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Adoption of IPM Technology on Bitter Gourd Production in Comilla District of Bangladesh

Shamima Islam*
M. Serajul Islam*
Romaza Khanum*

Abstract: *The present study was conducted to assess adoption of IPM technology on bitter gourd production at Chandina upazila under Comilla district of Bangladesh. Out of 70 farmers, 35 for IPM and other 35 for Non-IPM farmers were selected. Data were collected with structured questionnaire and analyzed by using descriptive and statistical techniques. In the study some independent variables such as age distribution of the sample farmers, family size, sex and work involvement of the sample farm households, educational status, occupational status, size of land holding, training experience, annual household income and expenditure of the sample farmers were considered. The study revealed that about 60% IPM farmers were young, where only 31%belong to Non-IPM farmers. The average annual household income for IPM farmers was found to be Tk. 255074 but in case of Non-IPM farmers, it was Tk. 18867 only. The findings indicated that farmers having higher level of education and greater farm income caused increase the probability of adopting IPM technology by renovating their production system which was more helpful to increase bitter gourd production. On the other hand, larger family size and greater non-farm income decreased the probability of adopting IPM technology.*

1. Introduction

Bitter gourd is one of the most popular cucurbitaceous vegetable in Bangladesh for its nutritive and medicinal value for diabetic patients. It is grown extensively throughout the country during Kharif season which was cultivated in 23890 acres and 52020 metric tons (BBS, 2013) per annum. It was homestead vegetable in the past years but now it is grown as field crop. However, bitter gourd farmers often fail to obtain the expected yield due to heavy damage caused by various insect, pests and diseases and farmers sprayed pesticides quite frequently. The word

* The authors are respectively Lecturer, Department of Agricultural Economics, BSMRAU, Gazipur, and Professor, PhD fellow, Department of Agricultural Economics, BAU, Mymensingh

"pest" refers to organisms such as insects, pathogens, weeds, nematodes, mites, rodents and birds that cause damage or annoyance to man, his animals, crops or possessions. Due to pest alone annual yield loss was 25 percent for vegetables crops in every year (FAO, 2001). For increasing productivity and better market, farmers are intensively using the improved food production technology and pesticides both in quality and quantity. Pesticide being toxic can become a potential hazard to the manufacturers, users, the public at large and the environment. Both overuse and misuse of pesticides lead to loss of effectiveness of pesticides due to the development of resistance and cause human health hazards and environmental pollution. To overcome increasing problems associated with the strategy of exclusive and indiscriminate use of pesticides, the concept of integrated control was first articulated by entomologists (Stern *et al*., 1959) as an approach that applied ecological principles in utilizing biological and chemical control methods against insect pests. IPM is a means of controlling pests on the basis of sound biological knowledge and principles. To reduce pesticides use on vegetables, Bangladesh has introduced Integrated Pest Management (IPM) practices on vegetables as well as other crops.

Presently a large number of farmers of the different regions in Bangladesh are producing huge amount of vegetables using eco-friendly pheromone trap instead of harmful pesticides and are being financially benefited by using the trap at lesser cost compared to pesticides (The New Nation, 2015). Although pesticides may provide temporary relief, it is now widely accepted that indiscriminate and excessive use of pesticides and the long-term dependency on them threaten the sustainability of agricultural production. Over dependence on chemical pesticides is not only expensive but also leads to negative environmental impacts, in addition to increased health hazards to both growers and consumers of vegetables. IPM has a broad approach to vegetable production based on a sound ecological understanding. IPM enables farmers to grow healthy vegetables and to increase their farm output and income on a sustainable basis while improving the environment and community health at the same time.

Few studies (Islam *et al*., 2013, Chowdhury, 2011 and Suraia, 2008) have been conducted on economic impact of IPM technology on bitter gourd production. Some studies (Rashid, 2001 and Hoque, 2001) addressed the attitudes, problems etc. But there is no any systematic study which attempted to analyze the factors that are affecting on IPM technology adoption for bitter gourd production. For this reason, the present study makes an attempt to analyze adoption of IPM technology on bitter gourd production in Comilla district with following specific objectives: i) to document the socioeconomic characteristics of bitter gourd producing farmers; ii) to determine the factors affecting adoption of IPM technology on bitter gourd production and iii) to suggest policy options for overcoming problems and exploring possible opportunities.

