

## **INTENTION TO ADOPT A NEW VARIETY OF PADDY AMONG FARMERS IN TERENGGANU, MALAYSIA**

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### **ABSTRACT**

Rice security has been consistently in Malaysia's self-sufficiency program as it is a staple food for vast majority of the population. One of the main reasons of low paddy productivity is due to rice blast disease which is caused by fungus pathogen, *Magnaporthe oryzae*. Putra 1 is one of the Universiti Putra Malaysia (PadiU Putra) technologies introduced in 2017 and has proven to be the best variety to combat blast diseases and increasing yield of paddy per acre based on trials that has been conducted in Besut, Terengganu. However, a clear perception about this new variety among paddy farmers is anonymous. Therefore, this research aims to explore the latent factors that could influence the adoption intention of Putra 1 by paddy farmers in Besut, Terengganu. Theory of Planned Behaviour (TPB) was used as theoretical framework to analyze the paddy farmer's intention to adopt Putra 1 as their new variety to replace the existing variety. Descriptive analysis and factor analysis were then performed in order to extract the latent factor from factor analysis while the descriptive analysis is used to measure the distribution of the data in term of its central tendency and normality. The interview of paddy farmers in Besut, Terengganu was done from April to May 2017. The results showed that four factors; attitude, subjective norms, knowledge and perceived behavioural control significantly affect farmers' intention to adopt Putra 1. Thus, encouraging paddy farmers to adopt the new variety can help to control blast diseases, increase production and hence the level of self-sufficiency.

**Keywords:** Theory of Planned Behaviour, blast disease, factor analysis, Putra 1

### **INTRODUCTION**

Paddy industry is always receiving special attention from the government due to its strategic importance to supply the staple food for Malaysian population. According to the Department of Agriculture (DOA) statistics report, the paddy farming covering more than 700 thousand hectares in 2016 and the total production is about 2.3 million metric tons (DOA 2018). Various efforts have been undertaken by the government to ensure the sustainability of the paddy industry such as the optimal level of input use, development of technology, farm management and input incentives to the farmers as well as price subsidies. Despite of various kind of efforts, the productivity of paddy is still low at 4.2 mt/ha on average though the potential could be as high as 10 mt/ha. The excess usage of chemicals above the recommended rate had made pests and weeds resistant to chemicals. In order to reduce the infestation, the seed varieties that are resistant to pest and diseases need to be developed and used. One

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of the serious and main diseases assaulting the paddy plant is blast disease that has a major contribution to low productivity of paddy in 85 paddy growing countries including Malaysia.

Rice blast disease caused by *Pyricularia oryzae* is the most critical rice disease in the rice growing regions in the world. The symptoms of rice blast include lesions that can be found on all parts of the plant (Tebeest *et al.*, 2007). In 2016 research and development unit of Universiti Putra Malaysia (UPM) has developed a new variety of paddy known as Putra 1 (ITAFos UPM, 2016). This variety is more tolerant to rice blast disease and able to increase the yield of paddy per ha. Nevertheless this new variety is unknown to most paddy farmers and the adoption process might take sometimes for fully adoption of this variety by paddy farmers. The field trials and awareness campaign has been conducted in Besut, Terengganu for 3 seasons from 2015-2016 and the field trials was successful in terms of controlling rice blast diseases and increasing yield. Thus, Putra 1 paddy variety could be the solution to paddy farmer's problems. Given the awareness about the existing of new paddy variety Putra 1, the knowledge about the advantages of the new variety in term of resistance to rice blast diseases and the performance of Putra 1 in term of its yield, it is inevitable to gauge paddy farmer's intention to adopt Putra 1 as their paddy seed in the future. The objective of this paper is to determine the latent factors that could significantly affect paddy farmer's intention to adopt Putra 1.

The Theory of Reasoned Action (ToRA) postulates that the behaviour of an individual is best anticipated by a person's intentions which are in turn affected by their attitude and perceived social pressure (Ajzen and Fishbein 1980). However, ToRA is unsuccessful in predicting behaviour which is not completely under individual volitional control. ToRA was limited in predicting skills. However the resources or opportunities available are not considered to be within the constructs of the ToRA or are likely to be poorly predicted by the ToRA (Fishbein 1993). The extension construct called perceived behavioural control was added to improve ToRA which is known as Theory of Planned Behaviour (TPB). According to Beedell and Rehman (2000), this new domain is to reflect factors that may influence an endeavor behaviour being carried out. Thus the intention to perform behaviours can be predicted from attitudes, subjective norms, and perceived behavioural control.

