The Proposed of ICT Adoption Foundation in Malaysian Agriculture

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Abstract. In the new knowledge era, Information and Communication Technology (ICT) has been a part of human life and play a great role in our society. The ICT revolution has brought great implication in both social and economic development especially varies fields and industries for most of the development countries including Malaysia. This article proposed a conceptual framework from general overview of the Information and Communication Technology (ICT) adoption in Malaysian agriculture. The researcher proposed a conceptual framework that was constructed from three main constructs such Farm Work Designs, Environment and Technology characteristics. The proposed framework underpinned Technology-Organization-Environment (TOE) framework that was introduced by Louis G. Tornatzky and Mitchell Fleischer (1990) in their book, "The Processes of Technological Innovation". In this article, the researcher introduced Farm Work Design as internal factor that was in contrast with the Environmental factors in context of technology adoption within an organization. The proposed framework outlined a direct effect from all three main constructs with the ICT adoption among farmers in Malaysia. There were 209 respondents answering questionnaire in this study and the measurement of internal consistency shows the Cronbach's alpha result $\alpha = 0.81$, which considered as accepted reliability value. All constructs show a positive significant coefficient of multiple correlations result, $R = 0.629$, which means all constructs have a strong positive multiple correlation with the ICT adoption. As conclusion, the proposed conceptual framework may consider as basic foundation for general ICT adoption overview in perspective of Malaysia agriculture industry.

Keywords: ICT adoption, Malaysian farmer, agriculture.

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INTRODUCTION

Malaysian agriculture has gone through many transformations since early 80's. The development of agriculture has taking place in rural area along with the land development in the country. The agriculture development includes the livestock, paddy rice, marine and aquaculture products, cash crops such fruits and vegetables, food processing and others (Performance Management and Delivery Unit (PEMANDU), 2011). It is important to sustain the development of agriculture to ensure the food security issue in the country.

In the new knowledge era, Information and Communication Technology (ICT) has been a part of human life and play a great role in our society. ICT has been one of the key feature to improve the livelihood (Chikaire et al., 2016; Duncombe, 2006). It is essential to introduce ICT in agriculture industry as part of the development towards the agriculture sustainability in this country. Therefore, this study was focused on ICT adoption in context of Malaysian agriculture.

LITERATURE REVIEW

There are many definition of ICT adoption introduced by great scholar in information systems study. The researchers interested to the definition which reflect to the scope of agriculture field. M.F. Warren (2002) defined the "ICT as tools that can be used to embrace stand-alone media such telephone, television, video, teletext, voice information systems and fax, as well as those requiring the use of a personal computer fitted with a modem" (Warren, 2002). Meanwhile, more comprehensive definition quoted by Michail Salampasis and Alexandros Theodoridis (2013) from World Bank's Agriculture and Rural Development division (Salampasis & Theodoridis, 2013):-

> *"ICT is any device, tool, or application that permits the exchange or collection of data through interaction or transmission. ICT is an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers. Second, these ICTs and others have gained traction even in impoverished regions. The increases in their affordability, accessibility, and adaptability have resulted in their use even within rural homesteads relying on agriculture"*

The researcher concludes the ICT adoption in agriculture as the ICT products and services which related to technology diffusion that enable farmers to perform tasks and activities in agriculture applications. In context of organization adoption, the technology-organization-environment (TOE) framework in information systems theory gave broad understanding towards the nature of phenomenon in this study.

Technology-Organization-Environment (TOE) framework was introduced by Louis G. Tornatzky and Mitchell Fleischer (1990) in their book, "*The Processes of Technological Innovation*". The TOE framework was first mentioned by Rocco DePietro, Edith Wiarda and Mitchell Fleischer in the chapter of the book entitled "The context for change: Organization, technology and environment", and described the technology adoption

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change within firm levels through the dimension of technological, organizational and environmental characteristics. It has been described in a "generic" manner, viewing the framework from a high level perspective within organizations (Zhu & Kraemer, 2005). For that reason, the TOE framework has widely been chosen as the underpinning theory for technology adoption in cross-discipline studies.

