Pertanika J. Soc. Sci. & Hum. 20 (S): 175 - 184 (2012)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Determinants of Successful Technology Adoption among Malaysian Cocoa Farmers

Ramle, K., Suandi, T.*, Maimunah, I. and Krauss, S. E.

Department of Professional Advancement and Continuing Education, Faculty of Educational Studies, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

ABSTRACT

The contribution of group dynamics is considered crucial in group development. This paper looks at the role of group dynamic factors in predicting the successful adoption of technology by Malaysian cocoa farmer clusters. A systematic collection of data and information on cocoa farmer clusters in Malaysia with parameters investigated were group process, extension agents' coordination ability and cocoa farmer clusters and extension agents' demographic data. Discriminant analysis of the data on cocoa farmer clusters and extension agents were undertaken to verify the differences in the group dynamic factors between successful and less successful cocoa farmer clusters. The findings reveal that the roles of participation in cocoa farmer clusters, membership attraction to cocoa farmer clusters and cohesiveness in cocoa farmer clusters are likely to have higher possibility to cocoa farmer clusters' success. In contrast, leadership and communication in cocoa farmer clusters were more likely to have low possibility to be successful.

Keywords: Group dynamics, cocoa farmers clusters, technology adoption, cocoa technology

INTRODUCTION

The current situation of the cocoa industry in Malaysia reflects the challenges it may face in the future. The gap between supply and demand is evident from time to time. This phenomenon is caused by the lack of involvement of major plantation companies in cocoa production in the country. Many of the plantation companies have replaced cocoa plantation with other commodities particularly oil palm. This inadvertently makes the cocoa smallholders or cocoa farmers the most important contributor to Malaysia cocoa beans supply. Therefore, in order to meet the supply and demand of cocoa production in Malaysia, participation

ARTICLE INFO

Article history:
Received: 20 November 2011
Accepted: 27 April 2012

E-mail addresses:
ramlekasin@gmail.com (Ramle, K.), turiman55@gmail.com (Suandi, T.), mismail@ace.upm.edu.my (Maimunah, I.), lateef@putra.upm.edu.my (Krauss, S. E.)
* Corresponding author

ISSN: 0128-7702

and involvement of farmers are vital in line with the nation's mission to stabilize the economy.

As an effort to address the cocoa bean production declining issue, MCB has taken steps to develop the industry in a large scale through farmers' cluster approach. One of the goals is to enhance technology adoption (TA) among farmers' cluster as improvement in TA is positively link to improve cocoa bean production. As such, MCB needs to establish and strengthen the Cocoa Farmer clusters (CFC) as the driver to enhance TA among CFC under its programme. The CFC is to assist MCB in performing its function as a centre for technology diffusion and adoption (Asgari & Wong, 2007; Choudrie & Dwivedi, 2005; Wejnert, 2002; Besley & Case, 1993) among the farmers.

The CFC is administered all over Malaysia in a collective manner and monitored periodically. The guidelines in administering and treating CFC are similar in all the regions where MCB has its physical capacities in terms of extension agents who carry out the operational duties of monitoring the CFC. Nevertheless, despite adopting similar guidelines and providing similar treatment to each of the CFC in Malaysia, MCB found that the performance of CFC in terms of technology adoption (TA) actually differs. Some CFCs adopt technology successfully, while others are less successful. This has caused concerns to MCB and therefore, the factors differentiating the performance of TA among CFC's in Malaysia need to be identified.

An advantage of farming in groups or clusters is that farmers will be able to share and help each other in adopting (Geroski, 2000; Hategekimana & Trant, 2002; Rogers, 2003) any new technological know-how. At the same time, the extension agents will be able to understand the needs and problems faced by the farmers better. In addition, the agents will also be able to provide encouragement in terms of innovation and be deeply involved in helping farmers plant their cocoa seedlings. The farming groups were formed through community development initiatives through government programmes or projects so that they are capable to meet the production target.

As CFCs is MCB's main instrument in enhancing farmers' rate of technology adoption (TA). It is therefore crucial to identify group dynamic factors that discriminate the successful TA among CFC members. The factors that discriminate to the success of TA among CFCs and group dynamic factors (GDFs) that have a significant contribution to TA are looked into in this paper.