In TPB theoretical framework, attitudes is one of the constructs in influencing the individual perception. In this study the attitudes refer to farmers' evaluation either positive or negative towards the performance of Putra 1 variety. In addition, individual tend to commit a behaviour when they have both favorable evaluation and belief and in the same token belief that a significant number of other people will have a similar evaluation. Again this individual's perception of so called social pressure will put him or her either to perform or not perform the behavior as indicated earlier. Social pressure which is basically the subjective norm within the construct of TPB (Ajzen and Fishbein 1980). In the previous study by Uaiene et. al (2009) highlighted the probability of farmers to adopt new technology was via observation of neighboring farmers' behaviour who have adopted the technology (Uaiene et al. 2009). Meanwhile, perceived behavioural control refers to the people or in this case are the farmers' perception on the adoption of the technology whether it is easy or difficult to performing the adoption behaviour. In another words, people's behaviour is influenced by their belief and confidence in their ability to perform the adoption of the technology which is basically the self-efficacy beliefs of the individual's to execute the behavior required to produce the outcome in this case the intention to adopt the new paddy variety.

Literature disclosed that perception on innovation characteristics is significantly contribute to adoption behavior. A study by Jamal and co-workers (2013) indicated that the technology characteristics that could give benefits to farmers' can influence paddy farmers' intention to adopt new paddy variety specifically the fragrant rice variety in Malaysia (Jamal et al. 2013). In addition, the farmers' knowledge also give significant effect to their willingness in adopting new innovation such as in the case of chicken feed formulation (Mohamad et al. 2015). Thus farmers that have knowledge were more prepared to accept innovation compared to those farmers who do not have any knowledge at all.

Chhetri, (2007) in his study showed that farmers in Nepal were willing to change their behavior and be more interested in adopting new technology development as they have knowledge on that particular technology. Adoption of new varieties of seeds and the new farm management systems will occur when the farmers receive information regarding the benefits of new technology such as; the new technology can increase the productivity and consequently can improve the profitability to farmer (Feder et al. 1985).

Based on a study conducted in India, it was found that individual characteristics such as demographic factors (age, education, farm size) will also influence farmer's perception and adoption decision of new innovation such as their attitude toward organic farming (Patidar and Patidar 2015). Another studies conducted by Abdulai and Huffman (2005) on acceptance of new technology among farmers in Tanzania, indicated that education background and knowledge of farmers were important factors in determining the adoption of new technology among farmers. In the same token according to Sall et al. (2000), based on the study conducted in Casamance area of Senegal, it was found that the farm and farmer characteristics as well as their perceptions on technology specific characteristics influence the adoption decision related to improved varieties. Nur Shuhamin and Norsida (2016) in their study on Muda Agricultural Development Authority (MADA) granary area reported that knowledge and experience of farmers in paddy farming give significant effect in adopting new paddy seed variety. Thus given the above discussion the TBP is appropriate to analyze the paddy farmer's intention to adopt Putra 1 paddy variety introduced by UPM. The three constructs of TPB explain well the behavior of the farmers in deciding to adopt the new variety.

