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Comparative profitability analysis of IPM and non-IPM technology on vegetable cultivation in selected areas of Kishoreganj District in Bangladesh

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Abstract

The present study is an attempt to examine the socioeconomic characteristics and compared profitability analysis of both IPM and Non-IPM vegetable growers, and to identify the problems faced by vegetables growers in use of IPM practices in some selected areas of Kishoreganj district. A total of 45 farmers were purposively selected where three different IPM practices were taken into consideration. To get a more complete picture of vegetable production using both IPM and non-IPM technology, the socio-economic profile of farmers was examined and compared. The study found that IPM farmers were in better-off condition than that of non-IPM farmers in all types of socioeconomic characteristics. The major findings of the study revealed that production of all the selected vegetables were profitable for both IPM and non-IPM farmers. But, IPM based cultivation was more profitable than that of non-IPM based cultivation. Average total costs were Tk. 86352.8 and Tk. 100061.5 for IPM and non-IPM farmers, respectively. Average gross returns were Tk. 257293.3 and Tk.235788.8 for IPM and non-IPM farmers, respectively. The average net return for IPM farmers was Tk.170940.5 and for non-IPM farmers it was estimated at Tk. 135727.3. The average benefit cost ratio for IPM farmers was 2.9 and for non-IPM farmers it was estimated at 2.3. Most of the farmers were in the categories of low to medium problem confrontation in using IPM practices. The first ranked constraint is lack of training facility. Thus, massive extension facility including training is needed in the study areas to increase the extent of use of IPM technology.

Key words: IPM, vegetables, comparative profitability, problem confrontation

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Introduction

Although Bangladesh is on course for middle income country status by 2021, agriculture remains the largest employer in the country by far; and 45.1% (BBS, 2013) of the population is directly employed in agriculture and around 70% depends on agriculture in one form or another for their livelihoods. Vegetables sub-sector plays an important role for development of Bangladesh. Vegetables are an herbaceous plant whose fruits, seeds, roots, tubers, leaves, etc. are used as food. Nearly 100 different types of vegetables comprising both of local and foreign origins are grown in Bangladesh. In Bangladesh, vegetables are grown generally in summer and winter seasons. Climate and soil of Bangladesh are also very much suitable for growing vegetables round the year. Vegetable is important for nutrition, economy and food security as well. Vegetables can be identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. The importance of vegetable can be realized from two stand points such as, economic point of view and nutritional point of view. In one hand, vegetables are generally labour intensive crops and thus offer a considerable promise for generating increased rural employment opportunities. It also creates a great opportunity of employment for the large number of unemployed women of Bangladesh. On the other hand, Vegetables compared to other food items provide low cost nutrition source. By this way, the country can reduce dependence on cereals gradually and release more land for production of crops. Bangladesh is an advantageous position as it has abundant labour supply and natural resources endowment like land and climate. The sector, however, is facing many problems such as declining agricultural productivity, soil degradation and land conversion. Pest and diseases infestation in the crop field is one of the main constrains for increasing agricultural production. Therefore, for increasing crop production it is imperative to reduce the crop loss caused by pests and diseases (Kausar, 2006).

Pest and pesticide management problems affect most countries around the globe, and Bangladesh is not an exception to this. A significant amount of production is lost every year due to relentless attack by various pests. High temperature and humidity in summer favor insect reproduction. To control pest, still majority of the farmers are rely on conventional system that is application of chemical pesticide. To rely fully on chemical control is not feasible in social, economic and environmental aspect. That is why, an alternative strategy is needed that can control pest in less expensive and environment friendly way. Chemical control is considered to be the principal method of pest control in Bangladesh. Although pesticides may provide temporary relief from pest problems, long-term dependency on pesticides is not desirable. It is now widely accepted that indiscriminate use of pesticides not only creates serious environmental and human health problems but also promotes development of pest resistance to insecticides, destroys beneficial insects, upsets the balance between the pests and their natural enemies leading to the increase in the population of the target pests and even the creation of new pest problem (Anonymous, 2003).