2. Methodology of the Study

Methodology refers to the ‘the strategy, plan of action, process, or design lying behind the choice and use of particular methods, and linking the choice and use of methods to the desired outcomes’ (Crotty, 1998). The study conducted in Comilla district which were selected purposively. Two villages were selected namely Atbarpur and Chaykot under Chandin upazila considering the higher bitter gourd production under supervision of the Department of Agricultural Extension (DAE) during summer season. Out of 70 farmers, 35 for IPM adopted farmers and other 35 for Non-IPM farmers were selected using purposive sampling technique. Moreover, both IPM and Non-IPM farmers were categorized into three categories such as as marginal farmer (having land up to 0.40 hectors), small farmer (having land 0.40- 1.01 hectors) and medium farmer (having land 1.01-3.03 hectors).

For the present study, data were collected during field visit for the period July-August, 2015. Data were collected through direct face to face interview method and analyzed with a combination of descriptive and statistical techniques. Descriptive statistics such as sum, average, ratio, percentages etc. were derived and calculated by using Microsoft Excel. Graphical representation was also done in Microsoft Excel. Logit model with marginal effect was done in STATA-13. The final results of the analysis were summarized and presented in tabular forms with their interpretations.

Analytical Tools

The logit model was used to identify the determinants of adoption of IPM technology on bitter gourd production. The implicit form of the model was as follows:

$$Y = \ln\left(\frac{P_i}{1+P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon_i$$

Where,

P_i is the probability of adoption and non-adoption of IPM technology;

$P_i = 0$ indicates non-adoption and$P_i = 1$ indicates adoption.

Dependent variable (Binary):

Y = Probability of adoption of IPM technology.

Independent variables:

X_1 = Age of the respondent (years);X_2 = Family size (number);X_3 = Educational level of the respondent (number of years);X_4 = Farm size (ha);X_5 = Farm income (Tk.);X_6 = Non-farm income (Tk.);β_0 = Intercept;β_1 to β_6 = Regression coefficients of the dependent variable; andε = Disturbance term or error term.

According to Gujrati (1995), the marginal probabilities of the key factors of adopting IPM technology to be estimated based on expressions derived from the marginal effect of the logit model which will be estimated as:

$dy/dx = \beta_i\{ P (1-Pi)\}$

Where,

β_i= Estimated logit regression coefficient with respect to the i^{th}factor; and

P_i = Estimated probability of a respondent adoption status.

Marginal effects are computed differently for discrete (i.e., categorical) and continuous variables. With binary independent variables, marginal effects measure discrete change, i.e., predicted probabilities change as the binary independent variable changes from 0 to 1. Marginal effects for continuous variables measure the instantaneous rate of change (defined shortly). They are popular in some discipline (e.g., economics) because they often provide a good approximation to the amount of change in Y that produced by a 1 unit change in X_k. But then again, they often do not.

To identify the major problems, a four point rating scale was used such as 'high for 3', 'medium for 2', 'low for 1' and 'not at all for 0' respectively. The problem confrontation score could vary from 0-24, 0 indicating 'no problem' and 24 indicating 'highest problem'. For making rank order, Problem Confrontation Index (PCI) was computed (Hossein and Miah, 2011) by using the following formula:

$$PCI = Ph \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0 \quad (3.9)$$

Where,

P_h = Total number of farmers expressed problem as 'high';

P_m = Total number of farmers expressed problem as 'medium';

P_l = Total number of farmers expressed problem as 'low'; and

P_n = Total number of farmers expressed problem as 'not at all'.

Thus, PCI of any problem could range from 0 to 210, 0 indicating 'no' problem confrontation and 210 indicating 'high' problem confrontation.

3. Results and Discussions

At first,the difference of socioeconomic characteristics between IPM and Non-IPM farmers with a set of variables, then factors affecting adoption of IPM technology and finally some major problems were presented in this section

3.1 Socioeconomic Characteristics Differences between IPM and Non-IPM farmers

Socioeconomic characteristics can be used as an important indicator in making comparison among different categories of the respondents.Demographic characteristics mainly illustrate the wide ranges of interrelated social attributes of the farmers and their family members which largely influences their economic activities, living condition and decision making process. This part provides the information on age distribution of the sample farmers, family size, sex and work involvement of the sample farm households, educational status, occupational status, size of land holding, training experience, annual household income and expenditure of the sample farmers, women's participation etc.