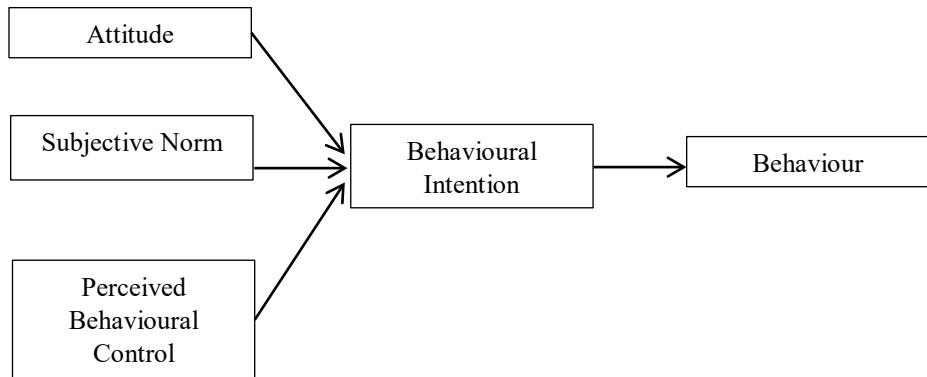
## MATERIALS AND METHODS

The sampling frame for this study were paddy farmers who had been introduced to the new variety Putra 1 through seminar or training conducted by Universiti Putra Malaysia in collaboration with the Department of Agriculture (DOA), MOA. A structured questionnaire was employed as the instrument for primary data collection. The study was conducted in the integrated agriculture development area of North Terengganu (IADA) KETARA, Besut, Terengganu. IADA KETARA was selected as the study area due to its role as the first granary area where demonstration plots and field trials being conducted for PadiU Putra technologies of UPM, including the new variety Putra 1. In the same token 466 farmers who had undergone field trials in Besut, Terengganu were also selected as a sample size. There were about 70 farmers who had gone through the planting trials. The structured questionnaires were distributed to 110 paddy farmers by using systematic random sampling. Face to face interviews were conducted in April 2017. The descriptive analysis and factor analysis were used to analyse the data.

**Instrument: Questionnaire.** In order to achieve the objective of the study, nominal scale (open-ended and close-ended questions) and ordinal scale questions were structured to measure the demographic profile and interval scale (7-point Likert scale) in assessing the factors influencing farmers perception and intention to adopt new paddy seed variety Putra 1 based on TBP constructs, respectively. To measure respondents' attitude, subjective norm, perceived behavioral control and knowledge, they were asked to appraise a seven-point attitudinal Likert scale statements with a range of 1 (strongly disagree) to 7 (strongly agree).

The theoretical framework used in this study was based on Theory of Planned Behaviour (TPB) developed by Ajzen (2002), which is regulated by the intention to execute the specific behavior; attitude predicts the intention, perceived behavioral control and subjective norm (Fig. 1). Perceived behavioral control is termed as the people's perception about the difficulty or ease of executing a particular behavior (Ajzen, 2002) (Fig. 1). According to Ajzen (2002), the fundamental aspect of the TPB is behavioral intent that has been proven to be a good replacement for behavior. TPB is better at explaining behaviors rather than ToRA (Theory of Reasoned Action). Another advantage of this model

is its specificity and thus TPB is more suited to examining specific adoption behaviors rather than a broad range of intended behaviors.



**Fig. 1.** Theory of Planned Behavior (Ajzen 2002)

**Statistical analysis.** Descriptive analysis was performed to analyze the socio-eco-demographic background of paddy farmers. Factor analysis was used to determine the latent factors that influence paddy farmers' perception and intention to adopt new paddy seed variety, Putra 1. As shown in Figure 1 there are 3 constructs which make up the TBP and their items within the constructs.

Exploratory Factor Analysis (EFA) was used to determine the underlying factors that influence farmer's intention to adopt Putra 1. Factor analysis will group together the statement items under a common underlying factor. Kaiser-Meyer-Olkin (KMO) sampling adequacy test and Bartlett's test of Sphericity were performed on all statements or items to confirm the appropriateness of applying the factor analysis as one of the analysis.

## RESULTS AND DISCUSSION

A total of 110 respondents of paddy farmers in Besut, Terengganu took part in the survey. Socio-eco-demographic characteristics are presented in Table I. Majority of the respondents were male (98.2%) and were in the age range of 41 to 50 years old (28.2%). In terms of education level, most of the respondents have gone through secondary education (62.7%) while about 5.5% had gone through the non-formal education. Majority of the respondents are full time farmers (72.7%).

Most of the respondents had experienced in paddy farming for more than 15 years (40.9%) and have total farm size of less than 5 acre (46.4%). The most popular current variety applied by most farmers was MR219 (44.5%). Some paddy farmers used two different varieties in their field and thus the total frequency of current variety used was more than the number of respondents. They have been using several varieties of paddy in their field as an initiative to overcome pest and diseases (n=50, 45.5%). Most of the farmers were willing to adopt Putra 1 (n=107, 97.3%) and recommendation from fellow friends and the motivation from themselves were the other reasons that influence farmers to change the variety of rice used (n=11, 10%) (Table 2). Beside the three main constructs of TPB, the other factors that can influence the farmers' adoption to new variety of seed include is knowledge (Fig. 1).

