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Factors Influencing Attitude towards Technology Adoption among Permanent Food Production Park (PFPP) Program Participants in West Malaysia

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Abstract: The study explores the factors influencing attitude towards agricultural technology adoption among Permanent Food Production Park (PFPP) program participants in West Malaysia and the factors that influence their attitudes. The PFPP program is one of the programs introduced by the government of Malaysia with the objectives of increasing food production, as well as supporting local agriculture entrepreneurs. The study employed a cross-sectional study design and has been conducted in four West Malaysian states with a sample of size of 275 respondents. The results indicated that the respondents had a positive attitude towards technology adoption and factors such as knowledge and skill, benefit, education level, years of experience in agriculture and gross income had influenced their attitude.

Key words: Agriculture, technology adoption, food production.

1. Introduction

Agriculture is one of the sectors that can play an important role for national economy for many countries around the globe. It provides the basic needs for human being, which keeps them alive and meets the demands of life. One of the ways to increase agricultural productivity is through the research, development, adoption and dissemination of agricultural technologies. In Malaysia, agriculture plays an important role in its economy development process. There are specific food products that are vital Malaysian sustenance yields, and they include rice, soil grown foods (e.g., papaya, banana and pineapple), vegetables (e.g., cabbage, chilli pepper and brassicas), beans and solanaceous products (e.g., tomato, eggplant and sweet pepper). Realizing the potential of science and technology in the development of national economy and social improvement, Malaysian government has been focusing on the innovation and research and development through the integration of technology and other sectors. The government introduced some technology-based activities in agriculture, biotechnology, agribusiness and so on and focus has been shifted from basic farming to generating value added products. The introduction of National Agro-Food Policy (2011-2020) proves that the government is committed to the adoption of technology in agriculture as one of the policy objectives is to build up the activities of research and development innovation and use of new technology [1].

The government has been extensively promoting the adoption of modern farm technology such as irrigation system, farm automation, mechanization and rain house shelter. In addition, vertical farming technologies have also been introduced to cater the agriculture activities in urban areas as well as areas

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with limited and less fertile soil. The Permanent Food Production Park (PFPP) program is a plan in Third National Agriculture Plan (DNP3) with an aim to increase food production and decrease food imports, as well as to support the application of large scale of agriculture entrepreneurs. The program focused on food production especially on fruits and vegetables in order to overcome the issue of shortage of suitable land of food production. The program provides land to the agricultural entrepreneurs for farming purposes, with basic requirement according to which the farm should be operated as required and with good agricultural practices, which consequently will increase the revenue. There are five categories according to technology production practiced in this program: (i) cultivation in the open field, (ii) planting under netted structure, (iii) aerobic rice cultivation under rain cover, (iv) management, and (v) land restoration. Apart from that, basic infrastructure such as electricity, water supply, farm road, drainage system, irrigation system, office buildings and store are also required.

Technology can be categorized into two main parts: (i) a physical component which comprises items such as products, tools, equipment, process, techniques and blueprints, and (ii) the informational component consists of knowledge in management, marketing, quality control, production, skilled labor, reliability and functional area [2]. Therefore, by this definition, two basic components can be identified which are knowledge or technique and “doing things”. In context of agriculture, technology adoption is an extensive concept. Technology adoption can be affected by the development, dissemination and application at the farm of present and new biological, chemical and mechanical techniques. It is also affected by education, training, assistance and information, which form the basis of farmers’ knowledge. In addition, it includes practices in the whole agri-food sector that have an impact on the farm.

In some modern and advanced countries having attributes underdevelopment and insurance schemes, farmers commonly insulate themselves against shocks by regulating their production and consumption decisions and as such frequently apply modern agricultural technology. Previous studies disclosed that increased farm technology development and adoption can raise agricultural output and reduce shortcoming of crop inconsistency [3-5]. Furthermore, other studies presented a significant role of technology adoption in agriculture such as improving crop varieties and productions. Through Information Communication Technology (ICT), farmers are able to access information at any time and this enables them to create networks with related agencies and other farmers, and eventually increase their chances to increase their agricultural productivity [6, 7]. In addition, websites are the most popular online services for farmers and are cheaper than telephone usage. Farmers are able to access information through ICT at any time, and enable them to create networks with development agencies and other farmers, and eventually increase their chances to double their agricultural productivity [8, 9].