METHOD

The objective of this study is to identify the discriminating factors on the group dynamics between successful and less successful TA among CFC. In order to attain the objective, discriminant analysis (DA) was used to verify the differences in Group Dynamic Factors (GDF) between successful and less successful CFC. Discriminant analysis is a statistical technique that is used when the dependent variables

categorical (nominal or non-metric) and the independent variables are metric (Hair, Anderson, Tatham & Black, 1995). In this study, comparisons of the groups were made using multiple discriminant analysis (contingency tables and cross-tabulations), and tested for significance with tests such as chi-square. In this study, discriminant analysis was also used to derive a linear combination of two or more predictors that will discriminate best between the defined groups.

For the purpose of this analysis, the level of TA was included as Independent Variables (IV) apart from the GDF. The Dependent Variables (DV) in the DA is the status of CFC, as classified by EAs that is successful and less successful. Hypothesis 1 is drawn to prove the existence of the differences in the CFC Group Dynamic Factors that discriminate the CFC level of performance (successful or less successful) in TA, as follows:

Hypothesis 1: *There are significant differences in the CFC Group Dynamic Factors that discriminate the CFC level of performance in TA.*

The main purpose of using DA in this research was to determine the predictors that accounted the most for the differences in the mean score of less successful and successful TA among CFC. Discriminant analysis is the appropriate statistical technique when the dependent variable is categorical and independent variables are metric (Hair, 1995). Using linear discriminant function, as shown in the following equation, the discriminant scores are the values resulting from assigning values to $X_1, X_2 \ldots X_i$ in the equation.

$$Z = W_1X_1 + W_2X_2 + \ldots W_nX_n$$

Key;

Z = Discriminant CFC score Levels of success (Less success or success)

Wi = Discriminant weight for independent variable i

Xi = Independent variable i

The relationship between the DV and the IVs is described as an equation in the following. Here, the equation was constructed based on the regression analysis. In this analysis, Enter method of DA was used.

$$Z = b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13}$$

Key of IVs:

Group Inputs: X_1 Role of participation; X_2 Cohesiveness; X_3 CFC Goal; X_4 Membership attraction; X_5 Communication; X_6 Leadership; X_{11} CFC Age; X_{13} Level of TA;

EA Coordination Ability: X_7 EA cultural competency; X_8 EA CFC coverage; X_9 EA professional skill;

Individual Inputs: X_{10} Cocoa Farming Experience; X_{12} EA Working Experience

Study Area

The study was conducted on Malaysian cocoa farmer clusters and Extension Agents of MCB. MCB defines cocoa smallholders

as farmers whose land holdings with cocoa plantings is not more than 40 ha. Under the MCB Cocoa Smallholders Development Program in the year of 2009, MCB has developed more than 7,984 cocoa farmers with the total area planted of more than 8,000 hectares (MCB Annual Report (2009).

Farmers who are involved in the programme have been listed and monitored by the EAs concern through the MCB's regional office. At present, MCB has 56 fronts line EAs in different categories. The EAs are placed in various regional offices so as to enable them to serve the cocoa farmers in their respective regions.

Data Collection

Stratified sampling method, according to Thomas and Lewis (1995), is commonly used in surveys. In this study, the sampling frames were the list of farmers in the CFC programme and the list of EAs that executed the MCB extension program and activities. In the stratified sampling method, the population is first divided into a homogeneous strata or sub-samples (grouping of individuals farmers or entities based on characteristics they share), and then simple random sampling or systematic sampling is used to select cases within each stratum.

CFCs were then compared among the eight regional offices (strata) and random sample of the CFCs from within each region. This is to ensure cases from each stratum are adequately represented in the full sample. Finally, out of 388 CFCs in Malaysia, 136 (36%) CFCs were sampled out (using Krejcie & Morgan, 1970) by using the stratified random sampling where each CFC is represented by 5 members (farmers). The sample comprised of a Chairman (compulsory), 2 or 3 committee members and 1 or 2 ordinary member(s). The total number of the CFCs' members involved in this study was 681 farmers. For the EAs, the sampling of all 56 EAs was undertaken. The farmers (respondents) were asked about their socio-economic characteristics, group leadership, participation, membership, cohesiveness, CFCs' goal and technology adoption. The questions asked on EAs relate to demographic, cultural competency, EA professional skill and intensity of CFC coordinated by EA.

Data Analysis

Discriminant analysis is a main statistical tool used in data analysis to verify the differences in Group Dynamic Factors (GDF) between successful and less successful CFCs. Besides that, basic statistical tools, i.e. frequency, means, and standard deviation, t-test, ANOVA and Pearson's correlation were also employed.

