

Original Research Article**USE OF INTEGRATED PEST MANAGEMENT (IPM) PRACTICES BY KALIA
UPAZILA FARMERS IN THE DISTRICT OF NARAIL - BANGLADESH****ABSTRACT**

The purpose of this study was to determine the extent of use of IPM practices by the farmers and to explore the relationship between the selected characteristics of the farmers with their use of IPM practices. The selected characteristics were age, education, farm size, annual family income, training exposure on IPM practices, farming experience, extension contact, problem faced in IPM practices, knowledge on IPM practices and attitude towards IPM practices. Data were gathered from 103 farmers of the villages of Joynagar, Naraghathi, Tona and Khasial of Khalia Upazila under Narail district by using proportionate random sampling method. Pearson's Product Moment Co-efficient of Correlation was used to examine the relationship between the selected characteristics of the farmers with their use of IPM practices. The findings revealed that more than three fifth (61.10%) of the farmers had medium use~~x~~ of IPM practices while 21.40 percent had high use~~x~~ and rest 17.50 percent had low use~~x~~ of IPM practices. Correlation analysis indicated that among the ten selected characteristics of the farmer's age, education, farming experience, knowledge on IPM practices and attitude towards IPM practices had significant positive relationship and problem faced in IPM practices had significant negative relationship with their use of IPM practices. The rest^{of the} characteristics of the farmer namely farm size, annual family income, training exposure on IPM practices and extension contact had no significant relationship with their use of IPM practices. The finding leads to the conclusion that there is a great scope to increase the use of IPM practices by the farmers.

Keywords: Use, integrated pest management, farmers, correlation analysis

1. INTRODUCTION

Pests (insect, pathogen, weeds etc.) are one of the most important barriers to increase^{ing} food production, a usual need for both develop^{ed} and developing countries. To ensure desire^d production or to minimize crop loss due to pest infestation, there is a trend to use large quantities of chemical pesticides across the countries. Research reports revealed^{while} about pesticide is efficient to protect crop loss from pests, its heavy use causes several negative impacts on environment like soil infertility, pollution of surface and ground water, destruction of natural enemies, emergence of new pests etc. [1] [2]. FAO estimated the global harvest losses due to pests to be about 42% of attainable production [3]. The farmers of Bangladesh are mostly dependent on chemical pesticides to control the insect pests. Pesticide consumption in Bangladesh was 0.70 kg/ha in 2000 which was increased to 9.80 kg/ha in 2009 and at present different kinds of pesticides with 211 trade names have been registered in Bangladesh [4]. The IPM practices are

designed to provide economic benefits, reduce environmental and health risks, and ^{reduce} ~~solve~~ the problem of pest resistance to pesticides [5]. IPM is a holistic way of thinking that improves our ability to reduce growers' reliance on a chemical-based approach [6]. The world supports the use of IPM in agriculture as the best environmentally sound approach to pest control [7]. The Environmental Protection Agency (EPA) has defined IPM as an effective and environmentally sensitive approach to manage pests that relies on a combination of common-sense practices [8]. Using current information about pests and the environment, IPM combines available pest control methods to manage pest damage by the most economical means, and with the least possible harm to people, property, and the environment. IPM is an approach which uses increased information to make pest control decisions, and also uses multiple tactics to manage pest populations in a way that is both economically efficient and ecologically sound [9]. IPM practices natural, environmentally friendly approaches that increase agricultural productivity. Examples of IPM practices are adoption of pest-resistant varieties of crops; biological and physical control methods; environmental modification; biopesticides; and when absolutely necessary, non-residual, environmentally-friendly and low mammalian toxic chemical pesticides [10]. In Bangladesh, IPM activities first started in 1981 with the introduction of the first phase of FAO inter-country programme (ICP) on IPM in rice crop. However, it was in 1987 that IPM activities began to expand and became a popular topic among people from all walks of life. From 1989 to 1995, the ICP played a strong catalytic role in promoting the IPM concept and approach among the government officials and donor community [11]. Integrated Pest Management (IPM) practices allows for keeping the pest level under an economic injury level. A huge literature focuses on the determinants of the implementation of such practices [12] [13] [14]. While almost all studies focus on farmer and farm characteristics, only a few ones underline the importance of technology, marketing and pesticides safety control. Moreover, only a few papers have studied IPM adoption in developing or emerging countries. A few studies have examined how farmer characteristics influence the decision to adopt IPM. High level of farmer education is likely to induce adoption of management technologies [15], while lack of active information may be obstacle to adoption [16]. Mahmoud and Shively reported that access to IPM technology and availability increase growers' adoption [17]. Dasgupta *et al.* characterized IPM farmers as those practicing at least one method among biological control, light traps, organic production, crop rotation and manual clearing [18]. In developing countries, studies related to IPM have not been as prevalent as in developed countries [6]. Moreover, extent and level of IPM use in Bangladesh is still largely unknown. Many extension led projects have been implemented by the Department of Agricultural Extension (DAE) and other NGOs to popularize IPM practices among the farmers throughout the country, since its inception. Farmers' training, result demonstrations, method demonstrations etc. have been conducted to educated the farmers about IPM practices but there is hardly any study on how the farmers are using IPM practices in their farming. Thus, an overriding need to investigate factors driving use of IPM practices by farmers in Bangladesh is important to private and public decision makers interested in expanding IPM use.

