Research Article

Factors Influencing Behavioral Intention of Farmers to Use ICTs for Agricultural Risk Management in Malaysia

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Abstract | The primary aim of this research was to examine the factors influencing behavioral intention of farmers to use ICTs for agricultural risk management. The past research reveals that many researchers had tried to determine factors affecting behavioural intentions of the respondents and TPB has been applied as technology acceptance model in various contexts. However, predicting behavioral intentions to use ICTs for agricultural risk management has not been evaluated from the actual field. Therefore, the data were collected from 360 farmers through multistage cluster sampling technique. Multiple linear regression through SPSS was administered for statistical procedure. The findings confirmed that the theory (TPB) was statistically feasible to predict behavioral intention of farmers to use ICTs for agricultural risk management. The results further reveal that attitude was one of the most influenced of intention, which was followed by perceived behavioral control and lastly the subjective norms. Thus, using TPB in this context would be helpful for other researchers and academia to understand the influence of each construct in the model.

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Introduction

Information and Communication Technologies (ICTs) are capturing attention of farmers and related stakeholders at the national and international level for increasing production and making the agriculture sector sustainable (Zhang et al., 2016; Jere and Maharaj, 2017; Gomez-Chabla et al., 2019; Morrar et al., 2019). The digital means have been offering numerous advantages to the farmers ranging from receiving weather updates, sharing adaptation strategies, keeping digital archives of risk practices, retrieving pertinent information and obtaining guidelines to manage risks to staying in touch with fellow farmers, extension workers and other relevant agricultural agencies. The ICTs are also directing and redirecting farmers to remain updated for their farm management practices (Milovanovic, 2014).

In fact, solutions being provided by ICTs are relevant and tremendous. It is beyond doubt that farmers have been already using various ICTs like cell phones in their routine life (Samsuddin et al., 2016; Ali et al., 2018) and remarkably penetrating in the agricultural sector as well (Islam and Grönlund, 2011). Farmers' attitude is either already positive or increasing due to enormous potential offered by ICTs in agriculture sector as well. Jere and Maharaj (2017)

hold an opinion that potential of ICTs particularly in the agriculture sector help farming community in increasing profit, production and efficiency which mirrors food security. However, absence of timely awareness about agricultural risk management pulls farmers particularly resource poor farmers into the vicious cycle of poverty, less food availability and consequently leads to food insecurity and other socio-economic impediments (Hansen et al., 2018). Thus, ICTs could be blessing in the agricultural sector.

Austin and Baharuddin (2012) highlighted that natural disaster (either minor or major) particularly floods had negatively affected farmers' production, agricultural land and even flow of advancement in Malaysia. According to Alam et al. (2012), the intensity of risk may differ in terms of location and available resources to cope with the risk. That is why, Bekhet and Latif (2018) opined that for the sustainable development of Malaysia, innovative technologies and tactical policies are urgently needed and should be properly administered. Importantly, Mittal (2012) argued that expected risks in the agricultural sector may be curtailed when the farmers are informed and have competency to use ICTs exclusively ICT skills. Additionally, Ospina et al. (2014) highlighted that various tools of ICTs may help in advance preparation and identification of risks faced by farmers in different areas.

In these days, a farmer's behavior is quite different from the past. Now, farmers are becoming mentally inclined towards use of ICTs as they want quick solutions within less fraction of time and remain updated (Shalendra et al., 2011; Das, 2014) about what is going on and what should be appropriate solutions. Hassan et al. (2011) stated that ICTs usage has transformed Malaysian farmers (Zaremohzzabieh et al., 2016) and leading to achieve national vision 2020. The logic behind this behavioral intention could be the magnitude of risk involved in the agriculture sector. Farmers in Malaysia are also facing challenges due to climate changes and these changes have made agricultural sector more risky.

Conceptual framework of the study

The previous studies reflect that behavioral intention of an individual to complete an action is relying on different behavioral factors. In this regard, the widely used model in various contexts for predicting human behavior (Pavlou and Fygenson, 2006; Adnan et al., 2017) is the Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) by Ajzen (1991). According to Ajzen and Fishbein (1980), this model is actually the offshoot of Theory of Reasoned Action (TRA). In the model, intention of a person relies on three variables namely attitude, subjective norms and perceived behavioral control. The first two variables are from TRA and last variable was included later in the model and became TPB (Karppinen, 2005). Ajzen (1991) has described human behavior as "a function of compatible intentions. So, when a person has strong intention then he would be more inclined towards particular behavior (Cheung and To, 2017).