Table 1 reported that majorityof IPM farmers (60%) were young and 40% were middle and old. In case of Non-IPM farmers, only 31% belong to young and 49% were middle age. About 54% IPM farmers were in small family, while only 11% Non-IPM farmers were small family. The average family size of IPM farmers was 4.51 which is lower than the national average of 4.53 (HIES, 2010) but the average family size of Non-IPM farmers was 5.92 which is higher than the national average.

In IPM farm households, male family members were 51%, 58% and 55% for marginal, small and medium farmers, respectively and average female family members for marginal, small and medium farmers were 49%, 42%and 45%, respectively. Most of the household members were engaged in agricultural activities and some of them were engaged in agriculture cum business, agriculture cum service and other activities including day laborer, rickshaw puller, shop keeping etc. Between the working members of the farm households male members were 73%, 70% and 75%, respectively and female members were 27%, 30% and 25%, respectively.For Non-IPM farm households, about 55%, 54% and 57% were male for marginal, small and medium farmers, respectively and about 45%, 46% and 43% were female for marginal, small and medium farmers, respectively. About 68%, 71% and 86% male were working members and 32%, 29% and 15% working members were female members, respectively.

Table 1: Socioeconomic Characteristics of IPM and Non-IPM farmers

Particulars	IPM farmers				Non-IPM farmers			
	Marginal	Small	Medium	All	Marginal	Small	Medium	All
Age								
Young (18 to 35)	8 (80)	7 (50)	6 (55)	21 (60)	5 (33)	3 (25)	3 (37)	11 (31)
Middle aged (36 to 50)	1 (10)	7 (50)	4 (35)	12 (34)	7 (47)	6 (50)	4 (50)	17 (49)
Old (above 50)	1 (10)	0 (0)	1 (10)	2 (6)	3 (20)	3 (25)	1 (13)	7 (20)
Family size								
Small (up to 4)	6 (60)	9 (64)	4 (36)	19 (54)	2 (13)	1 (8)	1 (12)	4 (11)
Medium (5 to 6)	4 (40)	5 (36)	6 (55)	15 (43)	8 (53)	7 (58)	4 (50)	19 (54)
Large (above 6)	-	-	1 (9)	1 (3)	5 (34)	4 (34)	3 (38)	12 (35)
Average family size	4.30	4.23	5.00	4.51	5.80	5.83	6.13	5.92

Sex								
Male	22 (51)	35 (58)	30 (55)	87 (55)	48 (55)	38 (54)	28 (57)	114 (55)
Female	21 (49)	25 (42)	25 (46)	71 (45)	39 (45)	32 (46)	21 (43)	92 (45)
Working members								
Male	11 (73)	14 (70)	12 (75)	37 (73)	17 (68)	15 (71)	12 (86)	44 (73)
Female	4 (27)	6 (30)	4 (25)	14 (28)	8 (32)	6 (29)	2 (15)	16 (27)
Educational status								
Illiterate	0	0	0	0	2 (13)	0	0	2 (6)
Sign only	0	0	0	0	2 (13)	1 (8)	0	3 (9)
Primary	1 (10)	3 (21)	1 (9)	5 (14)	8 (53)	8 (67)	6 (75)	22 (63)
Secondary	8 (80)	5 (36)	4 (36)	17 (49)	3 (20)	2 (17)	2 (25)	7 (20)
Higher secondary	1 (10)	4(29)	4 (36)	9 (26)	0	1 (8)	0	1 (3)
Graduate	0	2 (14)	2 (18)	4 (11)	0	0	0	0
Occupational Status								
Agriculture	1 (10)	4 (29)	2 (18)	7 (20)	3 (20)	3 (25)	2 (25)	8 (23)
Agriculture and business	5 (50)	8 (57)	6 (55)	19 (54)	10 (67)	6 (50)	4 (50)	20 (57)
Agriculture and service	1 (10)	2 (14)	2 (18)	5 (14)	0	0	2 (25)	2 (6)
Agriculture and others	3 (30)	0	1 (9)	4 (11)	2 (13)	3 (25)	0	5 (14)
Land holding								
Owned land	0.33 (89)	0.52 (66)	0.99 (78)	0.61 (75)	0.29 (83)	0.34 (57)	0.63 (58)	0.42 (62)
Leased in	0.02 (5)	0.08 (10)	0	0.03 (4)	0.04 (11)	0.17 (28)	0.15 (14)	0.12 (18)
Leased out	0.17 (46)	0.05 (6)	0.11 (9)	0.11 (14)	0.13 (37)	0.02 (3)	0.02 (2)	0.06 (9)
Homestead area	0.05 (14)	0.05 (6)	0.07 (6)	0.06 (7)	0.04 (11)	0.03(5)	0.06 (6)	0.04 (6)
Garden and pond area	0.14 (38)	0.17 (22)	0.31 (24)	0.21 (26)	0.10 (29)	0.07 (12)	0.25 (23)	0.14 (21)
Fallow land	0.004 (1)	0.01 (1)	0.09 (7)	0.10 (12)	0.01(3)	0.01 (2)	0.01 (1)	0.01(2)
Area under bitter gourd	0.08 (22)	0.09 (11)	0.10 (8)	0.09 (11)	0.08 (23)	0.08 (13)	0.09 (8)	0.08 (12)
Annual income								
Farm income	130820 (64)	182426 (77)	235873 (73)	183039 (71)	111002 (61)	104642 (66)	121875 (55)	112506 (60)
Non-farm income	74280 (36)	55788 (23)	86036 (27)	72035 (29)	72331 (39)	54525 (34)	100125 (45)	75661 (40)
Annual expenditure								
Food expenditure	85322 (52)	97191 (51)	126188 (49)	104070 (51)	79200 (54)	67486 (53)	90576 (51)	81777 (53)
Non-food expenditure	78758 (48)	93380 (49)	131339 (51)	99989 (49)	67466 (46)	59847 (47)	87024 (49)	72519 (47)