In view of the above background and facts, the present study was undertaken with the title “Use of Integrated Pest Management Practices by the Farmers of Kalia upazila under Narail District”. The study aimed at providing information regarding the following question:

- i. What is the extent of use of IPM practices by the farmers?
- ii. What are the selected characteristics of the farmers?
- iii. To what extent relationships exist between the selected characteristics of the farmers and their use of IPM practices?

2. MATERIALS AND METHODS

Kalia upazila of Narail district was selected purposively for the study as this is a typical upazila of Bangladesh. Out of 11 unions of this upazila 2 were selected randomly. Then four villages were selected randomly as the locale of the study by taking 2 villages from each selected union. Four separate lists of the farmers of the selected four villages were prepared with the help of the local Sub Assistant Agriculture Officers. There were 1030 farmers in these villages which constitute the population of the study. Data were collected from a sample rather than the whole population due to time and funding constraints. A total of 103 farmers were selected proportionately and randomly from the selected four villages by taking 10% from each village. A reserve list of 10 farmers was also prepared which was used in case of absence of any farmers included in the sample while interviewing.

Use of IPM practices was measured by computing the use of IPM practices score on the basis of a respondent's extent of use of IPM practices with 10 selected IPM technologies. Each respondent was asked to indicate the extent of use of IPM practices with four alternative responses as 'frequently', 'occasionally', 'rarely' and 'not at all' basis and weights were assigned as 3, 2, 1 and 0, respectively.

The use of IPM practices scores of a respondent was determined by summing up his/her scores of all the 10 selected IPM practices. Thus possible score could vary from zero (0) to 30, where Zero indicated no use and 30 indicated the highest level use of IPM practices. A similar four- point scale was used by Mamun (1995) in measuring the “extent of economic development perceived” by the respondents under Bangladesh Rural Advancement Committee (BRAC) agricultural credit program [19]. Islam (1996) used a similar type of scale in determining the “extent of use of Indigenous Technical Knowledge (ITK) in the context of sustainable agricultural development” [20]. In another study of Ahaduzzaman (2013) a similar type of scale was used in determining the “use of vegetable cultivation techniques by the farmers” [21].

Age of a farmer was measured by counting the actual years from his/her birth to the time of interview. Education of a farmer was measured by the number of years of schooling completed in an educational institution. A score of one (1) was given for each year of schooling completed. If a farmer didn't know how to read and write, his education score was zero, while a score of 0.5 was given to a farmer who could sign his name only. Farm size of a farmer is referred to the total area of land on which his/her family carried out farming operations, the area being in terms of full benefit to his/her family. The farm size was measured in hectares for each farmer using the following formula:

$$FS = A_1 + A_2 + \frac{1}{2} (A_3 + A_4) + A_5$$

What crops?