Based on the aforementioned discussion, the behavioral factors may also influence intentions of farmers to use ICTs for agricultural risk management. Therefore, the study was designed keeping in view theory of planned behavior as theoretical and conceptual model. Importantly, TPB has been tested and cited by various researchers. Additionally, the constructs of other technology acceptance models are also originated from TPB (Taylor and Todd, 1995; Perugini and Bagozzi, 2001; Mannetti et al., 2002; Venkatesh et al., 2003; Bosnjak et al., 2005). Some of the researchers such as Alavion et al., 2017; Al-Ajam and Nor, 2013 verified that the constructs of TPB was useful in examining behavioral intention of an individual. Nevertheless, all the models or technology acceptance theories have their own strengths and weaknesses so, none of the model or theory would be accepted as true at global level as noted by Ajzen, 1991; Mathieson, 1991; Gentry and Calantone, 2002; Venkatesh et al., 2003; Bosnjak et al., 2006; Crespo and del Bosque, 2008. On top of that, the constructs of other models/theories were also based on Theory of Planned Behavior so this theory was selected as conceptual model.

Although some of the researchers had decomposed TPB and included other variables from competing models like Chau and Hu (2001) but their model could not predict Information Technology (IT) acceptance well. Therefore, the original model by Ajzen was used in this study. In this point, Ajzen (1991) highlighted that the constructs of TPB are structured in way that high accuracy could be obtained to understand behavioral intentions. The other authors like Armitage and Conner (2001) have also accomplished meta evaluation of 185 TPB related studies and corroborated that this theory was useful in analyzing behavioral intentions. Likewise, Schulze

and Wittmann (2003) conducted TPB and TRA related meta evaluation of 27 studies and gathered that the constructs of TRA exhibited comparatively strong association. Importantly, TPB is the offshoot of TRA and perceived behavioral control was added and became TPB. In conclusion, the original form of TPB was adapted for this study.

Attitude is the first predictor of this model and defined by Ajzen (1991) as "the degree to which an individual favorably or unfavorably assess the behavior being examined." So attitude of the respondents affects their psychology to apply ICTs for management of agricultural risks. The subjective norm is the second important predictor in the model. According to Ajzen (1991) "it is the social pressure that makes a person to perform a particular behavior." While Li et al. (2012) stated that a person's intention to behave in particular setting could be positively influenced by subjective norms. In this study, subjective norms are the peer pressure from fellow farmers, extension field staff, opinion leaders or even family members to use or not to use ICTs for agriculture risk management.

The third important predictor is the perceived behavioral control which means that perceptions of an individual towards ease or difficulty in performing that behavior (Ajzen, 1991). Thus, respondents' intention would be high when they perceive that they are self-efficient and have competency to use ICTs. Ajzen (1991) stated that "the closest behavioral predictor is the behavioral intention. It reflects the strength of an individual that how that individual is self-motivated and willing to perform that particular behavior." In the context of this study, behavioral intention means farmers motivation and self-inclination towards ICT usage in agriculture risk management.

Some of the authors (Öhlmér, 1998; Webster, 1999; Edwards-Jones, 2006) argued that farmers are important partners in agriculture systems so, understanding of their behavior in agricultural research is very important. As this model has been pragmatic in various contexts and settings (Fielding, 2008; Al-ghaith, 2015; Meijer et al., 2015) so, the model was applied to assess factors influencing intention of farming community to use ICTs for agricultural risk management in the context of Malaysia. It was postulated that attitude, subjective norms and perceived behavioral control could positively influence behavioral intention of farmers in the study area (Figure 1). Thus, results of this study would contribute in technology acceptance progress in rural areas of Malaysia and other countries particularly in the context of agricultural risk management.