**Table 1:** Paddy farmer's socio-demographic characteristics in Besut, Terengganu.

Characteristics	Frequency (n=110)	Percentage (%)
Gender		
Male	108	98.2
Female	2	1.8
Age (years old)		
21-30	13	11.8
31-40	23	20.9
41-50	31	28.2
51-60	16	14.5
More than 60	27	24.5
Educational level		
Non-formal	6	5.5
Primary	30	27.3
Secondary	69	62.7
Tertiary	5	4.5
Types of farmer		
Full time	80	72.7
Part time	30	27.3

**Table 2:** Paddy farmers' firmographic background in Besut, Terengganu

Variable	Frequency (n=110)	Percentage (%)
Farm size		
Less than 5 acre	51	46.4
5-10 acre	41	37.3
11-15 acre	10	9.1
More than 15 acre	8	7.3
Paddy farming experience		
1-5 years	18	16.4
6-10 years	29	26.4
11-15 years	18	16.4
More than 15 years	45	40.9
Current variety		
MR219	57	44.5
MR220	3	2.3
MR220CL2	17	13.3
MR263	7	5.5
MR69	16	12.5
MR284	28	21.9
Main reason for changing variety		
Low price	10	9.1
Readily available	2	1.8
More resistance to pest and disease	50	45.5
High yield	37	33.6
Others	11	10.0
In your perception, could Putra 1 variety give benefits as being promoted?		
Yes	106	96.4
No	4	3.6
Do you intention to try Putra 1 variety		
Yes	107	97.3
No	3	2.7

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The KMO test result was 0.727 (Table 3). The value of 0.727 was acceptable as it was closer to 1 indicating that the sample size is adequate and the statement or items were appropriate. The Bartlett's test of Sphericity was significant at 1% level and indicated that the statement items used in factor analysis were also appropriate.

**Table 3:** Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)

<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</b>		<b>.727</b>
Bartlett's Test of Sphericity	Approx. Chi-Square	421.040
	Df	66
	Sig.	.000

There were four factors that influenced the paddy farmers' intention to adopt Putra 1 variety (Table 4). These are attitude, subjective norms, knowledge and perceived behavioural control. Only statements or items with a factor loading of at least 0.5 were considered as a significant items. The factor loading for four factors were from 0.611 to 0.897 with the total variance of 68.018, indicating that these four latent factors explaining approximately about 68 percent of variance in the paddy farmers' intention to adopt the new paddy variety Putra 1. The four latent factors were summarized as follows:

**Attitude.** The farmers' attitude has been recognized as the first factor. This factor consists of four sub-variables with total variance of 20.986 percent and eigenvalue of 3.496. The first sub-variable "I prefer to use variety that are more resistant to pest and diseases" showed the highest factor loading score (0.842). The results showed that those who have positive attitudes can influence their intention to adopt new paddy variety Putra 1.

**Subjective Norm.** The second factor which has influenced the paddy farmers' intention to adopt new paddy variety (Putra 1) is subjective norm. This factor comprises four sub-variables which explained by a total variance of 18.626 percent with eigenvalue of 2.181. The first sub-variable "I might use new variety (Putra 1) if it is recommended by seed sellers" showed the highest factor loading score (0.835). The results indicated that paddy farmers' intention to adopt new paddy variety (Putra 1) can be influenced by the social norms.

**Knowledge.** Knowledge is the third factor which explained by a total variance of 15.091 percent with eigenvalue of 1.773. This factor was described by three sub-variables: "basically, new paddy varieties are introduced to help farmers to increase the yield" (0.756), followed by "there might be different yields between variety Putra 1 and other varieties" (0.733), and "I believe that Putra 1, the new paddy variety has the potential to gain high yield" (0.722). These results indicated that knowledge has influence on the paddy farmers' intention to adopt new paddy variety (Putra 1).

**Perceived behavioral control.** The perceived behavioural control was recognized as the last factor with an eigenvalue of 1.393. This factor consisted of two sub-variables which were being explained by a total variance of 13.316 percent. The results showed that those paddy farmers' high self-efficacy will influence them to adopt new variety Putra 1.

The statistical analysis on factor analysis cumulative variance explained in this study using TBP constructs is 68.018, indicating that the total variance explaining the intention to adopt the Putra 1 paddy variety is explained by four constructs or factors in the TPB framework which is quite high and acceptable .The attitude factor has the highest variance of 20.986 indicating that this factor alone explain 20.986 percent of the variability of the attitude factor in the intention to adopt the new variety. Similarly others factors like subjective norm, knowledge and perceived behavior control explain about 18.626,

15.091 and 13.391 respectively the variability of the intention to adopt the new variety (Table 4). Thus these 4 factors are very important factors to be entrust to the paddy farmers.