There are three major components of variables related to the TOE framework which are Technology, Organization and Environment. Technology related to the technology characteristic that enable to ICT adoption within the organization. Meanwhile, Louis Tornatzky and Mitchell Fleischer (1990) defined the Organization characteristic as opposite to the Environment characteristic. Organization related to the internal organization characteristic that influence the technology adoption. Therefore, the researcher introduced Farm Work Design as specific characteristic within organization which related to the agriculture activities. Farm work design derived from the work and job design theory introduced by great scholars such Frederick P. Morgeson, Stephen E. Humphrey, and Adam M. Grant (Grant, 2007; Humphrey et al., 2007, 2009). Other than that, Environment characteristic related to the outside and external organization factor that influences the technology adoption.

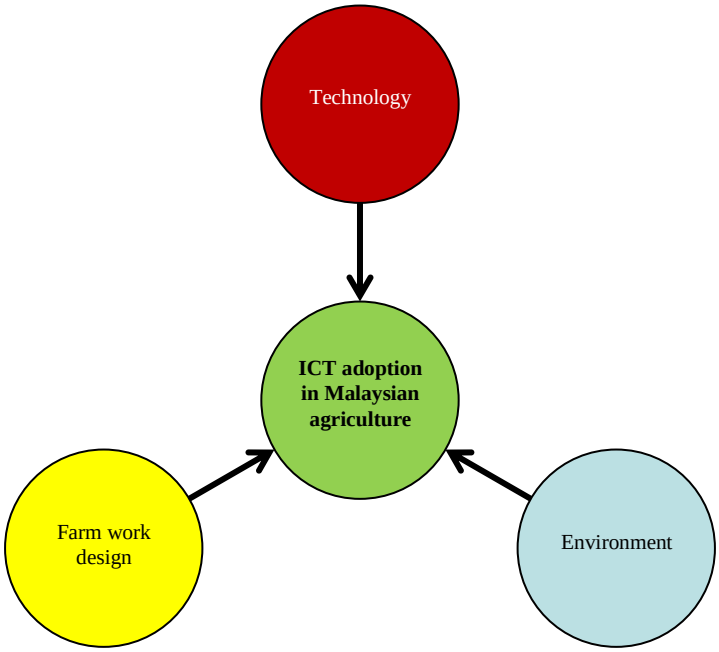

FIGURE 1. The ICT Adoption Framework in context of Malaysian Agriculture.

This article focused on more prevalent internet application and its related services, including web applications, mobile applications, and other World-Wide Web (WWW) services such online social network, text messaging, and others.

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METHODOLOGY

The researchers used the quantitative approach to be used in this study. The method of data collection is through survey questionnaire distributed to 336 smallholder farmers in Selangor state in Malaysia. Selangor has been selected as area of the study due to the highest rate of computer and internet usage in Malaysia (Malaysian Communications and Multimedia Commission, 2013). After the questionnaire had been distributed and then collected, the data obtained were keyed into the statistical software SPSS version 21 with a network license provided by Pejabat Teknologi Maklumat (InfoTech), Universiti Teknologi MARA.

Respondents and Participants

The study conducted among smallholder farmers in Taman Kekal Pengeluaran Makanan (TKPM) in Selangor. the researcher set a restriction to the respondents that they must have experiences in using computer or smartphone in order to answer the questionnaires. The restriction gave results only 209 (63%) respondents that able to answer the questionnaires.