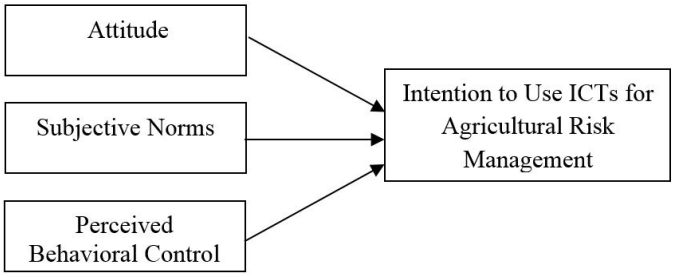

Figure 1: *Conceptual framework of the study.*
Source: *Modified from Ajzen, 2002.*

Materials and Methods

Location of the study and sampling of research population

The research was conducted in the four areas of Malaysia namely Cameron Highland and Pekan in Pahang; Muar and Segamat in Johor; Setiu in Terengganu and Pendang in Kedah (Map 1). The farmers using ICTs for risk management in the agriculture were considered as research sampling frame. Additionally, multi stage cluster technique was used as sampling procedure to collect data from farmers who were using ICTs in the areas of disaster (s). In this regard, the clusters were chosen geographically, and three states were selected which were depicting East, South and North zones. So, the areas from each state were selected randomly. Lastly, respondents were chosen through simple random sampling technique. Thus, the total data were collected from 360 farmers. These randomly selected 90 farmers were representative of various areas of state districts (Map 1).

Method of sample size selection

The sample size selection was done by adopting the method by Krejcie and Morgan (1970) at the reliability level of 0.95 along with the margin of error 0.5. If the population is more than 1 million, the suitable sample size could be 384 which is appropriate to represent the population. Cutting it short, the sample size of 360 was considered as suitable to assess factors affecting behavioral intention of farmers to use ICTs for agricultural risk management.

Development of the research instrument and statistical analysis

The research instrument in the form of questionnaire was developed by reviewing the existing literature

and keeping in mind the research objectives. The questionnaire was designed in the English language, however, the research instrument was translated and administered in the native language (*Bahasa Melayu*). The help of local enumerators was sought to collect the data from field by interviewing face to face from respondents.

Map 1: *Map showing states of Malaysia* .
Source:*google maps.*

Before data analysis, the collected data were checked properly to ensure completeness and avoid any inaccuracy. Lastly, the statistical analysis was performed by using SPSS (Statistical Package for Social Sciences, version 21) to generate regression results.

Importantly, Multicollinearity is one of the problems to be checked in regression analysis as this create issue in R^2 size and show high correlation between independent variables (IVs). So, this issue was checked through tolerance and Variance Inflation Factor (VIF) as these two methods are commonly used (Kleinbaum et al., 1988). Furthermore, in order to analyze the significant factors which could reveal the behavioral intention to use ICTs for agricultural risk management by the farmers, multiple regression analysis was used. Actually, multiple regression technique can identify the best independent factors among various factors on the single dependent variable. Therefore, attitude towards ICT use, subjective norms and perceived behavioral control about ICTs usage were considered as independent variables and behavioral intention to use ICTs were considered as dependent variable. Importantly, according to statistical guidelines suggested by Hankins et al. (2000), in case of using multiple regression technique in the context of TPB, adjusted R^2 should be used instead of R^2 while mentioning the results. According to Kianpisheh et al. (2011, November), "R square is an overall measure of the success of a regression in predicting dependent variable from independent variable. Adjusted R square measures the proportion of the variation in the dependent variable accounted for by the explanatory variables." Thus, adjusted R^2 has been used to explain variance in reporting of the results.

Results and Discussion

The statistical results revealed that there was no issue of multicollinearity between the selected independent variables as VIF was less than value of ten and level of tolerance was not ≤ 1 in any independent variable (Table 1).

Table 1: *Result of multicollinearity.*

Variables	Tolerance	Variance inflation factor (VIF)
Attitude	0.372	2.688
Subjective norms	0.529	1.889
Perceived behavioral control	0.429	2.333

According to the results shown in Table 2, there is high relationship between attitude, subjective norms, perceived behavioral control and intention of the farmers (r= 0.730) as prescribed in the Guildford rule. Furthermore, approximately 53% (adj. R^2) variance in the dependent variable (intention) is explained by three independent variables of TPB.

The results further depict that all the three independent variables had positive influence on the farmers' intention as Beta coefficient values were positive. Likewise, the first predictor was attitude, which showed highest influence (β=0.429) with positive sign and was statistically significant as mentioned in the Table 1. These findings are in line with other researchers (Nchise, 2012; Alavion et al., 2017), who used TPB as model in their research. However, these findings astonishingly contradict with the study of Park and Yang (2012) in which the first predictor (attitude) could not influence attitude of respondents. This variation could be due to individual intention which could vary from place to place, context, educational level, digital infrastructure, easy access, availability, cost, culture and ICT illiteracy.