**Table 4:** The summary of factor analysis

Items	Factor Loading
<b>Factor 1: Attitude</b>	
1. I preferred to use varieties that are more resistant to pest and diseases.	0.842
2. I like to use good quality variety based on my experience before.	0.812
3. For me, to try new varieties are very good.	0.800
4. I like to look at other farmers' result first before I decide either to use it or not.	0.742
Eigenvalues	3.496
Percentage of variance explained	20.986
Cumulative percentage	20.986
<b>Factor 2: Subjective Norms</b>	
1. I might use Putra 1 variety if it is recommended by seed sellers.	0.835
2. My thoughts about Putra 1 technology is influenced by my friends.	0.763
3. The adoption of Putra 1 technologies of other farmers will also influence me to adopt it.	0.757
4. I might use new paddy variety (Putra 1) if my friends use it.	0.611
Eigenvalues	2.181
Percentage of variance explained	18.626
Cumulative percentage	39.612
<b>Factor 3: Knowledge</b>	
1. Basically, new paddy varieties are introduced to help farmers to increase the yield.	0.756
2. There might have different yield between variety Putra 1 and other varieties.	0.733
3. I believe that Putra 1, the new paddy variety has the potential to gain high yield.	0.722
Eigenvalues	1.773
Percentage of variance explained	15.091
Cumulative percentage	54.703
<b>Factor 4: Perceived Behavioral Control</b>	
1. If I want, I can adopt Putra 1 if it can increase yield.	0.897
2. I am confident that I can adopt Putra 1 if it is more environmental friendly if I wanted to	0.875
Eigenvalues	1.393
Percentage of variance	13.316
Cumulative of variance	68.018

A reliability test checked whether all the factors are reliable in explaining the farmer's intention to adopt the new paddy variety. Cronbach's Alpha coefficient is used to reflect the average correlation among the items that have been selected. A reliability coefficient of 0.60 or higher is considered acceptable in most research situations. In this study, all of the statement items were over 0.60. The statement items of attitude generated the higher score, which Cronbach's Alpha coefficients of 0.826. Subjective norm, knowledge and perceived behavioral control have 0.770, 0.619; and 0.742 Cronbach's Alpha values, respectively (Table 5).

**Table 5:** Internal reliability test

Items	Items	Cronbach's Alpha
Attitude	4	0.826
Subjective norm	4	0.770
Knowledge	3	0.619
Perceived behavioural control	2	0.742

## CONCLUSION

It is important to understand farmers' decision to adapt new variety of paddy. This present study will contribute to the existing literatures on the adoption of new variety of paddy (Putra 1) developed by PaddyU Putra Technologies at UPM. Putra 1 is a new variety of paddy that is more resistance to the pest and diseases in particular rice blast disease as well as it can produce higher yield as compared to the existing varieties being used by the paddy farmers. This study shows that there are four latent factors that can influence the farmers' adaption of new variety of paddy (Putra 1) namely; attitudes, subjective norms, knowledge and perceived behavioral control as stipulate by the TPB. Since this study is about intention to adopt the new variety of paddy that is resistance to rice blast diseases, the factor analysis has identified the attitude as the latent factor that has the highest variance explain regarding the intention to adopt the new variety. The information on the advantages of Putra 1 paddy variety has created positive attitude to the farmers. Thus more extension services have to be conducted to educate and disseminate information about the new variety. Demonstration and trial plots should be carried out in order to demonstrate and give opportunity for farmers to share their experiences.

In the same token, given the demonstration or trial plot for the Putra 1, it will create a knowledge to the farmers about the benefits of this new variety to combat with the blast disease as well as can increase the production of paddy. Thus, they are able to differentiate what is best for them in terms of value that Putra 1 has compared to existing varieties. Hence the positive attitudes from experienced paddy farmers who have gone through the demonstration trial plots will create a knowledge base about the choice to be made. Not only that, the whole interaction among the factors will provide self-confidence and belief about the advantages of the new Putra 1 variety that will lead to the intention to adopt the new variety.