It is interesting to note that technology adoption has been traced to the success of the Green Revolution initiated by Norman Borlaug in Mexico in the 1940s [10]. The revolution enhanced the adoption of high-yielding crop cultivars and inputs such as organic fertilizer and irrigation. It also provides water for farming in areas with limited or no rainfall, consequently offering more land to use for food production [11]. Economic factors had also been contributing to the adoption of technology in agriculture. According to Awada *et al.* [12], the economic factors that enhanced the adoption of technology in Western Canada include the reduction in the market price, increase of crops yield and reduction of interest rate. In previous studies, the most cited factors that have been used to explain the variability in agricultural technology adoption and its

patterns of dissemination include farm size, human capital, labor availability, risk exposure and capacity, tenure, credit limitation and access to commodity markets. Economists studying consumer demand have been collected with extensive proof reveal that consumers mostly have been individual inclinations for characteristics of yields and their demand for yields is significantly impacted through observations of the product aspects while the role of farmers' inclinations in adoption decisions has expected immense consideration in adoption studies conducted by economists [13-20].

Some of the advantages of technology adoption in agriculture include ensuring food security, reducing the dependence on manpower, saving time and cost, enhancing production and products quality and also increasing quantity of yields. Several previous studies explained that the process of technology adoption and dissemination is complex, challenging and usually occurs through numerous functions [21-23], and consequently may affect the farmers' attitude towards agricultural technology adoption. Therefore, this study aimed to explore the attitude towards agricultural technology adoption among the participants of PFPP program and determine the factors that influence their attitudes towards technology adoption.

2. Materials and Methods

The study adopted a cross-sectional study design and has been conducted in four zones such as Negeri Sembilan, Selangor, Perak and Johor.

The sample of the study includes the PFPP program participations with a size of 275 farmers. The sample is formed using a simple random sampling technique. In this study, the attitude towards technology adoption is explored by considering two main elements (Fig. 1). These elements were selected based on the relevant theory and previous studies. The first element consists of two dimensions which are the socio-demographic factor and farm profile. Meanwhile, the second element consists of four dimensions, i.e., practices, attitude, knowledge and skill.

The data were collected using a well-structured questionnaire via face-to-face survey in order to

Fig. 1 The map of West Malaysia.

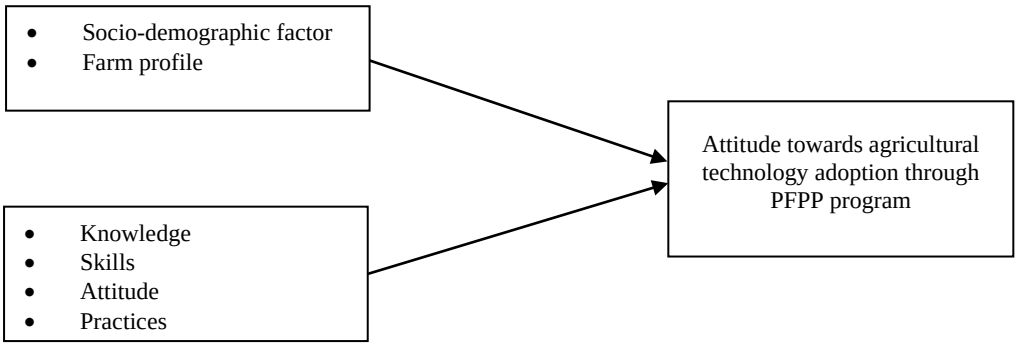

Fig. 2 Conceptual framework of the study.

obtain necessary information from the respondents and other relevant secondary data were obtained from the official website of PFPP programs, Department of Agriculture, Federal Agriculture Marketing Authority (FAMA), and related journal and articles. The questionnaire consists of five main sections: (i) socio-demographic profile of the respondents, (ii) farm profile, (iii) PFPP program activities, (iv) respondents' attitude, knowledge and skills in technology, and (v) the adoption of technology in PFPP and agriculture performance.

The conceptual framework showing factors influencing the adoption level of high technology in the study area is presented in Fig. 2.

In this study the adoption level of high technology was measured considering the two elements showing in Fig. 2. These elements were selected based on the relevant theory and literature studies. The first element has two dimensions which include socio demographic factors and farm profile. The second element shows four (4) dimensions such as knowledge, skills, attitude and practices. All these two (2) elements were considered to understand attitude towards technology adoption through PFPP program.

To ensure the reliability of the research instruments, a pilot study was conducted in Johor involving 48 farmers who were not part of the sample. The reliability test is carried out on 13 items and the Cronbach's alpha coefficient is > 80. The Cronbach's alpha values calculated for each items range between 89.2 and 97.1.

