FACTORS INFLUENCING A NEW INFORMATION AND COMMUNICATION TECHNOLOGY ADOPTION IN MALAYSIA'S AGRICULTURE COMMUNITY: APPLYING THE SUSTAINABLE LIVELIHOODS APPROACH

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─**Abstract**─

ICT intervention in agriculture sector is creating new challenges and opportunities for promoting sustainable farming in Malaysia. This study draws on a research program which is driven by a top research university in Malaysia collaboration with a local agriculture agency in developing a Mobile Community for Farmers. The Mobile Community is a web-based application that deploys Short

Messaging Service (SMS)-based technology to assist the farming community in improving their management of farming activities. This study focused on identifying the factors that influence the adoption of the information and communication technology (ICT). Sustainable livelihood framework is introduced in this study in order to fill the gaps in the existing studies of technology acceptance especially technology that promote sustainable livelihood. Most of the technology acceptance models today are overemphasized on the characteristics of the technology itself rather than understanding the impact of a technology towards the livelihood capital assets (human capital, social capital, finance capital, and natural capital). We used partial least square (PLS) analysis and structural equation modeling (SEM) to examine the relationships of human capital assets with farmers' attitude toward intention to adopt the ICT. The results, besides indicating the suitability of the PLS in statistical analysis, has also contributed to a better understanding of ICT intervention in the agriculture sector in Malaysia which has not been tested. Findings are useful for policy makers, agriculture agencies and information system developers to promote sustainable farming through ICT intervention.

Key Words: *Mobile Technology, Technology Adoption, Agriculture Management, PLS Analysis*

JEL Classification: Q000

1. INTRODUCTION

Driven by the desire to improve access to knowledge among the farmers community in Malaysia, the School of Computer Sciences, Universiti Sains Malaysia (USM) has collaborated with Muda Agricultural Development Authority (MADA) and Suka Setia Section C Farmer's Organization in Simpang Empat Kangkong, Kedah, Malaysia. The objective of the collaboration is to develop a Mobile Community for Farmers which is used to help the communities by fostering communication and knowledge sharing capabilities using information and communications technologies (ICT). The Mobile Community is a web-based application that deploys Short Messaging Service (SMS) based technology to assist the farming community in improving the management of farming activities. It allows an inexpensive and fast delivery of information to farmers via SMS. This information includes weather forecast, paddy disease notification, schedule of farming activities, and membership registration periods at the MADA office. Then, a survey is conducted to study the Mobile Community penetration and

adoption among the farmers community. The result of the survey shows that Mobile Community is pervasively adopted among the farmers community, but several perceived factors associated with Mobile Community usage were evident. Therefore, this paper aims to understand the factors that influence Mobile Community adoption and use.
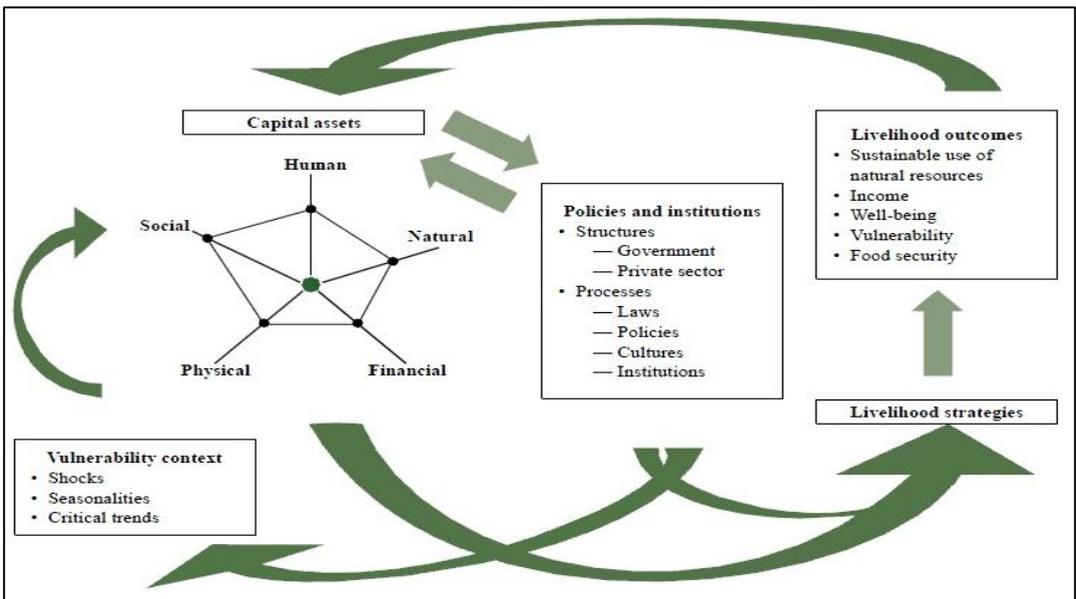
2. THE SUSTAINABLE LIVELIHOOD FRAMEWORK