In order for the government to introduce a new variety of paddy seed a lot of extension services has to be carried out in giving the information and explaining the advantages of the new variety over the existing one. The demonstration plot has to be carried out to ensure that the paddy farmers have the first hand information either from their fellow friends who have been volunteering to use their land as demonstration plots. This demonstration plot and the experiences by fellow paddy farmers will further enhance the intention of paddy farmers to adopt the new paddy variety Putra 1. Thus, government agencies such as DOA and agencies under the umbrella of Ministry of Agriculture and Agro-based Industry such as Muda Agricultural Development Authority (MADA), Kemubu Agricultural Development Authority (KADA) and Integrated Agricultural Development Project (IADP) should promote and create intention for the farmers to adopt this new paddy variety, which will help to increase paddy production and income of farmers. The issue of self-sufficiency in rice and dependence on imported rice can solved, not totally but at least at some higher level than what it is now.

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## REFERENCES CITED

- Abdulai, A. and Huffman, W. E. 2005. The diffusion of new agricultural technologies; the case of crossbred-cow technology in Tanzania. *American Journal of Agricultural Economics.* 87(3): 645-659.
- Ajzen, I., and Fishbein, M. 1980. Predicting and Changing Behavior. International Standard Book Number: 978-0-8058-5924-9.
- Beedell, J. and Rehman, T. 2000 Using social-psychology models to understand farmers' conservation behavior. *Journal of Rural Studies.* 16:117-127.  
[http://dx.doi.org/10.1016/S0743-0167\(99\)00043-1](http://dx.doi.org/10.1016/S0743-0167(99)00043-1)
- Chhetri, N. B. 2007. Understand the Process of Agricultural Adaptation to Climate-induced Innovation in Rice Based Coping System of Nepal. (Unpublished masters thesis). Pennsylvania State University.
- Department of Agriculture (2018). Statistik Tanaman (Sub-sektor tanamana makanan 2018), pp 27 Retrieved from [http://www.doa.gov.my/index/resources/aktiviti\\_sumber/sumber\\_awam/maklumat\\_pertanian/per\\_angkaan\\_tanaman/booklet\\_statistik\\_tanaman\\_2018.pdf](http://www.doa.gov.my/index/resources/aktiviti_sumber/sumber_awam/maklumat_pertanian/per_angkaan_tanaman/booklet_statistik_tanaman_2018.pdf)
- Feder G., Zilberman D., Richard E. Just. 1985 Adoption of agricultural innovations in developing countries: A Survey. *Economic Development and Cultural Change* 33(2):255-98
- Fishbein, M. 1993. Introduction. In D. J. Terry, C. Gallois and M. McCamish (Eds.), *The theory of reasorzed action: Its application to AIDS-preventive behaviour* (pp. xv-xxv). Oxford, UK: Pergamon.
- Institute Tropical Agriculture and Food Security (ITAFos). Universiti Putra Malaysia. 2016. Retrieved from [http://www.itafos.upm.edu.my/artikel/inovasi\\_teknologi\\_padiu\\_putra-33057?L=bm](http://www.itafos.upm.edu.my/artikel/inovasi_teknologi_padiu_putra-33057?L=bm)
- Jamal, K., Kamarulzaman, N. H., Abdullah, A. M., Ismail, M. M., and Hashim, M. 2013. Farmers' acceptance towards fragrant rice farming: The case of non-granary areas in the east coast, Malaysia. *Journal of International Food Research.* 20(5): 2895-2899.
- Mohamad, S. F., Mohamed, Z. A., Rezai, G., Sharifuddin, J. 2015. Farmers willingness to adopt new feed formulation: Poultry industry in Malaysia. Masters Thesis, Universiti Putra Malaysia. pp v-vi.
- Nur Shuhamin N., and Norsida M. 2016. Acceptance and practices on new paddy seed variety among farmers in MADA granary area. *Academic Journal of Interdisciplinary Studies.* 5 (2):105-110.
- Patidar, S., and Patidar, H. 2015. A study of perception of farmers towards organic farming. *International Journal of Application or Innovation in Engineering and Management.* 4(3): 269-277.
- Sall S., Norman D., Featherstone A.M. 2000. Quantitative assessment of improved rice variety adoption: the farmer's perspective *Agricultural Systems.* 66:129- 144
- TeBeest, D.O., C. Guerber and M. Ditmore. 2007. Rice blast. *The Plant Health Instructor.* DOI: 10.1094/PHI-I-2007-0313-07.
- Uaiene, R. N., Arndt, C., and Masters, W. 2009. Determinants of agricultural technology adoption in Mozambique. Discussion papers, No. 67E. National Directorate of Studies and Policy Analysis Ministry of Planning and Development Republic of Mozambique.