Figures in the parentheses indicate the percentage of total
Source: Field survey, 2015

Table 1 revealed that there were no illiterate IPM farmers but about 6% of Non-IPM farmers were illiterate. Again most of the IPM farmers (49%) received secondary level of education while 63% of Non-IPM farmers had primary level of education. In the study area, majority (54%) of the IPM farmer's and 57% of Non-IPM farmer's occupation were agriculture cum business. A good number (14%) of IPM farmers were engaged in various services including teaching, driving, government services, NGO services, etc. Other occupational activities included rickshaw/van puller, day laborer, wage laborer etc. Table 1 revealed that the average area under bitter gourd was 11% and 12% of total land holding by IPM farmers and Non-IPM farmers. The average annual household income of IPM farmers was found to be Tk. 255074 of which 71% of total income from farm activities. On the other hand, total annual household income of Non-IPM farmers was estimated to be Tk. 188167 of which 40% from non-farm resources.

3.2 Factors Affecting Adoption of IPM Technology on Bitter Gourd Production

The result of logit regression was presented in Table 2. The result showed that the model was accurate in explaining the determinants of adopting IPM technology on bitter gourd production. Out of six variables, 4 were significant in adopting IPM technology for bitter gourd production. These variables were family size, education level, farm income, non-farm income of the sample farmers in the study areas.

Therefore, the estimated equation is as follows:

$$Y_i = 1.918 - 0.036X_1 - 2.125X_2 + 2.680X_3 + 0.004X_4 + 0.000047X_5 - 0.000019X_6$$

Each coefficient increases the odds by a multiplicative amount, the amount is e^b. Every unit increases the odds by e^b. Here, e^b= Expected (B)

Logistic regression

Number of observations	=70
LR chi^2 (6)	=71.64
Prob> chi^2	= 0.0000
Log likelihood	= -12.699075
Pseudo R^2	= 0.7383

Family size

The empirical result shows that the coefficient of family size of the respondents has negative value (-2.125), which was statistically significant at 1percent level. It indicated that, smaller family size had higher probability of adopting IPM technology for bitter gourd production.

Table 2: Estimates of the logistic regression of determinants of adopting IPMtechnology on bitter gourd production

Variables	Coefficient (β)	Std. Err	z	P value
Constant	1.918	3.646	0.53	0.599
Age(X_1)	-0.036	0.074	-0.48	0.632
Family size (X_2)	-2.125***	0.816	-2.61	0.009
Education level (X_3)	2.680***	0.992	2.70	0.007
Farm size (X_4)	0.004	0.008	0.55	0.582
Farm income (X_5)	0.000047**	0.000021	2.20	0.028
Non-farm income (X_6)	-0.000019*	0.000011	-1.69	0.090

Source: Field survey, 2015.

