Index Summary

	PF	EF	SI
PF	**0.927**		
EF	0.449	**0.922**	
SI	0.136	0.535	**0.843**

Structural Model

The final hypothesized structural model for this study has achieved the threshold values for all indices except for GFI as portrayed in Table 6. Similarly, according to Hair et al. (2010), GFI below 0.9 still acceptable for relatively big sample size as long as other major indices achieved good fit values.

Table 6:
*Goodness-of-Fit (GOF) of Finalised Hypothesized Structural Model*

Goodness-of-Fit (GOF) Indices				
x^2/df	GFI	CFI	TLI	RMSEA
1.606	0.863	0.973	0.966	0.075

Hypotheses Testing for Moderating Effect

The conceptual framework of study has been using the theoretical framework proposed by Marikyan & Papagiannidis (2021) which asserted that the influences of *independent variables* (performance expectancy, effort expectancy and social influence) on behavioural intention of potential modern technology users i.e. small-holders crops farmers to adopt modern farming technology (*dependent variable*) are moderated by various factors (*moderators*) such as the farmer's gender, age, experience and voluntariness. To test the moderating effects of the aforesaid moderators, the following model has been used:
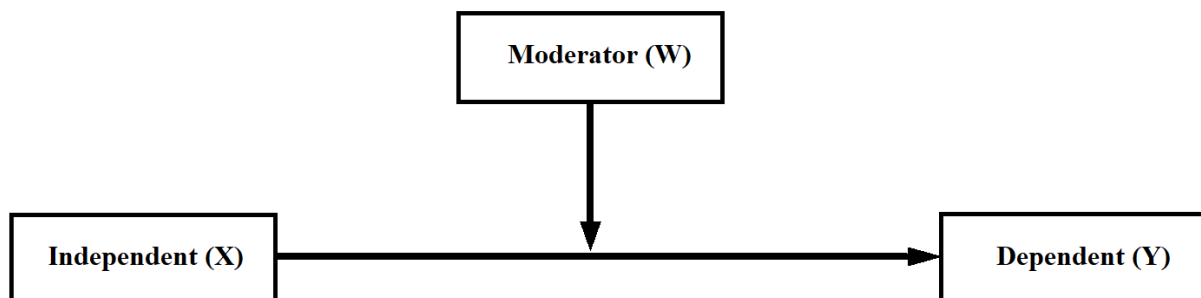
Figure 1: Simple Moderation Model

The hypotheses testing for aforesaid moderating effects were conducted according to the SEM path analysis as shown in the following figure:
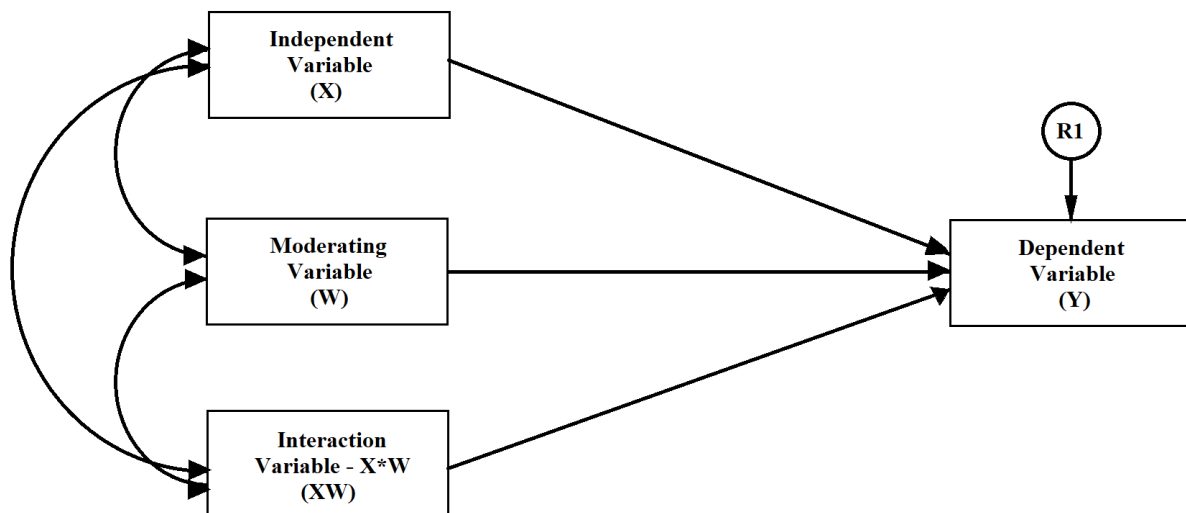
Figure 2: Moderating Effect Path-Analysis in AMOS