RESULTS AND DISCUSSION

Table 1 shows a summary of interpretive measure of DA. The summary of the univariate analysis indicates the influential variables to the low/high intention to share. Based on the canonical correlation result of 0.45, it is concluded that 20.3% (square of the canonical correlation) of the variance in the dependent variable is accounted for by this model.

The result of the discriminant analysis stepwise procedure, as shown in Table 1, reveals that out of the thirteen factors tested, six have significant value ($p<0.05$). Out of the six significant factors, four significant factors carry positive sign, which are the level of TA in CFC, role of participation in CFC, membership attraction to CFC and cohesiveness in CFC. Meanwhile, two significant factors carry negative sign which are leadership and communication in CFC. The variables with positive sign indicate that it helps to discriminate the CFC with high level of success, whereas the ones that carry negative sign help to predict the low level of success by CFCs. Thus, CFCs with more positive sign are more likely to have higher possibility to success. On the other hand, CFCs with more negative sign are more likely to have low possibility to be successful. The group centroids are -0.51 for the less successful and 0.44 for successful group (Table 1). High scores on the discriminant function are associated with the CFC success.

Based on the results as presented in Table 1, it can be observed that none of the variables from the external factor contribute significantly in the DA. These findings reveal that the success of TA in

TABLE 1
A summary of Interpretive Measure of CFC Discriminant Analysis

Variables		Unstd	Std	Discriminant Loading (Rank)	F Ratio	Sig.
X_{13}	Level of TA	1.04	.59	0.76 (1)	17.58^{***}	.000
X_1	Role of participation	1.57	.71	0.74 (2)	16.60^{***}	.000
X_4	Membership attraction	.90	.38	0.63 (3)	12.10^{**}	.001
X_2	Cohesiveness	.33	.10	0.49 (4)	7.20^{**}	.008
X_6	Leadership	-.84	-.32	0.40 (5)	24^{*}	.028
X_5	Communication	-.22	-.10	0.37 (6)	4.18^{*}	.043
X_3	CFC Goal	-.71	-.28	0.33 (7)	3.33	.070
X_{10}	Cocoa Farming Experience	.01	.11	0.17 (8)	.88	.350
X_{11}	CFC Age	-.09	-.28	0.16 (9)	.76	.386
X_8	EA CFC coverage	.00	.02	-0.15 (10)	.72	.396
X_{12}	EA Working Experience	.03	.16	0.12 (11)	.44	.506
X_7	EA cultural competency	-.05	-.02	0.12 (12)	.41	.521
X_9	EA professional skill	-.53	-.27	-0.02 (13)	.01	.916
	(Constant)	-6.09				.000
Group centroid at Less Success		-.51				
Group centroid at Success		.44				
Wilks Lambda		.82				
(Canonical correlation)^2		.20				

Note: Significant: $^{*}p<.05$; $^{**}p<.01$; $^{***}p<.001$
Note: Unstd= Unstandardized; Std= Standardized

a cluster largely depends on the internal strength of the CFC. They also reveal that EA coordination ability did not contribute significantly to categorising CFC. This could be because MCB adopt participatory approach in developing its CFC. As such, decision making in the cluster was left to the members of CFC rather than made by the EA in charge. In relations to TA, the EA function is to disseminate the technology to the best possible, but whether or not the CFC members adopt the technology successfully is dependent on how CFC members perceive the usefulness of the technology to their cocoa farms. As such, CFC may not adopt a technology disseminate by the EA even if it is effective, if the majority of their members refuse to accept it.

The results presented in Table 2 reveal that from the DA carried out, several GDF variables are significant at 0.05 level, indicating substantial differences in variables between the groups. As such, the findings support Hypothesis 1 that there are significant differences in the CFC's GDF that discriminate level of CFC performance in TA. The results of the DA clearly indicate the existence of discriminating capability in terms of GDF between the less successful and successful CFC. The six most significant GDF identified from the DA are the level of TA, role of participation, membership attraction to CFC and cohesiveness in CFC as well as leadership and communication in CFC. The first four show positive sign while the last two show negative sign.