Note: *** indicates significant at 1 percent level; ** indicates significant at 5percent level; and * indicates significant at 10percent level.

Education level

The parameter of education level estimated a positive result (2.680) and statistically highly significant at 1percent level. It implies that the higher level of education, the greater probability of adopting IPM technology in bitter gourd production.This result evidently demonstrates that education emerges as an important factor in influencing adoption of IPM technology.

Farm income

This result implies that annual average farm income of the respondents was positive which was 0.000047 and significant at 5 percent level. This implies that the higher farm income, the greater probability of adopting IPM technology in bitter gourd production.

Non-farm income

The empirical result shows that the coefficient of annual average non-farm income of the respondents had negative value, significant at 10 percent level. It indicated that, the higher non-farm income lowers the probability of adopting IPM technology for producing bitter gourd.

Age of the respondents explained the negative effect on the probability of adopting IPM technology, which was statistically insignificant. Farm size presents positive effect but it was statistically insignificant.

3.3 Marginal Effect after Logistic Regression

Marginal effects are computed differently for discrete (i.e., categorical) and continuous variables. Marginal effects measure discrete change i.e., how predicted probabilities change as the binary independent variable changes from 0 to 1. Marginal effects for continuous variables measure the instantaneous rate of change.

Family size

The result of marginal effect shows that the farm size has negative value of dy/dx (0.514), which was statistically significant at 1percent level. It indicated that, one unit decrease in the family size may increase the probability of adopting IPM technology by 0.514 unit, keeping other factors held constant. So, the marginal effect on the probability of adopting IPM technology on bitter gourd production was 0.514 units greater for small family size than the larger, keeping all others factors constant.

Table 3:Estimates of the marginal effect of determinants of adopting IPM technology on bitter gourd production

Variables	dy/dx	Std. Err.	z	P value
Age (X_1)	-0.009	0.017	-0.48	0.629
Family size (X_2)	-0.514***	0.217	-2.37	0.018
Education level (X_3)	0.648***	0.245	2.64	0.008

Farm size (X_4)	0.001	0.001	0.56	0.574
Farm income (X_5)	0.000011***	0.000	2.34	0.019
Non-farm income (X_6)	-4.49e-06*	0.000	-1.69	0.091

Source: Field survey, 2015.

Note: *** indicates significant at 1 percent level; and * indicates significant at 10percent level.

Education level

The level of education has a positive value of dy/dx (0.648), which is statistically highly significant at the level of 1percent. It indicated that,one unit increase in the level of education of the respondentwill increase the probability of adopting IPM technology on bitter gourd production by 0.648 units, keeping other factors remaining constant. The results of marginal effect showed that, the predicted probability of adoption was 0.648 units higher for the higher educated farmers than relatively less educated, held other factors remain equal.

Farm income

This result of marginal effect i.e., dy/dx implies that annual average farm income of the respondents was positive and significant at 1 percent level. This indicates that, if other things being equal, one unit increase in the level of farm income increased the probability of respondent to be adopted IPM technology on bitter gourd production by 0.000011unit. The results of marginal effect confirmed that, the predicted probability of adoption was 0.000011 units higher for the higher farm income than the lower farm income earner, other things being equal.

Non-farm income

The result of marginal effect shows that the annual average non-farm income of the respondents has a negative value (-4.49e-06), which was statistically significant at 10 percent level. It indicated that, one unit increase in the non-farm income decreased the probability of adopting IPM technology for producing bitter gourd by 4.49e-06unit, keeping other factors held constant. The results of marginal effect showed that, the predicted probability of adoption was lower (4.49e-06) for receiving higher non-farm income, held other factors remain equal.

3.4 Problem Confrontation Index (PCI)

To find out the problem confronted by the farmers in practicing and adopting IPM technology, several consultations were held with the relevant personnel. Various problems were faced by the farmers in adopting and practicing IPM technology in the study areas. The computed PCI of the 8 problems ranged from 42 to 184 (against a possible range from 0 to 210) and have been arranged in rank order according to their problem indices which presents in Table 4.