The determine whether the moderating variables have effect on the relationship between XY, the assertion made by Dawson (2014) which emphasized that moderating effect can be characterized as when moderating variable (W) influence the relationship XY. In this study dependent variable is behavioural intention which was assigned as BHV_INT in path analysis in AMOS graphic.

The following table (Table 7) shows the summary of overall result of the moderation effect analyses conducted in this study. The results of moderating effects stated in the table were made based on methods proposed by Zainudin (2012) which emphasized that moderation effect occurs when the relationship of W-Y is not significant while the relationship of XW-Y is significant. Meanwhile, the significance status of the relationship X-Y will determine the type of moderating effect that occurs, in which significant relationship of X-Y indicates partial moderation and insignificant relationship of XY signifies complete moderating effect has occurred.

Table 7:
Summary of Overall Moderation Analyses Results

Moderating Effect	Path	Estimate	P-Value	Result
Gender on PF–BHV_INT	BHV_INT <- PF	0.601	***	***Partial moderating effect***
	BHV_INT <- Gen	0.357	0.127	
	BHV_INT <- interPF*Gen	0.166	0.011	
Age on PF–BHV_INT	BHV_INT <- PF	0.609	***	***Partial moderating effect***
	BHV_INT <- Age	0.030	0.745	
	BHV_INT <- interPF*Age	0.166	0.012	
Gender on EF–BHV_INT	BHV_INT <- EF	0.193	0.016	No moderating effect
	BHV_INT <- Gen	0.434	0.154	
	BHV_INT <- interEF*Gen	0.020	0.097	
Age on EF–BHV_INT	BHV_INT <- EF	0.167	0.046	***Partial moderating effect***
	BHV_INT <- Age	0.029	0.810	
	BHV_INT <- interEF*Age	0.134	0.040	
Experience on EF–BHV_INT	BHV_INT <- EF	0.162	0.057	No moderating effect
	BHV_INT <- Exp	-0.036	0.836	
	BHV_INT <- interEF*Exp	-0.209	0.195	
Gender on SI–BHV_INT	BHV_INT <- SI	0.038	0.766	No moderating effect
	BHV_INT <- Gen	0.426	0.173	
	BHV_INT <- interSI*Gen	-0.203	0.418	
Age on SI–BHV_INT	BHV_INT <- SI	-0.040	0.762	***Complete moderating effect***
	BHV_INT <- Age	-0.042	0.738	
	BHV_INT <- interSI*Age	0.275	0.023	
Experience on SI–BHV_INT	BHV_INT <- SI	0.052	0.694	No moderating effect
	BHV_INT <- Exp	-0.262	0.257	
	BHV_INT <- interSI*Exp	0.194	0.380	
Voluntariness on SI–BHV_INT	BHV_INT <- SI	0.008	.0746	***Partial moderating effect***
	BHV_INT <- Vol	0.609	***	
	BHV_INT <- interSI*Vol	-0.033	0.032	

The results generated from the moderation effect analyses were discussed by referring to the objectives of this study and past literatures pertaining farmers adoption behaviour on modern farming technologies.

According to Table 7, only farmer's age having complete moderating effect on the relationship between farmers' social influences and their intention to adopt modern agricultural for their farming activities. The result shows that the younger generation of farmers tend to have stronger intention to adopt modern agricultural as they are not greatly influenced by social influences such as their family member, friends and other fellow farmers. This finding supported the assertion made by Gao et al. (2022) that emphasized that social factors offer non-conclusive effect on farmers' adoption behaviour on modern agricultural technology. It also agreed to assertion that described eldest farmers are afraid to take risk to adopt modern agricultural technology compared to younger generation of farmers (Mwangi & Kariuki, 2015; Sennuga et al., 2020).