[Where FS= Farm size, A_1 = Homestead area, A_2 = Own land under own cultivation, A_3 = Land given to others on barga, A_4 = Land taken from others on barga, A_5 = Land taken from others on lease]

Annual family income of a farmer was measured in Thousand Taka. The total yearly earning from farm sources (crop, livestock, poultry and fisheries) and non-farm sources (business, job, laborer and others) by the farmer himself/herself and other members of his family was determined. Training exposure on IPM practices of a farmer was measured by the total number of days he/she participated in different training programmes. A score of one (1) was assigned for each day of training received. Farming experience of a farmer was measured by the total number of years of his/her cultivation. A score of one (1) was assigned for each year of farming experience. Extension contact was measured by computing an extension contact score on the basis of a respondent's extent of contact with 10 selected media. Each respondent was asked to indicate the frequency of his contact with each of the selected media with four alternative responses as 'regularly', 'occasionally', 'rarely' and 'never' basis and weights were assigned as 3, 2, 1 and 0 respectively. Problem faced in IPM practices was measured by computing the extent of various problems of the respondents with 10 selected problems. Each respondent was asked to indicate the extent of his/her problem as high problem, medium problem, and low problem and not at all problem and score was assigned as 3, 2, 1 and 0 respectively. Ten questions regarding IPM practices were selected and those were asked to the respondent to determine their knowledge on IPM practices. A score of two (2) score was assigned for each correct answer and zero (0) for wrong or no answer. Partial score was also assigned for partially correct answer. Attitude of a respondent towards IPM practices was measured by developing an attitude scale. Five-point Likert method of summated ratings was used to find out the farmers' attitude towards IPM practices. Eight statements expressing positive and negative feelings towards IPM practices were constructed. A statement was considered positive if it indicated a favourable attitude towards IPM practices. If the case was reverse, it was considered as a negative statement. Out of these eight statements four were positive and four were negative. Scoring was done by assigning 5, 4, 3, 2 and 1 scores to the five alternative responses as "strongly agreed", "agreed", "undecided", "disagreed", and "strongly disagreed", respectively in case of a positive statement. Reverse score was assigned for a negative statement. However, attitude towards IPM practices of a farmer was obtained by summing up his/her scores for all the eight statements. The data were analyzed in accordance with the objectives of the study. Qualitative data were converted into quantitative data by means of suitable scoring technique wherever necessary. The statistical measures such as range, means, standard deviation, number and percentage distribution were used to describe the variables. Pearson's Product Moment Coefficient of Correlation (r) was used in order to explore the relationships between the concerned variables. Five percent (0.05) level of probability was the basis for rejecting any null hypothesis throughout the study. The SPSS computer package was used to perform all these process.

3. RESULTS AND DISCUSSION

Use of IPM practices

Scores for use of IPM practices of the respondents ranged from 14 to 28 against the possible range of 0 – 30 with an average score of 21.06 and standard deviation of 4.32. Based on the observed scores of use of IPM practices, the respondents were classified into the three categories i.e. low use, medium use and high use. The distribution has been shown in Table 1.

Table 1. Distribution of the farmers according to their use of IPM practices

Categories	Basis of categorization (score)	Farmers		Mean	Standard deviation
		Number	Percent		
Low	<16.74 (<Mean-1sd)	18	17.50	21.06	4.32
Medium	16.74-25.38 (Mean $\pm$ 1sd)	63	61.10		
High	>25.38 (>Mean+1sd)	22	21.40		
Total		103	100		