The data collected from the survey were analyzed using the Statistical Package for Social Science (SPSS) software version 22. Descriptive analysis, factor analysis and multiple regression analysis were used to analyze the data collected from the survey. Descriptive analysis in terms of frequencies and percentages, mean and standard deviation, was adopted to provide easy understanding and interpretation of the raw data. Frequency distributions and percentages were employed to describe socio-demographic characteristics of the respondents and farm profiles.

In order to analyze the factors influencing the respondents' attitude towards technology adoption, multiple regression analysis was employed. In multiple regression analysis, several independent variables are combined predict a value for the dependent variable [24]. In this study, various independent variables such as age, educational level, years of experience in agriculture, farm size, family dependents size, gross income, net income, knowledge and skills in technology and benefit were used to predict the outcome of the dependent variable which is the factor that influences respondents' attitude towards technology adoption.

2.1 Dependent Variable

The dependent variable in this study is the respondents' attitude towards technology adoption, which is a continuous variable measured in score and represents the score of respondents' attitude towards technology adoption through PFPP program.

2.2 Independent Variables

The following explanatory variables were hypothesized to influence the respondents' attitude towards technology adoption through PFPP program:

- Age: A continuous variable and measured in years. Respondents' age is expected to affect their attitude towards technology adoption, either positively or negatively
- Education level: It is a dummy variable taking a value of nine categories of level of education. One's education level is believed to increase respondents' exposure and ability to accept and adopt technology in agriculture.
- Years of experience in agriculture: A continuous variable that indicates the total number of years of experience that respondents possess in agricultural field. An experienced respondent is believed to have mastered the productive ways of farming. As a result, experience in agriculture is expected to influence respondents' attitude towards technology adoption.
- Farm size: It is a continuous variable that indicates the total hectares of land owned by the respondents. Land, as one of the important factors of production has an effect on the adoption of technology in agriculture, as bigger farm size needs more practical ways to maintain it and technology has been advancing in providing more offers in farm maintenance and agricultural sector in general. Therefore, farm size is expected to have an effect on respondents' attitude towards technology adoption.
- Family dependents size: A continuous variable that indicates the total number of people who are in immediate family. It is believed that family dependents size has a potential effect on family farming and manual labor, and therefore somehow affects the attitudes towards technology adoption.
- Gross income: A continuous variable that indicates the respondents' gross income measured in Ringgit Malaysia (MYR). Gross income refers to total amount of earnings before anything is deducted. The earnings can be used to improve farm facilities and conditions, hence gross income is expected to have an effect on respondents' attitude towards technology adoption.
- Net income: A continuous variable that indicates the respondents' net income measured in MYR. Net income refers to total amount of amount remaining after the deduction from gross income. The deductions may have been for taxes, debts, retirement plans contributions, expenses and so on. The remaining earning can be used to improve the farm conditions and facilities, therefore net income is expected to have effect on respondents' attitude towards technology adoption.
- Knowledge and skill: A continuous variable measured in score and represents the score of respondents' knowledge and skills towards technology adoption through PFPP program. Knowledge and skills in technology can be useful in harnessing agricultural practices and technology adoption as agriculture is becoming more knowledge-intensive and farm management becomes more complex. Therefore, respondents' knowledge and skills are expected to affect their attitude towards technology adoption, either positively or negatively.
- Benefit: A continuous variable measured in score and represents the score of benefit of technology adoption through PFPP. It is expected that the benefit of technology adoption in agriculture may have an effect towards technology adoption among the respondents.

3. Results and Discussion

3.1 Socio-Demographic Characteristics of the Respondents

The gender problem in technology adoption had determined for a long period as almost had been investigated or reported the combined proof for the gender as means that women and men occurred a vital role in adoption of technology [25]. Apart from that, majority authors revealed that the rate of technology adoption was insignificant or negative effecting on education [26, 27]. Adoption of new technology assumed and determined by age. Along with that, younger farmers are not more gained knowledge and

experience to evaluate or estimate technology information as compared to older farmers [28, 29].

Table 1 highlights the results of the finding, which relates to the socio-demographic characteristics of the sample population. In this section, several analyses are presented that discuss different socio-demographic characteristics of the respondents as shown in Table 1.