One of the benefits of discriminant analysis is that it produces a classification table that shows where the data are categorized and in which groups they are

TABLE 2
Mean Comparison of Success levels of CFC

Variables		Levels of Success		F Value	*Sig.*
		Less Successful	Successful		
X_{13}	Level of TA	3.61	4.02	17.58***	.000
X_1	Role of participation	3.82	4.14	16.60***	.000
X_4	Membership attraction	3.57	3.82	12.10**	.001
X_2	Cohesiveness	4.49	4.63	7.20**	.008
X_6	Leadership	3.45	3.60	24*	.028
X_5	Communication	3.17	3.33	4.18*	.043
X_3	CFC Goal	3	4.23	3.33	.070
X_{10}	Cocoa Farming Experience	7.84	9.02	0.88	.350
X_{11}	CFC Age	4.39	16	0.76	.386
X_8	EA CFC coverage	13.90	12.73	0.72	.396
X_{12}	EA Working Experience	6.70	7.40	0.44	.506
X_7	EA cultural competency	4.52	4.56	0.41	.521
X_9	EA professional skill	3.86	3.85	0.01	.916

Note: Significant *p< .05; **p<.01; ***p <.001

predicted to be (Hair, 1995). Meanwhile, Table 3 explains the hit ratio for less successful and successful CFCs that were selected in the analysis. From the early evaluation made by EA, it was determined that there were 63 less successful CFCs and 73 successes CFCs, as shown in Table 3.

The original classification results showed that out of the 63 less successful CFCs (in terms of the rate of adoption), about 62% predicted to be members in the less successful group, while 38% predicted to have successful CFC members' characteristics. From 73 successful CFC, 22% were predicted to have the characteristics of members of less successful CFC, while 78% predicted to be members of the successful group.

As shown in Table 3, the overall predictive accuracy of the model for the analysis sample was 70.6% from the original classification. Predictions on the CFC membership showed that success was classified with slightly better accuracy (78.1%) than less success (61.9%). Based on the result presented in Table 3, discriminant function using discriminant weights value can therefore be translated into a DA Equation 1, as follows:

$$Z = .59X_{13} - .32X_6 + .71X_1 + .10X_2 + .38X_4 - .10X_5 \quad \text{Equation 1}$$

Equation 1 is used to calculate the discriminant CFC score levels of success. This finding provides MCB with a model to predict or keep track of CFC's performance in TA and also helps identify CFC categories (successful or less successful) based on their GDF. The ability to ascertain GDF that discriminates successful and less successful CFC provides MCB with early warning signal to take corrective action to support successful TA among CFC. The equation may not specifically tell MCB what is wrong with the CFC, but it encourages them to predict or to identify problems and take immediate and effective actions to minimize incidence of TA failure among the CFC.

The DA performed in this study revealed that the performance of CFC could be predicted using GDF. By using GDF as the determinant, the CFC can be categorised as successful or less successful. This finding is consistent with that of Forsyth (2006), Wheelan (2005) and Burn (2004) who stated that group performance could be differentiated through GDF. The GDF is the group communications, group structure or membership, goals and tasks, status and

TABLE 3
The Hit Ratio for Original Classification

CFC TA Levels	Predicted CFC Membership		No of Cases
	Less Success (%)	*Success (%)*	
Less Successful	39 *(61.9)*	24 *(38.1)*	63 *(100)*
Successful	16 *(21.9)*	57 *(78.1)*	73 *(100)*

The percentage of "grouped (CFC)" cases correctly classified: 70.6%. Numbers in italics indicate the row percentages.

role, leadership, and cohesion. In this study, the GDF with significant contributions to CFC performance level in TA includes the roles of participation, membership attraction to CFC and cohesiveness in CFC as well as leadership and communication in CFC. The first four of the GDF show positive sign while the last two show negative sign. The positive sign indicates a positive contribution to the CFC successful performance in TA, while the negative sign shows otherwise. Therefore, MCB could use the DA as predictors to CFC potential for success in TA. Hence, in order to ensure successful TA, MCB should give specific emphasis on the four positive GDF in the CFC early development process.

The results from the DA carried out on EA coordination ability variables indicated that they did not contribute significantly into categorising CFC as successful or less successful. This finding is interesting as EA spent most of their time disseminating information to farmers yet DA carried out revealed that this did not contribute significantly to categorise CFC as successful or less successful. A further observation confirmed that the approach in CFC development process adopted by MCB might influence this outcome. EA is given the responsibility to ensure development process goes well in CFC. However, MCB does not encourage the EA to make decisions on behalf of the CFC. In other words, MCB adopts the participatory approach of the farmers first (Chamber *et al*., 1989). As such, the final decision to adopt technology or otherwise was made by the members of CFC themselves, while EA could only advice. Despite this finding, it is important to note that without the EA, cocoa technology may not reach the farmers at all. Therefore, the role played by the EA is somehow indirectly significant to CFC TA.