TABLE 1. Frequency Distribution of Respondent Profile

Variables		Number of Respondents	Percentage
Gender	Male	185	88.5%
	Female	24	11.5%
Race	Malay	191	91.4%
	Chinese	17	8.1%
	Indian	1	0.5%
	Others	0	0%
Farm Location	TKPM Serdang, Petaling	8	3.8%
	TKPM Sg.Blankan, Sepang	152	72.7%
	TKPM Hulu Chuchoh, Sepang	22	10.5%
	TKPM Semenyih, Hulu Langat	1	0.5%
	TKPM Sg. Batangsi, Hulu Langat	5	2.4%
	TKPM Hulu Yam, Hulu Selangor	4	1.9%
	TKPM Sg. Kelambu, Kuala Langat	3	1.4%
	TKPM Kundang, Kuala Langat	9	4.3%
	TKPM Bkt Changgang, Kuala Langat	4	1.9%
	TKPM Sg. Panjang, Sabak Bernam	1	0.5%
Major Crop Planted	Fruits	20	9.6%
	Vegetables	29	13.9%
	Herbs and Landscape	4	1.9%
	Others	156	74.6%
Farm Size	Less than 1 acre	3	1.4%
	1-5 acres	147	70.3%
	6-10 acres	42	20.1%
	11-20 acres	12	5.7%
	More than 20 acres	5	2.4%

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Among the 209 smallholder farmers, 185 (88.5%) were male whereas 24 (11.5%) were female farmers. There were 191 (91.4%) farmers is Malay, 17 (8.1%) farmers is Chinese and 1 (0.5%) is Indian. The highest answered questionnaire was at TKPM Sg. Blankan, Sepang with 152 (72.7%) smallholder farmers. Meanwhile, the lowest answered questionnaire was at TKPM Semenyih, Hulu Langat and TKPM Sg. Panjang, Sabak Bernam with only 1 (0.5%) farmer. Most of the smallholder farmers' farm sizes were between 1-5 acres with 147 farmers (70.3%). There were only 3 farmers (1.4%) have farm size less than 1 acre. The summary demographic information of the respondents presented in TABLE 1TABLE 1. **Frequency Distribution of Respondent Profile**.

Instrument

The instrument used in this study was adapted from multiple resources from previous researches (Davis, 1989; Morgeson & Humphrey, 2006; Porter, 1979; Samaras, 2000). The questionnaire was selected due to the reliability and validity of the questionnaire in context of their previous study which will assist researcher in this study. This survey used 5-point Likert scale, ranging from 1 which is strongly disagree (*sangat tidak setuju*) to 5 which is strongly agree (*sangat setuju*). The translation of the questionnaire between Bahasa Malaysia and English were done by a professional translator who possesses a certificate in 'General Translation Course' conducted by the Malaysia National Institute of Translation. The translation works were done by a professional translator to provide consistency in the data analysis process and safeguard the reliability of the questionnaire as measurement tools in this study.

ANALYSIS AND FINDINGS

The questionnaires collected were analyzed using SPSS statistical software. The result from Cronbach alpha's shows in TABLE 2 for N=209 respondents. The coefficient alphas for all type of variables were between .788 for environment and .874 for ICT adoption. As all variables showed results of between 0.6 and 1.0, the questionnaire was considered reliable and reasonable with sufficient internal consistency for this research. Meanwhile, the total reliability analysis through Cronbach Alpha result was 0.843 which is considered as high reliability.

TABLE 2. Results of All Variables Reliability Analysis (N=209)

No	Variables	Type	No of item (s)	Cronbach's Alpha
1	ICT Adoption	Dependent	12	.874
2	Farm Work	Independent	16	.830
3	Technology	Independent	16	.841
4	Environment	Independent	24	.788

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Correlation Analysis

The simple correlation coefficient gives information on the scatter of one interval/ratio variable to another. It is also used to test the degree of association between variables within the sample distribution of all of the possible values in statistic. The r value is the correlation assessment which normally between range of -1 and +1 (Pallant, 2005).