The analysis of the survey revealed that 93.5% of the samples are male and 6.5% are female. The religion of majority of the respondents is Islam (68%). Buddha, Hindu and Christian make up of 27.6%, 2.5% and 1.8% of the sample, respectively. Majority of the respondents (67.6%) are Malay, 29.1% are Chinese, 2.9% are Indian and 0.4% are of other races. Meanwhile, 84.4% of the respondents are married, 12.4% are single, 2.9% are widow and 0.4% are divorced. For education level, almost half of the respondents (45.1%) possess an SPM/STPM/SPMV qualification and 15.3% of the respondents study until Standard 6. Respondents that possess diploma qualification, bachelor degree, SRP/PMR qualification, master degree and doctorate make up of 13.1%, 12.0%, 8.0%, 0.7% and 0.4%, respectively. Four percent (4.0%) of the respondents have no formal education (illiterate) and 1.5% possess other education level. More than half of the respondents (54.5%) work as a fulltime farmer whereas the other 45.5% work as a part time farmer. From these 45.5%, 35.6% are self-employed and 8.7% and 1.1% of the respondents work in private company and government sector, respectively. The mean of respondents' age is 49.98.

Table 1 Socio-demographic characteristic of the respondents.

Variables	Frequency	Percentage (%)
Gender		
Male	257	93.5
Female	18	6.5
Religion		
Islam	187	68.0
Christian	5	1.8
Hindu	7	2.5
Buddha	76	27.6
Race		
Malay	186	67.6
Chinese	80	29.1
Indian	8	2.9
Others	1	0.4
Marital status		
Single	34	12.4
Married	232	84.4
Widow	8	2.9
Divorced	1	0.4
Educational level		
No formal education	11	4.0
Primary school	42	15.3
SPR/PMR	22	8.0
SPM/STPM/SPMV	124	45.1
Diploma	36	13.1
Bachelor	33	12.0
Master	2	0.7
Doctorate	1	0.4
Others	4	1.5
Main job		
Farmer	150	54.5
Government staff	3	1.1
Private company worker	24	8.7
Self-employed	98	35.6

3.2 Attitude Score towards Technology Adoption through PFPP Program

It can be observed from Table 2 that the mean value for all nine items for attitudes ranged from 3.81 to 4.03, whereby Item 8 has the highest mean score and Item 2 has the lowest mean score. It indicates that most respondents adopt technology because they believe that the adoption has importance in their farm and it would benefit them.

3.3 Relationship between Respondents' Attitude and Technology Adoption

The agricultural technology adoption tested in this study includes fertigation system, irrigation system, drainage system, agricultural mechanization, ICT, netted structure and rain protective structure. According to the result of test statistic in Table 3, there is a statistically significant negative correlation between attitude score and level of technology adoption for fertigation system (r_s = -0.218, p < 0.01), netted

Table 2 Test statistics for relationship between attitude and technology adoption.

Item No.	Description	Mean
1	The technology adoption on farm production is important.	3.97
2	I believe the adoption of technology can guarantee the quality and quantity of my farm production.	3.81
3	Technology adoption guarantees national food security.	3.93
4	I believe the adoption of technology can increase my production.	3.94
5	I am confident the adoption of technology can be carried out easily.	3.97
6	To me, technology is needed.	4.02

Table 3 Attitude towards technology adoption through the Permanent Food Production Park (PFPP) program.

			Fertigation system	Irrigation system	Drainage system	Agricultural mechanization	Information Communication Technology (ICT)	Netted structure	Rain protective structure
Spearman's rho	Attitude	Correlation coefficient	-0.218**	0.080	0.083	-0.087	-0.185**	-0.133*	-0.146*
		Sig. (2-tailed)	0.000	0.187	0.169	0.150	0.002	0.028	0.015
		N	275	275	275	275	275	275	275
	Knowledge & Skill	Correlation coefficient	-0.245**	0.005	0.036	-0.069	-0.217**	-0.128*	-0.036
		Sig. (2-tailed)	0.000	0.939	0.557	0.252	0.000	0.034	0.550
		N	275	275	275	275	275	275	275

*correlation is significant at 0.05 level (2-tailed); **correlation is significant at 0.01 level (2-tailed).

structure (r_s = -0.133, p = 0.28) and rain protective structure (r_s = -0.146, p = 0.015). Meanwhile, there is a statistically non-significant negative correlation between attitude score and level of technology adoption for agricultural mechanization (r_s = -0.087, p = 0.150) and ICT (r_s = -0.185, p = 0.002). There is a statistically non-significant positive correlation between attitude score and level of technology adoption for irrigation system (r_s = 0.080, p = 0.187) and drainage system (r_s = 0.083, p = 0.169).