Partial moderating effects happened in several relationships tested in this study. Farmer's gender has been found to cause slight change in the strength of relationship between farmer's performance expectancy on modern agricultural technology and their intention to adopt the technology. Likewise, similar effect occurred in the relationship between farmer's performance expectancy and their adoption intention as it is partially moderated by farmer's age. The aforesaid partial moderating effects indicate that male farmers and older farmers tend to have greater intention to adopt modern agricultural technology as their have strong believe that the technology will improve their farming activities output and quality. These findings support the assertion made by Crentil et al. (2018) that claimed strong confidence that the technology will bring greater performance will increase the tendency to adopt the technology. It also agreed to Lavinson (2013) and Sennuga et al., 2020) that emphasized that male farmers are bolder to try new technology.

Meanwhile, farmer's age has also indicated partial moderating effect on the relationship between their effort expectancy on the modern agricultural technology and their adoption intention on the technology as younger farmers are slightly having stronger confidence in modern agricultural technology compared to older ones, hence, enhancing their intention to adopt the technology as younger farmer believe that modern agricultural technologies are user-friendly or easy to be operated. This finding agreed to the notion made by Mwangi and Kariuki (2015), and Sennuga et al. (2020) regarding the effect of farmers' age on their modern agricultural technology adoption.

The last partial moderating effect in this study occurs in the relationship between social influences and farmer's intention to adopt modern agricultural technology as the strength of the relationship is slightly being changed by farmer's willingness or voluntariness to adopt the technology. This finding indicates that the stronger the willingness of the farmer's to adopt the modern technology, the higher would be their intention to adopt the technology. This finding fit the assertion that claimed the more knowledge the farmers have regarding the new technology, the lower would be their anxiety on risk associated to the technology, hence, enhancing their willingness and intention to adopt the technology (Karunathilaka & Thayaparan, 2016; Chandrasiri, 2013).

The rest of the moderation effect analyses have found that there are no moderation effect on several relationship namely. Farmer's gender has been found not to have moderating effect on the relationship between their effort expectancy on the modern agricultural technology and their adoption intention as the direct relationship between dependent and independent variable remain strongly significant. This finding support the assertion made by Mwangi and Kariuki (2015) that claimed gender yielded no conclusive effect on technology adoption. Similarly, the moderating analyses result indicates that farmer's experience also did

not causing significant effect on the direct relationship between effort expectancy and farmer's adoption intention.

Furthermore, the relationship between social influence and farmer's intention to adopt modern agricultural technology are also not been moderated by farmer's gender and past experience. Once again the result is congruent with assertion made by Mwangi and Kariuki (2015) that gender has no conclusive effect on farmer's adoption behaviour on the technology. Meanwhile, the insignificant effect of farmer's past experience as found in this study opposed the findings made by Sunnuga et al. (2020) Karunathilaka and Thayaparan (2016).

Finally, based on the above discussion, the following table portrays the summary of the overall result of hypotheses tests:

Table 8:
Summary of the Overall Result of Hypotheses Tests

H1: Farmer's age moderate the effect of performance expectancy, effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.	
Farmer's age moderate the effect of farmer's performance expectancy on farmers' adoption intention on modern agricultural technology	***SUPPORTED***
Farmer's age moderate the effect of farmer's effort expectancy on farmers' adoption intention on modern agricultural technology	***SUPPORTED***
Farmer's age moderate the effect of farmer's social influence on farmers' adoption intention on modern agricultural technology	***SUPPORTED***
H2: Farmer's gender moderate the effect of performance expectancy, effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.	
Farmer's gender moderate the effect of performance expectancy on farmers' adoption intention on modern agricultural technology.	***SUPPORTED***
Farmer's gender moderate the effect of effort expectancy on farmers' adoption intention on modern agricultural technology.	***REJECTED***
Farmer's gender moderate the effect of social influence on farmers' adoption intention on modern agricultural technology.	***REJECTED***
H3: Farmer's past experience moderate the effect of effort expectancy and social influence on farmers' adoption intention on modern agricultural technology.	
Farmer's past experience moderate the effect of effort expectancy on farmers' adoption intention on modern agricultural technology.	***REJECTED***
Farmer's past experience moderate the effect of social influence on farmers' adoption intention on modern agricultural technology.	***REJECTED***
H4: Farmer's voluntariness moderate the effect of social influence on farmers' adoption intention on modern agricultural technology.	***SUPPORTED***