Chambers and Conway (1992) defined sustainable livelihoods as:

"A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base".

The sustainable livelihood framework is adapted from UK's Department for International Development to improve the understanding of the livelihoods of the poor. This framework combined factors that constraint and enhance livelihoods opportunities. The framework is shown in Figure-1.

Figure-1:   **The Sustainable Livelihoods Framework**

Source: Deparment for International Development of the United Kingdom:1999

The main interest in this study is to understand how capital assets (the central notion of the framework) affect the farmer's attitudes in adopting the ICT. Therefore, the discussion of the framework will concentrate more on the capital assets.

In this framework, different households have different access to the capital assets mentioned in the framework. The capital assets include: the human capital, social capital, natural capital, physical capital, and financial capital. Sometimes, the poor people have to make trade-off and choices about the capitals according to the perceived values that they can derive from the capital itself. The *human capital* refers to the skills, knowledge, ability to work which enable people to pursue different livelihood strategies. The *social capital* refers to the networking and relationship which people can draw in pursuit of livelihoods. *Natural capitals* refer to the natural resource stocks from which resource flows useful for livelihoods are derived. *Physical capital* refers to the basic infrastructure for the supply of energy, shelter, water, transport and communications, and production equipment. Finally, the *financial capital* is related to the financial resources available which provide livelihood enhancement. None of the single category of capital assets can be sufficient on its own to yield all the livelihoods outcome mentioned in the framework.

3. RESEARCH FRAMEWORK

Research on technology acceptance and use has been done extensively and many adoption models have been developed to explain the users' acceptance and use. These models originated from multi-theoretical disciplines such as Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Innovation Diffusion Theory (IDT), and Unified Theory of Acceptance and Use of Technology (UTAUT). Those theories are very successful in predicting technology adoption in certain domain area but it seems to be insufficient to demonstrate the equivalent predicting power when the usage of the technology itself is aimed to enhance the livelihoods of the user.

Applying sustainable livelihoods approach provides a framework for understanding the ICT interventions that is primarily focused on the needs of the farmers rather than on the technology. Technology adoption behaviour as the use of technology among the farmers largely depends on the ability of the technology to create impacts on their livelihoods rather than the characteristics of the technology. This study aimed to assess the ability of the technology to create impact on livelihoods which subsequently affect the farmers adoption behaviour.

The main impacts on livelihoods are measured in terms of the capital assets: human capital, financial capital, social capital, and natural capital. Physical capital is removed from the research framework because the technology itself basically functioned to improve the communication and information sharing among the farmers related to agriculture information rather than improving the infrastruce of the area. Then, the impact of the technology to enhance the capital assets will create a postive attitude among the farmers and subsequently affecting their intention to adopt the technology. *Attitude* has been an important antecedent in many technology adoption theories like TRA, TAM, and TPB. Hence, the conceptual framework is proposed in Figure-2.