As cited by Napier and Gershenfeld (1999), individuals are more attracted to join a cluster or to continue as a member in a cluster that is successful. This supports the findings of the regression analysis in this study which indicates that membership attraction to CFC is the most significant factor that influences TA among CFC. As stated by Bell *et al*. (1998), participation in a cluster helps enhance members' personal knowledge, beliefs or skills. This was elaborated further in the study by Rouse (1996) who stated that being part of a group contributed to enhancement in knowledge, empowerment, confidence and ability to make decisions among members. This contributes to the success of TA among members of CFCs. As this study opens up a new direction on ways to form successful CFC in TA, it is crucial that the approach is followed to ensure more farmers register themselves willingly as members of CFC, particularly farmers who are influential in terms of knowledge and experience in cocoa farming. This will motivate other farmers to be in the group so as to enjoy the benefits of being part of a potentially successful CFC.

CONCLUSION

The level of TA among CFCs depends largely on the assimilation of the GDF during group process. This study has highlighted that of

the six significant factors, four significant factors carry positive sign, which are level of TA in CFC, role of participation in CFC, membership attraction to CFC and cohesiveness in CFC. Meanwhile, two significant factors carry negative sign which are leadership and communication in CFC. The variables with positive sign indicate that it helps to discriminate the CFC with high level of success, whereas the variables that carry negative sign help to predict the low level of success by CFCs. Thus, CFCs with more positive sign are more likely to have higher possibility to success. On the other hand, CFCs with more negative sign are more likely to have low possibility to be successful.

REFERENCES

Asgari, B., & Wong, C. Y. (2007) Depicting the technology and economic development of modern Malaysia. *Asian Journal of Technology Innovation, 15*(1), 167-93.

Bell, M. E., Futterer, S., Gruenewald, M., Hintz, K., Lepeska, M. F., McLean, A., Nordgren, P., Rychter, P., & Taylor-Powell, E. (1998). *Community Group Member Survey: Using the Results*. Retrieved February 2009 from University of Wisconsin- Extension-Cooperative Extension at http://learningstore.uwex.edu/ assets/pdfs/G3658-9.PDF.

Besley, T., & Case, A. (1993). Modeling Technology Adoption in Developing Countries. *American Economic Review Papers and Proceedings*, *83*(2). 396-402.

Burn, S. M. (2004). *Groups, Theory and Practice*. Sydney: Thomson Wadsworth.

Choudrie, J., & Dwivedi, Y. K. (2005) Investigating the research approaches for examining the technology adoption in the household, *Journal of Research Practice, 1*(1), 1-12. Retrieved from http://jrp.icaap.org/ content/v1.1/choudrie.pdf.

Forsyth, D. R. (2006). *Group Dynamics, 4th Edition*. Belmont, CA: Thomson Wadsworth.

Geroski, P. A. (2000). Models of technology diffusion, *Research Policy*, *29*, 603-625.

Hair, J., Anderson, R., Tatham, R., & Black, W. (1995). *Multivariate Data Analysis, 4th edition.* Englewood Cliffs: Prentice Hall.

Hategekimana, B., & Trant, M. (2002). Adoption and diffusion of new technology in agriculture: genetically modified corn and soybeans, *Canadian Journal of Agricultural Economics*, *50*, 357-371.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities, *Educational and psychological Measurement*, *30*, 607-610.

MCB, TOT. (2009). *2009 Annual Report*. Kota Kinabalu: MCB.

Napier, R. W., & Gershenfeld, M. K. (1999). *Groups - Theory and Experience.* Boston: Houghton Mifflin Company.

Rogers, E. M. (2003). *Diffusion of Innovations (5th ed.).* New York, NY: The Free Press.

Rouse, J. (1996). *Empowering Zambian rural women through small farmer groups*. Sustainable Development Department of the Food and Agriculture Organization of the United Nations. Retrieved on January 8, 2009 from http://www. fao.org/waicent/faoinfo/sustdev/ PPdirect/PPan 0005.htm

Thomas, R. B., & Lewis, J. L. (1995). An evaluation of flow-stratified sampling for estimating suspended sediment loads. *Journal of Hydrology 170,* 27-44.

Wejnert, J. (2002). Integrating models of diffusion of innovations: a conceptual framework. *Annual Review of Sociology*, *28*, 297-326.

Wenger, E. (1998), Communities of practice: learning as a social system. *The Systems Thinker*, *9*(5).

Wheelan, S. A. (2005). *Group Processes – A Developmental perspective- Second Edition*. Boston: Pearson Education, Inc.