Findings reveal that more than 61.10% of the farmers had medium use of IPM practices while 21.40 percent had high use of IPM practices and rest 17.50% had low use (Table 1). This scenario is moderately satisfactory. This may be ^{because} ~~due to the reason that~~ knowledge on IPM and extension media contact of the farmers are medium to high which developed positive mindset of the farmers towards the use of IPM practices in controlling pests in cultivation of crops and vegetables. In addition, about 97 percent of the farmers had functional literacy which is essential for creating awareness and capacity building of the farmers also influence them towards the use of IPM practices. Education helps in increasing the body of knowledge, analytical skills and decision making ability of an individual. These are the factors plays vital role in the satisfactory level of use and IPM practices in farming activities. Extension media contact in the study area was satisfactory. Because extension media contact influence the farmer to use IPM practices in cultivation of crops. On the other hand, farmers had medium to high faming experience and knowledge on IPM and organizational participation. Also they confront various problems during IPM practices. They also think that IPM is a time consuming process. So, they use chemical pesticides for quick killing of harmful insects but, they are indifferent about killing beneficial insects unconsciously. By taking proper strategy to overcome these problems, use of IPM practices can be increased more in the study area. Government's respective organization should come forward to take initiative to overcome ^{barriers} ~~hindrance~~ by supplying the adequate tools of IPM and providing information and training to farmers.

Selected characteristics of the farmers

Age

What crops did the 103 farmers grow? All the same? Different?

The most (55.32%) of the respondents were middle aged as compared to 40.78 percent being young and 3.90 percent old aged (Table 2). Findings again reveal that overwhelming majority (96.10%) of the respondents were young to middle aged. Therefore, it could be said that decision regarding the farming practices in the study area were expected to be considerably influenced by the young and middle aged farmers. Therefore, the extension worker should give proper attention to include the young & middle aged groups in their programmes. On the other hand age of the farmers had positive and significant relationship with their use of IPM practices (Table 3). Nkamleu *et al.* reports of older farmers being more experience and have accumulated more capital as a result they are more likely to invest in innovation [22]. Similarly, However, Haba (2004) suggest that older people were unwilling to pay for agricultural information delivery technologies such as print, radio, farmer-to-farmer, expert visit, and television [23]. He revealed that, as age increased, the willingness to pay for these agricultural information delivery technologies decreased, meaning that older farmers were less willing to get information than younger ones. Old age also increases with conservativeness and negatively impact on adoption while young farmers tend to be more innovative and risk adverse [24] [25]. A study conducted by Deribe (2007) on diary women farmers proved that age has a negative influence on agricultural information network of farm women. ^{In that} ~~The study is that~~ older women ^{did} ~~do~~ not seek many new ideas, since they try to conform to practices they have followed for a long time in their life [26]. Ayele and Bosire (2011) also found out that both younger and old tried new things introduced to them thus there was no significant relationship between age and the use of improved inputs and practices [27]. However, from this study it can be said that with the increase of farmers' age their use of IPM practices will increase.

but weak

Contradictory?

Too strong

Education

36.90 percent of the farmers had secondary education while 26.20 percent had primary level of education compared to 19.40 percent above higher secondary education, 14.60 percent higher secondary education and rest 2.90 percent were illiterate (Table 2). The findings of this study, however, indicate that almost all (97.10%) of the farmers had ^{some} ~~different~~ level of education which is very much helpful for diffusion of any innovation. Education had positive and significant relationship with use of IPM practices (Table 3). David and Asamoah (2011) found that use of IPM increases as level of education increases [28]. Education develops human mind & it increases the power of observation, analysis, understanding & decision making ability. A comparatively educated person is relatively more responsive to the technology and new innovation. So, the extension service providers need to consider level of education and the farmers during conducting extension activities.

and relatively strong

Farm size

The most (57.28%) of the farmers had small farms compared to 38.83 percent having medium farms and 3.89 percent large farms (Table 2). In Bangladesh most of the farmers live on below a subsistence level and this is in one of the vital reasons for not ^{belonging} ~~having~~ large farms.

sized

having

Annual family income

About half (49.52) of the respondents had low family income while 25.24 percent and 25.24 percent of the respondents had medium and high annual family income respectively (Table 2). The gross annual family income of a farmer is an important indicator of how much s/he can invest in his farming. Generally higher income encourages one's integrity to achieve better performance and to show his/her individual better status in the society. The higher income increases the risk taking capacity of the farmers.