 Figure-2:   **Conceptual Framework**
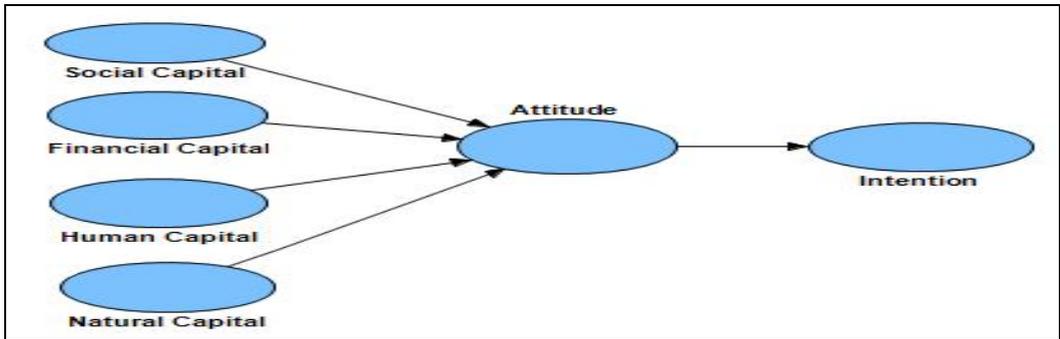
According to the conceptual framework, hypotheses are formulated as below:

H_1 : Social capital is positively related with attitude towards adopting the Mobile Community

H_2 : Financial capital is positively related with attitude towards adopting the Mobile Community

H_3 : Human capital is positively related with attitude towards adopting the Mobile Community

H_4 : Natural capital is positively related with attitude towards adopting the Mobile Community

H_5 : Attitude is positively related with intention to adopt the Mobile Community

H_6 : The impact of social capital on intention is mediated by attitude towards adopting the Mobile Community

H_7 : The impact of financial capital on intention is mediated by attitude towards adopting the Mobile Community

H_8 : The impact of human capital on intention is mediated by attitude towards adopting the Mobile Community

H_9 : The impact of natural capital on intention is mediated by attitude towards adopting the Mobile Community

4. RESEARCH METHOD AND ANALYSIS

The unit of analysis in this study is all the paddy farmers who have been selected to use the Mobile Community in Simpang Empat Kangkong, Kedah, Malaysia. A total of two hundred self-administered questionnaires were used for data gathering from the respondents. A total of 150 questionnaires were received and used for this study which give a 75% response rate.

4.1 Convergent Validity

Convergent validity refers to the degree in which items measuring the same concept are consistent. Three methods are used to assess the convergent validity namely factor loadings, composite reliability, and average variance extracted (loading, CR and AVE respectively in Table-1). The cut-off value for factor loadings are 0.5 (Hair, Black, Babin, & Anderson, 2010). Composite reliability values depict whether the construct indicators indicate the latent construct, should show a value above 0.7 (Hair, Black, Babin, & Anderson, 2010). The average variance extracted is the variance in the indicators as explained by the common factor. It should be greater than 0.5 to justify using a construct (Barclay, Thompson, & Higgins, 1995). Table-1 summarizes the result of the measurement model. The result shows that all the constructs used in the model are valid measures based on their parameter estimates and statistical significance.

4.2 Discriminant validity

Discriminant validity measures the degree in which items differentiate among constructs. To show discriminant validity, items should load more strongly on their own constructs in the model compared to other constructs. The average variance shared between each construct and its measures should be greater than the variance shared between the construct and other constructs (Compeau, Higgins, & Huff, 1999). Table-2 shows that the squared correlations for each construct are less than the average variance extracted by the indicators measuring

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that construct. In total, both convergent validity and discriminant validity are demonstrated in the measurement model.

Table-1:   **Result of Measurement Model**

Model Construct	Measurement Items	Loadings	AVE	CR	t-Value
Attitude	ATT 1	0.925	0.786	0.936	38.563
	ATT2	0.904			38.804
	ATT3	0.778			12.884
	ATT4	0.929			57.193
Financial Capital	FC1	0.894	0.780	0.914	38.391
	FC2	0.855			25.202
	FC3	0.899			50.863
Human Capital	HC1	0.837	0.733	0.892	28.300
	HC2	0.885			28.652
	HC3	0.846			18.372
Intention	INT1	0.943	0.857	0.947	64.704
	INT2	0.935			57.016
	INT3	0.899			27.092
Natural Capital	NC1	0.770	0.717	0.883	6.697
	NC2	0.866			17.009
	NC3	0.900			31.706
Social Capital	SC1	0.923	0.794	0.920	64.550
	SC2	0.872			27.222
	SC3	0.877			29.686