Table 2: *Factors affecting intention of farmers to use ICTs for agricultural risk management.*

Model	Coefficient						
	R	R^2	Adj. R^2	B	Beta	t	Sig.
Predictor	0.730	0.533	0.529	.863		5.147	0.000
Attitude				.429	.460	7.747	0.000
Subjective norms				.109	.100	2.002	0.046
Perceived behavioral control				.245	.240	4.348	0.000
Durbin Watson				1.861			
F Value				135.650			

** Significant at 0.05 level. a. Dependent Variable: Intention of farmers to use ICTs for agricultural risk management.*

Although the second predictor in the model is subjective norms but perceived behavioral control revealed comparatively higher influence (β=0.245) on the intention of farming community. Additionally, this predictor also displayed a positive sign and was statistically significant. Therefore, it can be gathered that second highest influence was created by perceived behavioral control. The third predictor was subjective norms in the TPB. This variable was also statistically significant and shown positive sign. Nevertheless, the subjective norms shown significant influence on intention of farmers but comparatively less (β=0.109). Thus, the results generated through multiple regression technique reveal that all the three predictors of TPB had influence on intention of farmers to use ICTs for agricultural risk management. Importantly, this model (Figure 2) shows that the data are fit to explain the behavioral intention of farmers to use ICTs for agricultural risk management in the lens of Malaysia, and the regression equation is presented as under.

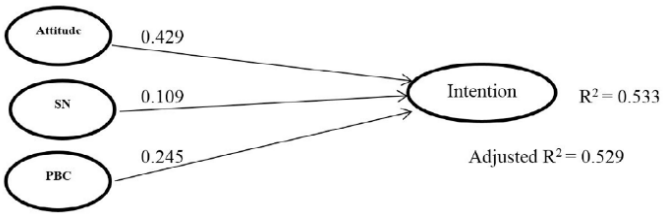

Figure 2: *Study's fit model (Intention = 0.429 (attitude) + 0.109 (SN) + 0.245 (PBC)).*

Conclusions and Recommendations

The research was designed to evaluate factors affecting behavioral intention of farmers to use ICTs for managing agricultural risks. Understanding factors influencing behavioral intention of farmers assist extension service providers (public and private), policy makers and other interested players to devise policies and programmes accordingly. So three constructs of TPB were used in the model to achieve the objective. The findings show that all the three constructs were statistically able to predict behavioral intention of farmers. Furthermore, among the three predictors, attitude had highest influence on farmers' intention. Attitude was followed by perceived behavioral control and subjective norms were at last to influence intention of farmers. Overall, 53% variance (adj. R^2) was explained by the three predictors of the model. In conclusion, the findings support the TPB in predicting behavioral intention of farmers to use ICTs for agricultural risk management in the context of Malaysia.

Timely provision of extension services with commitment by the agricultural advisors makes significant contribution, not only uptake of agricultural innovations but also reduce adverse impacts of climate changes due to which agriculture business has become more risky. Therefore, farmers need continuous guidance and support from agricultural advisors to manage agricultural risks through digital interventions. In this regard, agricultural advisors are also required to get equipped with various ICTs so that they can easily change attitude and inclination of farming community. Pre service and in service trainings should be planned by the management of public and private sectors for their agricultural extension staff on a routine basis as these slots are directly linked with farmers and may influence in adoption or use of ICTs in the agricultural sector. Another important concern is the addition of ICTs in the agricultural policies of Malaysia and other countries so that true potential of ICTs may be harvested in order to increase crop production, farm income and disaster resilience of the farmers. Thus, the results of this research would be useful for various agricultural stakeholders from the context of Malaysia and other countries where ICTs are flourishing in the agricultural sector in general and agricultural risk management in particular.

Author's Contributions

The findings are from PhD research work of Muhammad Ali. Muhammad Ali, Norsida Man, Farrah Melissa Muharam and Siti Zobidah Omar brainstormed about the application of Theory of Planned Behaviour (TPB) in the perspective of Malaysia. Later the research instrument (questionnaire) was formulated and assessed by all the authors for validity. Muhammad Ali collected the data, written the first draft and reviewed the literature. Norsida Man supervised the research and directed in data analysis. Farrah Melissa Muharam and Siti Zobidah Omar also assisted in proofreading, editing and value addition of the manuscript.

Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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