Training exposure on IPM practices

Most (87.40%) of the farmers had no training exposure; while 12.60 percent of the farmers had short term training exposure (Table 2). Training helps the farmers to acquire deep knowledge and improve skills about the respected aspects. Trained farmers can cope with and handle smoothly the adverse situation in their farming practices. But the data in the above table shows that most of the farmers had no training. This is because of providing training to all the farmers is a costly approach and the concerned extension organizations may not have enough resources to arrange training program regularly.

Farming Experience

Most (64.08%) of the farmers had medium to long farming experience while 35.92 percent had short farming experience (Table 2). Farming experience is helpful to increase knowledge, improve skill and change attitude of the farmers. Generally, experience helps to cope with any problematic situation. Therefore, the higher experience might be increased the risk bearing ability of the farmers. However, Farmers' farming experience had significant and positive relationship with their use of IPM practices (Table 3). In the study area 78.60 percent of the farmers had low to medium use of IPM practices. This may be due to the existence of 68.92 percent short to medium experienced farmers. Generally experience and specialization of farming system related to IPM practices helps to increase the use of IPM practices.

Extension contact

An overwhelming majority (93.20%) of the farmers had low to medium extension contact while 6.8 percent had high extension contact (Table 2). Extension contact is an effective source of receiving information about recent and improved technologies. Generally people having high extension media contact assume that they have more information regarding crop cultivation as well as IPM practices. More extension contact make the people acquainted with new technologies and information. Discussion with the agriculture related personnel makes the people more up to date about the modern practices. In the study area, it is noticed that farmers had low to medium extension media contact.

Problem faced in IPM practices

The overwhelming majority (82.50%) percent of the farmers faced medium to high problems and 17.50 percent faced low problems in IPM practices (Table 2). Problem faced in IPM practices by the farmers had significant and negative relationship with their use of IPM practices (Table 3). In the study area overwhelming majority (87.40%) of the farmers had no training exposure. This is one of the main reasons

of farmers' problem facing in IPM practices. The failure of extension to function as a vehicle providing technical support and training to farmers, the lack of investment in research, and the prominence of pesticide-based solutions have long been put forward as reasons for problem in IPM practices. However, collective action may be more important for IPM in developing countries because pests can more easily move between farms that are small and therefore separated by short distances. Aware of the requirement for collective action in IPM, farmer field schools routinely integrate this concept into their otherwise technical training programs, obtaining good results. It is all the more surprising, therefore, that the literature on IPM adoption appears to have overlooked the collective action dilemma, which is potentially inherent to IPM, as an obstacle to its adoption.

Knowledge on IPM Practices

79.65% of the respondents fell in medium knowledge category followed by 15.50 percent in high knowledge category and only 4.85 percent in low knowledge category (Table 2). Knowledge on IPM practices of the farmers had positive and significant relationship with their use of IPM practices (Table 3). Godtland and colleagues (2003) report that improved knowledge about IPM practices significantly impacted potato productivity [29]. Malone et al. (2004) who found that the lack of familiarity with IPM was the major reason for its low usage by farmers [30]. It therefore means that increasing farmers' knowledge on IPM may possibly lead to an increase in the use of IPM. A rigorous dissemination process can play important role to improve farmers' level of knowledge regarding IPM. In this context, DAE is the most responsible. The organization had already developed four dissemination techniques namely FFS training, extension contact, field day and IPM club to disseminate this approach. Besides, they used mass media for publicity. They should continue these approaches with more attention. In addition, some initiative like establishment of adult school or farmer organization in the rural level may be helpful to fill their knowledge gap of IPM.

Attitude towards IPM practices

More than half (50.50%) of the respondents had less favorable attitude towards IPM practices out of which 21.40% unfavorable and 18.40% highly favorable only 9.70 percent had neutral attitude (Table 2). These may be due to the ~~less~~ ^{lack of} training on IPM practices and ~~most~~ ^{that} of the farmers faced medium problems in the study area. Attitude towards IPM practices of the farmers had significant and positive relationship with their use of IPM practices (table 3). The extension agents, NGO's personnel and mass media should ~~more highlight IPM issues that help the farmers~~ ^{develop} ~~create~~ ^s favorable attitude towards IPM program. On the other hand, arranging more practical training and demonstration program may assist the farmers about effective use of IPM technologies that can save their time. Additionally, through participation on these events, they may realize that as IPM give emphasize on non-chemical ways for controlling pests, then it is normal to take a little more time than conventional practice that is use of chemical pesticides.