Note: AVE = Average Variance Extracted, CR = Composite Reliabilit

Table-2:   **Discriminant Validity of Constructs**

Constructs	1	2	3	4	5	6
1. Attitude	**0.786**					
2. Financial Capital	0.505	**0.78**				
3. Human Capital	0.437	0.579	**0.733**			
4. Intention	0.717	0.464	0.416	**0.857**		
5. Natural Capital	0.146	0.216	0.244	0.183	**0.717**	
6. Social Capital	0.338	0.408	0.443	0.413	0.578	**0.794**

Note: The diagonal entries represent the average variance extracted while the other entries represent the squared correlations

5. HYPOTHESES TESTING

Path analysis is used to test the nine hypotheses created in this study. The R^2 value was 0.556 suggesting that 55.6% of the variance attitude can be explained using social capital, financial capital, human capital, and natural capital. Social capital is found to have a positive relationship ($\beta = 0.234$, $p<0.1$) with attitude. Financial capital ($\beta = 0.444$, $p<0.01$), and human capital ($\beta = 0.223$, $p<0.05$) were positively related to attitude. The relationship between natural capital and attitude is found to be insignificant at any significant level. Therefore, H1, H2, H3 are supported and H4 is rejected. Next H5 is supported where the attitude is found to have a positive relationship ($\beta = 0.847$, $p<0.01$) with intention. The R^2 value further explains that 71.7% of the variance in intention can be explained by attitude.

The mediation effect of attitude on intention and the independent variables have been tested using Sobel's test (Sobel, 1982). The result shows that attitude mediates significantly on the relationship between social capital, finance capital, human capital, and natural capital towards intention. Next, the mediator effect is further tested using Baron and Kenny's test (Baron & Kenny, 1986) to justify whether partial or full mediation occurs. The result shows that attitude mediates partially on social capital, finance capital, human capital, and natural capital towards intentions. These result supported H6, H7, H8 and H9. The full result of hypotheses testing is shown in Table 3.

Table 3. Path coefficients and hypotheses testing

Hypothesis	Relationship	Beta	t - value	Decision
H1	Social capital -> Attitude	0.234	1.866*	Supported
H2	Finance Capital -> Attitude	0.444	4.253***	Supported
H3	Human Capital -> Attitude	0.223	2.490**	Supported
H4	Natural Capital -> Attitude	-0.112	1.304	Rejected
H5	Attitude -> Intention	0.847	29.297***	Supported
H6	Social Capital -> Attitude -> Intention		6.481***	Supported
H7	Financial Capital -> Attitude -> Intention		8.360***	Supported
H8	Human Capital -> Attitude -> Intention		8.670***	Supported
H9	Natural Capital -> Attitude -> Intention		4.137***	Supported

***p<0.01, **p<0.05, *p<0.10

6. CONCLUSION

The results showed that the attitude towards the new information and communication technology is a function of the perception that the technology is able to improve farmers' social capital, finance capital, and human capital. Subsequently, the positive attitude will determine their intention to use the technology. Surprisingly, natural capital is found no relationship in shaping farmer's attitude towards the system. One of the functions provided by this technology is that it allows the authority to provide SMS alert on weather forecast and pest management techniques to the farmers. It is believed that the farmers can get the same information from other sources and hence degraded the impact of the technology in improving the farmers livelihoods through natural capitals. This study showed that among the capitals, financial capital placed the greater role in affecting farmers' attitude towards the technology. The result implied that for the development of ICT intervention in promoting sustainable agriculture, the technology should be able to increase the user financial benefits, widen their social network, and improve their skills in using computer to learn new farming techniques. System developer and policy maker should take note of the outcome

of this study because technology characteristics is the only answer to technology acceptance but how the technology can improve user livelihoods in term of capital assets is another main concerns to be considered.

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