For knowledge and skills, the findings revealed that there is a statistically significant negative correlation between attitude score and level of technology adoption for fertigation system (r_s = -0.218, p < 0.01), ICT (r_s = -0.217, p < 0.01) and netted structure (r_s = -0.128, p = 0.034). There is a statistically non-significant negative correlation between knowledge and skill score and level of technology adoption for agricultural mechanization (r_s = -0.069, p = 0.252) and rain protective structure (r_s = -0.036, p = 0.550). There is a statistically non-significant positive correlation between knowledge and skill score and level of technology adoption for irrigation system (r_s = 0.005, p = 0.939) and drainage system (r_s = 0.036, p = 0.557).

3.4 Factors Influencing Respondents' Attitude towards Technology Adoption

The multiple regression analysis was conducted to examine the factor that influences the respondents' attitude towards technology adoption through PFPP. As can be seen in Table 4, the multiple regression analysis with all the predictors (age, educational level, family dependents size, years of experience in agriculture, farm size, gross income, net income, benefit score and knowledge and skills score) produces R^2 = 0.487, F = 27.012, p < 0.001.

Table 4 shows the regression analysis result. It depicts that gross income, knowledge and skill and benefit scale had a significant positive regression weight, indicating that respondents with higher score on these scales were expected to have higher score for their attitude toward technology adoption, after controlling the other variables in the model. Meanwhile,

Table 4 Regression analysis for factors influencing respondents' attitude towards technology adoption.

Independent variable	*B*	Variable *p* value	Model *p* value	R^2	Std. error
Constant	1.183	0.000			
Age	-0.004	0.138			
Educational level	-0.066	0.001			
Family dependents size	-0.001	0.944			
Year of experience in agriculture	-0.005	0.038	0.000	0.478	0.430
Farm size	0.001	0.584			
Gross income	2.752E-7	0.017			
Net income	-2.422E-7	0.378			
Knowledge and skill	0.506	0.000			
Benefit	0.306	0.000			

education level and years of experience in agriculture had a significant negative weight, indicating that after accounting for gross income, knowledge and skill and benefit, respondents with higher educational level and more years of experience in agriculture were expected to have lower score for attitude toward technology adoption. Age, family dependents size, farm size and net income did not contribute to the multiple regression model.

Based on the findings, the main factors that influence respondents' attitude towards technology adoption are knowledge and skill, benefit, education level, year of experience in agriculture and gross income.

4. Conclusions

Agricultural technology adoption is significant and still needs relevant improvement for food production in agriculture sector. Although there has been an increase in funding and support for agriculture research and development, significant adoption of emerging technologies, particularly in less developed or developing countries, has not been fully achieved due to lack of information, ethical concerns, cultural beliefs and so on. Therefore, better understanding for further research and improvement technological advancement and commercialization, will serve as a guide for technology developers to develop better strategies and techniques in order to promote technology adoption in agriculture.

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References

[1] Ministry of Agriculture and Agro-Based Industry. 2011. *National Agro-Foods Policy (2011-2020)*. Putrajaya: Ministry of Agriculture.

[2] Kumar, V., Kumar, U., and Persaud, A. 1999. "Building Technological Capability through Importing Technology: The Case of Indonesian Manufacturing Industry." *The Journal of Technology Transfer* 24 (1): 81-96.

[3] Kennedy, E. T., and Bouis, H. E. 1993. *Linkages between Agriculture and Nutrition: Implications for Policy and Research*. Washington D.C.: International Food Policy Research Institute.

[4] D'Silva, J. L., Shaffril, H. A. M., Uli, J., and Samah, B. A. 2010. "Socio-Demography Factors That Influence Youth Attitude towards Contract Farming: A Case from Peninsular Malaysia." *Am. J. Applied Sci.* 7: 603-8.

[5] Cochrane, L. 2014. "Agricultural Intensification in Ethiopia: Review of Recent Research." *African Journal of Agricultural Research* 9 (31): 2377-90.

[6] Abdullah, F. A., and Samah, B. A. 2013. "Factors Impinging Farmers' Use of Agriculture Technology." *Asian Social Science* 9 (3): 120.

[7] Aker, J. C. 2014. "Dial 'A' for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries." *Agricultural Economics* 42 (6): 631-47.

[8] Sharma, S. N., Kumar, V., and Mathur, S. 2009. "Comparative Analysis of RAPD and ISSR Markers for Characterization of Sesame (*Sesamum indicum* L.) Genotypes." *Journal of Plant Biochemistry and*

Biotechnology 18 (1): 37-43.

