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Use of Integrated Pest Management (IPM) Practices by Kalia Upazila Farmers in the District of Narail – Bangladesh

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Authors' contributions

This work was carried out in collaboration between all authors. Author DD designed the study, managed literature searches and wrote the first draft of the manuscript. Authors MSA, KZH and TM conducted data collection, performed data analysis and contributed writing up manuscript. Author MJA supervised the study, contributed writing up the manuscript and reviewed the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The purpose of this study was to determine the extent of use of IPM practices by the farmers and to examine relationships between farmer's selected characteristics and their use of IPM practices. Those 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, Naraghati, Tona and Khasial of Khalia Upazila under Narail district in Bangladesh by using proportionate random sampling method. Pearson's Product Moment Co-efficient of Correlation was the statistic used to examine the relationship above indicated. The

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findings revealed that 61.10% of the farmers were medium users of IPM practices while 21.40% were high users and 17.50% were identified as low users of IPM practices. The correlation analysis indicated that farmer's age, education, farming experience, knowledge on IPM practices and attitude towards IPM practices revealed significant positive relationships while problem faced in IPM practices displayed a significant negative relationship with their use of IPM practices. The rest of the characteristics assessed such as farm size, annual family income, training exposure on IPM practices and extension contact showed no significant relationships. 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 food production, a usual reality for both developed and developing countries. To secure production levels or to minimize crop loss due to pest infestation, the use of large quantities of chemical pesticides is a major trend across the countries. Research reports revealed while pesticide is efficient to protect crop loss from pests, its heavy use causes several negative impacts on the 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 the 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 to reduce 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 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 [9]. 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 only until 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 [10]. Integrated Pest Management (IPM) practices allows for keeping the pest level under an economic injury level. There is vast literature reporting focuses on the determinants of the implementation of such practices [11,12,13]. While almost all studies are focused on farmers and farm characteristics, only a few have underlined 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. Farmers with higher education are likely to adopt management technologies [14], while the lack of proper information may create obstacles to adoption [15]. Mahmoud and Shively reported that access and availability to IPM technologies and would increase growers' adoption [16]. Dasgupta et al. [17] characterized IPM farmers to those practicing at least one method of biological control, light traps, organic production, crop rotation and manual clearing. 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. Farmers' training, result demonstrations, method demonstrations etc. have been conducted to educated the farmers on IPM practices but there is hardly any study on how the farmers are implementing IPM practices in their farming. Thus, the need to investigate factors promoting the use of IPM practices by farmers in Bangladesh is important to private and public decision makers interested in expanding the use of IPM.

In view of the above background and facts, the present study was undertaken 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

2.1 Target Location and Group

Kalia upazila of Narail district was selected purposively for the study as this is a typical upazila of Bangladesh. Upazila is a geographical region in Bangladesh used for administrative or other purposes. They function as sub-units of districts. 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 sub-sample rather than the whole population due to time and funding constants. A total of 103 farmers were selected proportionately and randomly from the selected four villages by taking 10% from each village. A backup list of 10 additional farmers was also prepared which to be used in case of the absence of any farmers.

2.2 Estimation of the Use of IPM

An estimate of the use of IPM practices score was calculated on the basis of the respondent's answer on the extent of use of IPM practices with 10 selected IPM technologies. Each responder was asked to indicate the extent of use of IPM practices with four options: 'frequently', 'occasionally', 'rarely' and 'not at all'. The score were assigned as 3, 2, 1 and 0, respectively.

The use of IPM practices scores of a responder 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 would indicate the highest level use of IPM practices. A similar four-point scale was used by Mamun (1995) to measure the "extent of economic development perceived" by the respondents under Bangladesh Rural Advancement Committee (BRAC) agricultural credit program [18]. 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" [19]. In another study of Ahaduzzaman [20] a similar type of scale was used in determining the "use of vegetable cultivation techniques by the farmers".

2.3 Profiles and Socio-economic Factors of the Targeted Populations

The factor age of a farmer was measured as the actual number of years from his/her birth to the time of the interview. Education 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 did not 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:

$$FS=A_1+A_2+{}^1/_2\,(A_3+A_4)+A_5$$

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

Annual family income 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

3.1 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, medium and high use. The distribution is shown in Table 1.

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

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		
Medium	16.74-25.38 (Mean ± 1sd)	63	61.10	21.06	4.32
High	>25.38 (>Mean+1sd)	22	21.40		
Total		103	100		

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 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. 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.

3.2 Selected Characteristics of the Farmers

3.2.1 Age

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. On the other hand age of the farmers had positive and significant but weak relationship with their use of IPM practices (Table 3). However, from this study it can be said that with the increase of farmers' age their use of IPM practices will increase.