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with IPM

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Table 2. Predominant Features of the Farmers Selected Characteristics

Characteristics (with measuring unit)	Range		Categories	Farmers		Mean	SD
	Possible	Observed		No.	%		
Age (years)	Unknown	20- 60	Young aged (up to 35)	42	40.78	37.87	7.57
			Middle aged (36-50)	57	55.32		
			Old aged (>50)	4	3.90		
Education (schooling years)	Unknown	00 -17	Illiterate (0)	3	2.90	8.94	4.55
			Primary (1-5)	27	26.20		
			Secondary (6-10)	38	36.90		
			Higher secondary (11-12)	15	14.60		
			Above higher secondary (>12)	20	19.40		
			Small farm (≤ 1)	59	57.28	1.13	0.78
Farm size (hectare)	Unknown	0.06 – 3.66	Medium farm (>1-3)	40	38.83		
			Large farm (>3)	4	3.89		
			Low income (up to 250-tax free income)	51	49.52	389.0 9	277.3 6
Annual family income ('000'Taka)	Unknown	90 – 1500	Medium income (251-500)	26	25.24		
			High income (>500)	26	25.24		
			No training (0)	90	87.40	0.38	1.0
Training exposure on IPM practices (number of days)	Unknown	00 - 03	Short term training (1-3)	13	12.60		
			Short farming experience (<5.89)	37	35.92	8.92	6.05
Farming experience (Years)	Unknown	02 - 30	Medium farming experience (5.89-11.95)	34	33.00		
			Long farming experience (>11.95)	32	31.08		
			Low contact (<12.60)	21.40	21.40	14.39	1.79
Extension contact (score)	00-30	10-20	Medium contact (12.60 – 16.18)	71.80	69.90		
			High contact (>16.18)	6.80	6.80		
			Low (<12.10)	18	17.50	16.40	4.30
Problem faced in IPM practices (score)	00 - 30	10-26	Medium (12.10-20.70)	63	61.14		
			High (>20.70)	22	21.36		
Knowledge on IPM	00 - 20	10-20	Low knowledge (<13.70)	5	4.85		

practices (score)			Medium knowledge (13.71-18.58)	82	79.65	16.16	2.42
			High knowledge (>18.58)	16	15.50		
Attitude towards IPM practices (score)	8 - 40	18-40	Unfavourable (8-23)	8-23	22		
			Neutral (24)	24	10		
			Less favourable (25-32)	25-32	52	28.11	5.51
			Highlyfavourable (33-40)	33-40	19		

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296 Relationship between the Selected Characteristics of the Farmers and their Use of IPM 297 Practices

298 The purpose of this section is to examine the relationship of 10 selected characteristics of the farmers
299 with their use of IPM practices. The 10 characteristics of the farmers included: age, education, farm size,
300 annual family income, training exposure on IPM practices, farming experience, extension contact,
301 problem faced in IPM practices, knowledge on IPM practices and attitude towards IPM practices. Each of
302 the characteristics constituted the causal variables, while use of IPM practices was the predicted variable.
303 Correlation analysis indicated that among the ten selected characteristics of the farmer's age, education,
304 farming experience, knowledge on IPM practices and attitude towards IPM practices had significant
305 positive relationship and problem faced in IPM practices had significant negative relationship with their
306 use of IPM practices. The rest of the characteristics of farmer namely farm size, annual family income,
307 training exposure on IPM practices and extension contact had no significant relationship with their use of
308 IPM practices. The summary of the results of the correlation analysis has been presented in Table 3.