[9] Obiechina, J. 2004. "ICT and Agriculture." A Contest Project on ICT and Agriculture, African Youth Foundation.

[10] Pikernel, D. G., Christie, M. J., Rowe, P. A., Putterill, L. G., and Lynn, G. J. 2004. "Farmers Markets in Wales: Making the Network." *British Food Journal* 106 (3): 194-210.

[11] Rahman, S. 2015. "Green Revolution in India: Environmental Degradation and Impact on Livestock." *Asian Journal of Water, Environment and Pollution* 12 (1): 75-80.

[12] Awada, L., Gray, S., and Nagy, C. 2016. "The Benefits and Costs of Zero Tillage RD&E on the Canadian Prairies." *Canadian Journal of Agricultural Economics* 64 (3): 417-38.

[13] Besley, T., and Case, A. 1993. "Modeling Technology Adoption in Developing Countries." *The American Economic Review* 83 (2): 396-402.

[14] Zeller, M., Diagne, A., and Mataya, C. 1997. *Market Access by Smallholder Farmers in Malawi*. Washington D.C.: International Food Policy Research Institute.

[15] Neill, S. P., and Lee, D. R. 2001. "Explaining the Adoption and Disadoption of Sustainable Agriculture: The Case of Cover Crops in Northern Honduras." *Economic Development and Cultural Change* 49 (4): 793-820.

[16] Arellanes, P., and Lee, D. R. 2003. "The Determinants of Adoption of Sustainable Agriculture Technologies: Evidence from the Hillsides of Honduras." In *Proceedings of the 25th International Conference of Agricultural Economists (IAAE)*, 16-22.

[17] Fuglie, K. O., and Kascak, C. A. 2001. "Adoption and Diffusion of Natural-Resource-Conserving Agricultural Technology." *Review of Agricultural Economics* 23 (2): 386-403.

[18] Adesina, A. A., and Baidu-Forson, J. 1995. "Farmers' Perceptions and Adoption of New Agricultural Technology: Evidence from Analysis in Burkina Faso and Guinea, West Africa." *Agricultural Economics* 13 (1): 1-9.

[19] Moser, C. M., and Barrett, C. B. 2003. "The Disappointing Adoption Dynamics of a Yield-Increasing, Low External-Input Technology: The Case of SRI in Madagascar." *Agricultural Systems* 76 (3): 1085-100.

[20] Feder, G., Just, R. E., and Zilberman, D. 1985. "Adoption of Agricultural Innovations in Developing Countries: A Survey." *Economic Development and Cultural Change* 33 (2): 255-98.

[21] Zaltman, G., Duncan, R., and Holbek, J. 1973. *Innovations and Organizations.* Hoboken, NJ: John Wiley & Sons.

[22] Kidder, L. H. 1981. "Qualitative Research and Quasi-Experimental Frameworks." In *Scientific Inquiry and the Social Sciences*. San Francisco, CA: Jossey-Bass, 226-56.

[23] Pallant, J. 2011. *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS.* Crows Nest, New South Wales: Allen & Unwin.

[24] Tabachnick, B. G., and Fidell, L. S. 2007. *Using Multivariate Statistics*. New York, NY: Allyn & Bacon.

[25] Bonbana, W. J. 2002. *Assessing Factors Affecting Adoption of Agricultural Technologies.* The Case of Integrated Pest Management in Kumi District, Eastern Uganda.

[26] Khanna, M. 2001. "Sequential Adoption of Site-Specific Technologies and Its Implications for Nitrogen Productivity: A Double Selectivity Model." *American Journal of Agricultural Economics* 83 (1): 35-51.

[27] Samiee, A., Rezvanfar, A., and Faham, E. 2009. "Factors Influencing Adoption of Integrated Pest Management (IPM) by Wheat Growers in Varamin County, Iran." *African Journal of Agricultural Research* 4 (5): 491-7.

[28] Kariyasa, K., and Dewi, Y. A. 2013. "Analysis of Factors Affecting Adoption of Integrated Crop Management Farmers Field School (icm-ffs) in Swampy Areas." *International Journal of Food and Agricultural Economics* 1 (2): 29-38.

[29] Mignouna, D., Manyong, V., Rusike, J., Mutabazi, K., and Senkondo, E. 2011. "Determinants of Adopting Imazapyr-Resistant Maize Technologies and Its Impact on Household Income in Western Kenya." *AgBioforum* 14: 158-63.