3.2.2 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 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 [21] found that use of IPM increases as level of education increases.

3.2.3 Farm size

The most (57.28%) of the farmers had small farms compared to 38.83 percent having medium sized 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 having large farm.

3.2.4 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). It is observed that average annual family income of the study area (389.09 thousand taka) is more than the average annual family income of the country (137.39 thousand taka) [22]. In this region of Bangladesh different crops mainly vegetables grow well and its production is high. This is one of the reasons of high annual family income of the study area.

3.2.5 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.

3.2.6 Farming experience

Most (64.08%) of the farmers had medium to long farming experience while 35.92 percent had short farming experience (Table 2). 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 64.08 percent medium to high experienced farmers. Generally

experience and specialization of farming system related to IPM practices helps to increase the use of IPM practices.

3.2.7 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. It is observed that all of the farmers had more or less extension contact. Generally people having high extension media contact assume that they have more information regarding crop cultivation as well as IPM practices. Discussion with the agriculture related personnel makes the people more up to date about the modern practices.

3.2.8 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.

3.2.9 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 [23] report that improved knowledge about IPM practices significantly impacted potato productivity. Malone et al. [24] who found that the lack of familiarity with IPM was the major reason for its low usage by farmers. It therefore means that increasing farmers' knowledge on IPM may possibly lead to an increase in the use of IPM. In the study area all of the farmers had more or less farming experience. Farming experience helps to gain farm related knowledge as well as solution of a problem.

3.2.10 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 lack of training on IPM practices and that most of the farmers faced medium problems with IPM in the study area. Attitude towards IPM practices of the farmers had significant and positive and relatively strong relationship with their use of IPM practices (Table 3). The extension agents, NGO's personnel and mass media should help farmers to develop favorable attitudes 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.

3.2.11 Relationship between the selected characteristics of the farmers and their use of IPM practices

The purpose of this section is to examine the relationship of 10 selected characteristics of the farmers with their use of IPM practices. The 10 characteristics of the farmers included: 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. Each of the characteristics constituted the causal variables, while use of IPM practices was the predicted variable. 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 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 summary of the results of the correlation analysis has been presented in Table 3.

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		
			Middle aged (36-50)	57	55.32	37.87	7.57
			Old aged (>50)	4	3.90		
Education (schooling years)	Unknown	00 -17	Illiterate (0)	3	2.90		
			Primary (1-5)	27	26.20		
			Secondary (6-10)	38	36.90		
			Higher secondary (11-12)	15	14.60	8.94	4.55
			Above higher secondary (>12)	20	19.40		
Farm size (hectare)	Unknown	0.06 – 3.66	Small farm (≤1)	59	57.28		
			Medium farm (>1-3)	40	38.83	1.13	0.78
			Large farm (>3)	4	3.89		
Annual family income (‘000’Taka)	Unknown	90 – 1500	Low income (up to 250-tax free income)	51	49.52		
			Medium income (251-500)	26	25.24		
			High income (>500)	26	25.24	389.09	277.36
Training exposure on IPM practices (number of days)	Unknown	00 - 03	No training (0)	90	87.40		
			Short term training (1-3)	13	12.60	0.38	1.0
Farming experience (Years)	Unknown	02 - 30	Short farming experience (<5.89)	37	35.92		
			Medium farming experience (5.89-11.95)	34	33.00		
			Long farming experience (>11.95)	32	31.08		
						8.92	6.05
Extension contact (score)	00-30	10-20	Low contact (<12.60)	21.40	21.40		
			Medium contact (12.60 – 16.18)	71.80	69.90	14.39	1.79
			High contact (>16.18)	6.80	6.80		
Problem faced in IPM practices (score)	00 - 30	10-26	Low (<12.10)	18	17.50		
			Medium (12.10-20.70)	63	61.14	16.40	4.30
			High (>20.70)	22	21.36		
Knowledge on IPM practices (score)	00 - 20	10-20	Low knowledge (<13.70)	5	4.85		
			Medium knowledge (13.71-18.58)	82	79.65		
			High knowledge (>18.58)	16	15.50	16.16	2.42
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		

Table 3. Co-efficient of correlation showing relationships between each of the selected 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*	0.196	0.254
	➢ Education	0.605**		
	➢ Farm size	0.130 ^{NS}		
	➢ Annual family income	0.067 ^{NS}		
	➢ Training exposure on IPM practices	0.138^{NS}		
	➢ Farming experience	0.233*		
	➢ Extension contact	0.129 ^{NS}		
	➢ Problem faced in IPM practices	- 0.549**		
	➢ Knowledge on IPM practices	0.483**		
	➢ Attitude towards IPM practices	0.633**		

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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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