309 **Table 3. Co-efficient of correlation showing relationships between each of the selected**
310 **characteristics of the farmers and their use of IPM practices**

(n= 103; with df 101)

Predicted variable	Causal variable	Computed value "r"	Tabulated value of "r"	
			at 0.05 level	at 0.01 level
Use of IPM practices score	➤ Age	0.215*		
	➤ Education	0.605**		
	➤ Farm size	0.130 ^{NS}		
	➤ Annual family income	0.067 ^{NS}		
	➤ Training exposure on IPM practices	0.138 ^{NS}	0.196	0.254
	➤ Farming experience	0.233*		
	➤ Extension contact	0.129 ^{NS}		
	➤ Problem faced in IPM practices	- 0.549**		
	➤ Knowledge on IPM practices	0.483**		

Largest effects

Attitude

modest effects

4. CONCLUSION

On the basis of the results and their interpretation it can be said that majority of the farmers had medium use of IPM practices. Therefore, DAE may take effective steps for strengthening extension services in order to change using percentage of the farmers regarding IPM practices. Age, education, farming experience, knowledge on IPM practices and attitude towards IPM practices had significant positive relationship and problem faced in IPM practices had significant negative relationship with their use of IPM practices. IPM practices were used more by old aged farmers than young aged farmers. Attempts should be taken by the concerned authorities to increase use of IPM practices especially for the young and middle aged farmers and an adult learning centre should establish to increase educational level of the farmers. The study clearly shows that higher levels use of IPM practices could be achieved by increasing their knowledge about IPM, developing positive attitude towards these practices. According to the findings of this study, In order to improve the knowledge of and attitude towards IPM, the farmer level social participation, and the number of extension contacts should be increased by the DAE as well as technical support should provide to minimize their problem in IPM practices. Steps should, therefore, be taken to arrange more practical training and demonstration program may assist the farmers about effective use of IPM technologies that can save their time. Additionally, through participation on these events, they may realize that as IPM gives emphasize on non-chemical ways for controlling pests, then it is normal to take a little more time than conventional practices that is use of chemical pesticides.

Most important ✓

5. REFERENCE

1. Kabir MH, and Rainis R. Farmers' perception on the adverse effects of pesticide on environment: a case of Bangladesh. *International Journal of Sustainable Agriculture*. 2012; 4(2): 25-32.
2. Kabir MH and Rainis R. Sustainable development strategies and challenges for promotion of integrated pest management program in Bangladesh agriculture. *American-Eurasian Journal of Agricultural and Environmental Sciences*. 2013; 13(7):988-995.
3. FAO. 2004. FAOSTAT-Agriculture. Available: <http://www.fao.org>.
4. Abdullah M. Statistical Data Book for agricultural Research and Development in SAARC countries. SAARC agriculture centre. BARC Campus, Farmgate, Dhaka 1215, Bangladesh. 2012; 47(2).
5. Ratcliffe ST and Gray ME. Will the USDA IPM centers and the national IPM roadmap increase IPM accountability? Responses to the 2001 general accounting office report. *American Entomologist*. 2004; 50:6-9.
6. Bonabana-Wabbi J. Assessing factors affecting adoption of agricultural technologies: The case of integrated pest management (IPM) in Kumi District, Eastern Uganda, Blacksburg, Virginia. Master Thesis. 2002; pp 146.
7. Barnes C, Sutherland S, Brattesani M, Wilhoit L and Messenger B. A survey of California public school districts' ant and weed management practices and a review of their use of IPM. *Journal of Environmental Health*. 2012; 74: 18-22.
8. EPA, Environmental Protection Agency. 2007. What is IPM? Accessed 02 February 2008. Available: <http://www.epa.gov/pesticides/ipm/brochure/whatipm.htm>