TABLE 3. Results of Pearson correlations between all variables

		FARMWORKS	ENVIRONMENT	TECHNOLOGY	ICT
FARM WORKS	r	1	.185**	.143*	.181**
	Sig. (2-tailed)		.008	.039	.009
	N	208	208	207	208
ENVIRONMENT	r	.185**	1	.430**	.423**
	Sig. (2-tailed)	.008		.000	.000
	N	208	209	208	209
TECHNOLOGY	r	.143*	.430**	1	.599**
	Sig. (2-tailed)	.039	.000		.000
	N	207	208	208	208
ICT	r	.181**	.423**	.599**	1
	Sig. (2-tailed)	.009	.000	.000	
	N	208	209	208	209

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

*. Correlation is significant at the 0.05 level (2-tailed).

TABLE 3 shows the Pearson correlation, r, significant between all variables. The Technology and ICT Adoption with r = .599, n = 208, p <.01, that is, a strong positive relation with a level of significance (p < .01). Meanwhile, Environment and ICT Adoption also showed a significant indicator of a strong and positive relationship between Technology and ICT Adoption with r = .423, n = 209, p <.01. The Farm Work Design relationship with ICT Adoption showed a significant indicator of a positive relationship with r = .181, n = 208, p <.01. Meanwhile, the Technology and Environment also showed a significant indicator of a positive relationship with r = .430, n = 208, p <.01. Other than that, Farm Work Design relation with Technology showed significant indicator of positive relationship with r = .143, n = 207, p <.05.

Regression Analysis

Multiple linear regression analysis is used to analyze two or more variables to establish the strength of the relationship between them. The two variables are regularly represented as X and Y, with one an independent variable (or explanatory variable), and the other a dependent variable (or output/outcome variable).

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The multiple linear regression models can be written as follows:

$$Y = a + b1X1 + b2X2 + b3X3 + \ldots + bnXn + e$$

Where;

Y = Dependent variable
a = Constant
b1, b2, b3, and bn = Weight/ Regression coefficient
X1, X2, X3 and Xn = Independent variables
e = Error/ Residual due to other factors

The multiple linear regressions for all independent variables had correlation and contribution (39.6%) at significance ($p < .01$) towards ICT adoption among smallholder farmers in Malaysia. Using the enter method it was found that environment and technology explained a significant amount of the variance in the ICT adoption by smallholder farmers in Malaysia ($F(3, 203)=34.407$, $p<.01$, $R^2=.396$, R^2Adjusted=.387).

TABLE 4. Results of Pearson correlations between all variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.069	.464		.149	.000
	TECHNOLOGY	.554	.067	.499	8.241	.000
	FARM WORK DESIGN	.077	.058	.074	1.321	.048
	ENVIRONMENT	.323	.099	.199	3.264	.001

a. Dependent Variable: ICT

R = .629
R square (R^2) = .396
Adjusted R square = .387
Standard Error of the Estimate = .566

TABLE 5. Variances analysis (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.739	3	14.246	34.407	.000[b]
	Residual	65.125	203	.321		
	Total	107.864	206			

a. Dependent Variable: ICT

b. Predictors: (Constant), ENVIRONMENT, FARM WORK DESIGN, TECHNOLOGY

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As a final result, the multiple linear regression models for ICT adoption in Malaysian agriculture can be written as:-

$$Y = 0.069 + 0.544X + 0.077Z + 0.323W + 0.566$$

Where,
Y = ICT Adoption
X = TECHNOLOGY
Z = FARM WORK DESIGN
W = ENVIRONMENT
Constant = 0.069
e = 0.566

CONCLUSION

This study was conducted to find out the foundation of ICT adoption framework in Malaysian agriculture. The insight framework gave indication that the adoption of ICT totally relies on the setting of Technology, Environment and Farm Work Design which derived and underpinned from TOE framework (Tornatzky et al., 1990).

The framework has outlined the influence factors in ICT adoption among smallholder farmers specifically in the Malaysian context. The framework could lead to better of future IS implementation in the Malaysia. However, the framework needs to be improved by using multi-methodologies, adding mediator or moderator, and avoiding common method variance (CMV). In addition, more sample size will lead for better generalization of the findings.

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