Recommendation and Comment from Respondents
The responses obtained from the respondent also have also provide valuable information. Among the most recommended by the respondents is the government or any relevant parties to conduct training and awareness programmed exactly in village instead of conducting the programme in the cities of town as most of the farmers are located deep in the rural areas of Sarawak. Another obvious comment regarding the existing assistances offered by the government which seldom being offered directly to the target group. Responses from the

respondents described that small-holders farmers in rural areas of Sarawak are very passive and shy to apply for the assistance as well as having small knowledge about the available assistances provided by the government. Therefore, based on responses it would be better for the authorities to formulate the appropriate training and awareness programme at the location the provide convenience to the target group.

In conclusion, based on the presentation and discussion it can be concluded that all research questions are answered and all research objectives are successfully achieved.

Recommendation And Conclusion
Theoretical Contributions of the Study
The result of this study offers empirical indication regarding how farmers' adoption intention being affected by their expectation on modern agricultural technology performance, the level of effort they need to put to utilise the technology as well as social factors that influence their decision in the presence of several moderators namely: farmers' gender, age, past experience and voluntariness to adopt the technology. Well-renowned theory developed by Marikyan and Papagiannidis (2021) and Venkatesh et al. (2003) has asserted that the aforesaid factors bear significant effects on individual's adoption intention and decision on new technology. The results of hypotheses tests displayed in the previous chapter highlights several opposing findings which offer better understanding on how the adoption behaviour small-holder crops farmers in Sarawak's rural areas on modern agricultural technology differ from other part of the world as several moderating variables did not yield significant result as asserted by renowned theory mentioned earlier on.

Practical Contributions of the Study
The findings of this study provide valuable information for policy maker in enhancing the adoption of modern agricultural technology among small-holder crops farmers in Sarawak's rural areas. The findings will help relevant parties to locate relevant group of farmers that need intensive effort to enhance their awareness and willingness to adopt the modern technology so that the nation's aim to increase foods self-sufficiency ratio could be achieved as modern agricultural technology has been proven to be the most effective way to increase the output and quality of foods crops.

The finding also may contribute indirectly to UN Sustainability Development Goals particularly to those related poverty and hunger eradications as well as decent work and economic growth. The findings of this result could lead to the enhancement farming performance especially in term of output and quality of food crops. Consequently, high performance farms will create more job opportunities and could contribute to nation's economic development.

Limitation and Recommendation for Future Study
The study has been facing several limitations that should be considered seriously by future researchers. As rural farmers in Sarawak are widely geographically-scattered, only limited respondents can be reached, thus, the sample may not be the representative of the whole small-holder farmers in the state. Researcher also facing respondents' reluctant to share their honest answers as they having a stigma that they being audited by authorities as most of the farmer running their farming activities on NCR lands.

Future studies should be focusing more why small-holders farmers tend to reject modern agricultural technology despite robust government effort to enhance the adoption rate. Since

that this study focusing broadly on the small-holder farmer, future study should focus on certain type of crops or agricultural activity. Lastly, more areas should be covered in the future study for better generalization as well as obtaining even comprehensive findings.

Conclusion

Based on the research findings, farmer's age plays significant roles in affecting small-holder crop farmers to adopt modern agricultural technology. Meanwhile, farmer's knowledge on the benefits of adopting the technology must be enhanced to increase farmer's willingness to adopt the technology. Younger generation should be encourage to involve in agricultural activities as this group has been proven to be group that bold in adopting new technology as most of them are well-educated and having good knowledge of how the technology works. Furthermore, government efforts such skill and awareness training should be conducted in respective villages instead of centrally as most of the farmers are located deeply in the rural area. Government incentives should also be communicated directly to target group of farmers.

Acknowledgement

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