9. Norton GW, and Mullen J. Economic Evaluation of Integrated Pest Management Programs: A Literature Review. 1994. MS thesis, Virginia Polytechnic Institute and State University.
10. IPM CRSP. 2008. IPM CRSP Countries at a Glance. Accessed 09 August 2008. Available: http://www.oired.vt.edu/ipmcrsp/IPM_2008/Countries.htm.
11. National IPM Policy. 2002. Ministry of Agriculture. Government of the People's Republic of Bangladesh, Dhaka.
12. Burton M, Rigby D and Young T. Modeling the adoption of organic horticultural technology in the UK using duration analysis. *The Australian Journal of Agricultural and Resource Economics*. 2003; 47(1): 29-54.
13. McNamara MEW and Douce GK. Factors affecting peanut producer adoption of integrated pest management. *Agricultural & Applied Economics Association*. 1991; 13:129-139.
14. Fernandez-Cornejo J and Ferraioli J. The environmental effects of adopting IPM techniques: The case of peach producers. *Journal of agricultural and applied economics*. 1999; 31:551-564.
15. Caswell M, Fuglie K, Ingram C, Jans S and Kascak C. Adoption of agricultural production practices: Lessons learned from the US. WashingtonDC. US Department of Agriculture. Economic Research Service, Agriculture Economic Report No. 792. 2001.
16. Feder G and Slade R. The acquisition of information and the adoption of new technology. *American Journal of Agricultural Economics*. 1984; 66:312-320.
17. Mahmoud C and Shively G. Agricultural diversification and integrated pest management in Bangladesh. *Agricultural Economics*. 2004; 30: 187-194.
18. Dasgupta S, Meisner C and Wheeler D. Is environmentally friendly agriculture less profitable for growers? Evidence on integrated pest management in Bangladesh. *Review of Agricultural Economics*. 2007; 29:103-118.
19. Mamun, A.A. Credit Use Efficiency of BRAC Agricultural Credit Programme in Selected Area of Mymensingh District. *M.Sc. (Ag. Ext. Ed.) Thesis*. 1995. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.
20. Islam MM. Farmers' Use of Indigenous Technical Knowledge (ITK) in the Context of Sustainable Agricultural Development. *M.S. (Ag. Ext. Ed.) Thesis*. 1996. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.
21. Ahaduzzaman M. Use of vegetable cultivation technologies by the farmers. MS (Agricultural Extension) Thesis. 2013. Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.
22. Nkamleu GB, Coulibaly O, Tamo M and Ngeve JM. *Adoption of storage pest control technologies by Cowpeas' Taders in Western Cameroun: Probit Model Application Monograph*. International institute of Tropical Agriculture. 1998.
23. Haba, S. *Factors influencing the willingness to pay for agricultural information delivery technologies by cooperative-oriented agribusinesses in Rwanda: evidence from the Abahuzamugambi Coffee Growers Cooperative of Maraba*. Master's thesis. Texas A&M University. 2004. Available: <http://handle.tamu.edu/1969.1/2414>
24. Zhangn WLi, Xiong FY and Xia Q. Econometric analysis of the determinant of adoption of raising sheep in folds by farmers in the semiarid Loess Plateau. *Ecol. Econ*. 2012; 74:145-152.
25. Adesin A, Mbila D, Nkamleu GB and Endamana D. Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of Southwest Cameroon. *Agr. Ecosyst. Environ*. 2000; 80:255-265.
26. Deribe K. *Agricultural information networks of farm women and role of agricultural extension: The Case of Dale Woreda, Southern Nations, Nationalities & Peoples' Region*. M. Sc. Thesis. 2007. Alemaya University.
27. Ayele S and Bosire C. *Farmers' use of improved agricultural inputs and practices: Review and synthesis of research in Ethiopia*, IPMS. 2011.
28. David S and Asamoah C. Farmer's knowledge as an early indicator of IPM adoption: a case study of cocoa farmer field school in Ghana. *Journal of Sustainable Development in Africa*. 2011; 13(4): 213-224.

- 407 29. Godtland E, Sadoulet E, de Janvry A, Murgai R. and Ortiz O. *The impact of farmer field schools*
408 *on knowledge and productivity: A study of potato farmers in the Peruvian Andes*. Department of
409 Agricultural and Resource Economics. CUDARE Working Paper 963, University of California,
410 Berkeley, CA. 2003.
- 411 30. Malone S, Herbert DA and Pheasant S. Determining adoption of integrated pest management
412 practices by grains farmers in Virginia. *Journal of Extension*. 2004. 4(4):34-43.