Majority of the farmers point out that lack of proper training facilities was the main problem in the study areas in practicing and adopting IPM technology. It was also a major problem faced by the Non-IPM farmers in case of adopting IPM technology because they did not get any training on practicing IPM technology and detailed information about this technology. Out of 70 farmers, 51 farmers confronted this problem at high extent, 15 farmers at medium extent, 1 farmer at low extent but only 3 farmers were indifference with the problems. In this case, the computed value of PCI was 184 [(51×3) + (15×2) + (1×1)] against a possible range from 0 to 210 and hence was considered as the 1st ranked problem. A good number of farmers point out that, lack of technological knowledge in using IPM technology was an important problem in the study areas. Basically, the reason behind was the lack of training facilities in the study areas. Most of the farmers did not have clear ideas about IPM technology. In this case, the calculated value of PCI was 160 [(36×3) + (18×2) + (16×1)] against a possible range from 0 to 210 and was considered as the 2nd ranked problem.

Table 4: Farmers' problem confrontation along with rank order

SL No.	Problems	Extent of problem confrontation (N=70)				PCI	Rank order
		High (3)	Medium (2)	Low (1)	Not at all (0)		
1	Lack of proper training facilities	51	15	1	3	184	1
2	Lack of technological knowledge in using IPM technology	36	18	16	0	160	2
3	Weak extension services	38	15	14	3	158	3
4	Unavailability of pheromone trap	0	12	18	40	42	8
5	Labor scarcity	11	17	6	36	73	5
6	Lack of knowledge on the harmful effect of insecticides	2	16	13	39	51	6
7	Unavailability of skilled labor	17	11	5	37	78	4
8	Lack of awareness	3	9	23	35	50	7

Source: Field survey, 2015.
Note: PCI = Problem confrontation index (Possible score range 0 to 210).

In this way, comparatively fewer problems were identified as unavailability of pheromone trap. During field survey the farmers were asked to indicate probable suggestions to overcome the problems in practicing and adopting IPM technology. Majority of the farmers suggested that training facilities should be improved. The rate of adoption of IPM was low due to the ignorance of growers. Therefore, adequate training should be provided to the vegetables growers on different aspects of IPM technology. Farmers awareness and motivation should be increased through training, demonstration plot, group meeting of farmers, field day etc.

Knowledge of the input retailers and Sub Assistant Agricultural Officers (SAAOs) on IPM should be increased through training exposure, visit etc. in order to provide appropriate initiatives for the farmers. Extension services should be improved because there was lack of coordination between farmers and extension workers in the study areas. It should be an opportunity to get services by the extension workers in time of necessity. DAE should take initiative to increase IPM technology adoption and proper practices for more profitable vegetable as well as crop production without harming the environment. Community approach should be done to popularize IPM method. Educated, commercially oriented and lead farmers should be involved to introduce IPM technology at farmers' level for vegetable and crop production to increase farm income. It would also be an easy way to introduce IPM technology at farmers' level by the establishment of more IPM clubs. Finally, the reasonable price of the IPM-applied vegetables should be ensured through cooperative markets or growers' market so that the growers are motivated to use IPM and grow vegetables and other crops that are safe and of superb quality.

4. Conclusions and Policy Implications

Findings of the study and the logical interpretation of their meanings in the light of other relevant facts enabled the researcher to draw the conclusions. The idiosyncratic factors (i.e. age, family size, education level, farm size, farm income and non-farm income etc.) have been influenced on adopting IPM technology, and farmers faced various problems in practicing and adopting IPM technology. Moreover, lack of training facilities was the major problem in the study areas and as a result many of them were not aware about the benefit of the use of IPM technology.

The farmers also suggested the probable solutions to get rid of those problems. On the basis The policy implications ensure from the findings of the study.

- The training facilities should be increased. For the better adoption and practices of this technology farmers need better skills and knowledge. Strategy for different training programs should be based on community participation and principles of field-based experimental learning in the light of Non-Formal Adult Education.
- The extension services should be strengthened to increase coordination between farmers and extension workers and to give support to the farmers for the adoption and practice of IPM technology by which they can determine their factors, which influences their adoption and practices, and change those according to their influence.
- A regular system for monitoring and evaluation of and follow-up to IPM activities and its impacts at the farmers' level should be established.
- IPM related publicity should be promoted through the mass media and awareness on dangers of pesticides, pesticide residues in food, health and environmental hazards of pesticides will be created.

- Government of Bangladesh should make an annual budget allocation for IPM activities and place the fund with the National IPM Program. As a result more farmers could be interested on adopting IPM practices in future.

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