Fortunately, agricultural research continues to combat farmer dependence on pesticides by developing strategies to manage pests while reducing the volume of chemical input needed to control them. Integrated Pest Management (IPM) is one such sustainable strategy for controlling pests. IPM is a broad ecological approach to pest control using various pest control tactics in a compatible manner. It is a holistic approach to crop production based on sound ecological understanding. Integrated pest management (IPM), an approach where to control pest emphasize are given on non-chemical or organic ways and chemicals are only applied when pest infestation is severe. IPM is an approach where pest are controlled by following a number of environment friendly practices or technologies. Though generally there is a similarity about IPM technologies around the globe, in some extent these vary country to country as well as crop to crop. Over the years several IPM technologies have been developed in Bangladesh though all are not suitable for vegetables. The IPM practices that are suitable and use in vegetable cultivation are pheromone trap, biological control, soil solarization, soil amendments, grafting, botanicals and manual cleaning. The integrated pest management, which has an important role in sustainable agriculture, is described as the integrative use of all available pest control methods to control the pests.

Some relevant studies that conducted in the past at home and abroad as far as available have been presented. Islam (2015) performed a research on an economic study on practicing IPM technology for producing bitter gourd in selected areas of Comilla district and the study revealed that IPM farmers gained more profit than non-IPM farmers on bitter gourd production. The average per hectare total cost of bitter gourd production was Tk. 368335 and Tk. 444508 for IPM and non-IPM farmers respectively in the study areas. The study also revealed that farmers in the study areas expressed their opinion on some problems confronted by them in practicing and adopting IPM technology. McCarthy *et al.* (2015) evaluates the effectiveness and impacts of USAID's IPM IL vegetable technology transfer subproject in Bangladesh. The results from the adoption analysis suggest the number of years of agricultural experience of the household head, the number of IPM adopters known by the household, and learning agricultural information from media sources and/ or farm training events such as field days significantly increase the likelihood of IPM adoption. The impacts of IPM adoption on vegetable yields, pest management costs, and the number of pesticide applications were non-significant for vegetable crops. Hristovska (2009) conducted a study on economic impacts of integrated pest management in developing countries: evidence from the IPM CRSP. This thesis summarizes previous IPM CRSP impact studies, and provides additional impact assessments of IPM practices developed on the program based on additional secondary information on elasticities, prices and quantities, economic surplus analyses were conducted. Akter *et al.* (2008) conducted a study on returns to investment on research and development of soil borne disease management strategy for brinjal in Bangladesh. The study estimated the economic returns to the past investment on the development of two IPM practices. The study showed that about 20.10% more brinjal production was made available due to adoption of IPM practices (i.e. use of poultry refuse and mustard oilcake) during 2002-2003. The yields of brinjal under IPM practices were 33% and 34% higher, respectively, over the non-IPM practices. Though many study have been conducted but the economic and social issues are very often avoided. For this reason, present study makes an attempt to determine the profitability of IPM based vegetable production and compare with that of the conventional vegetable production. On the basis of the findings of the present study specific recommendations will be made for realistic policy formulation which will help the farmers to become aware about using IPM practices instead of chemical pesticides. In one word, this study is a modest attempt to find a way of sustainability in agriculture. The general objective of this study was to assess the profitability of IPM based vegetables production. The specific objectives are to study the socioeconomic profile of IPM and non-IPM vegetable growers, compare the profitability of vegetable cultivation with and without IPM technology and identify the problems faced by vegetables growers in use of IPM practices and suggest some policy guidelines/recommendations.

Materials and Methods

Two villages from Kishoreganj district namely Vodropara and Kashiarchor under Mohinando union of Sadar upazila were purposively selected based on intensive vegetable growing areas. In selecting the area, necessary help was taken from the Department of Agricultural Extension (DAE). A proportionately selected sample size of 45 farmers was drawn who are growers of three selected vegetables (wax gourd, Okra, Papaya) in both IPM and non-IPM technology. An interview schedule was used as the research instrument in order to collect relevant information from the respondents. Data were collected by the researcher herself. The task was accomplished through a field to field visit. The entire process of data collection took one month from 15 February to 15 March 2016.

To achieve the objective of examining socioeconomic characteristics, data were analyzed with a combination of descriptive and statistical techniques. Descriptive statistics such as sum, average, ratio, percentage etc. were derived and calculated by using Microsoft Excel. Per acre profitability of wax gourd, okra and papaya production was measured in terms of gross return, gross margin, net return and benefit Cost ratio (undiscounted). The formulas used for the calculation of profitability; are:

Gross return, GR = P×Q; where, P = Selling price of the product (Tk.); Q = Yield per acre (Kg);

Gross cost, GC = TFC + TVC; where TFC = Total fixed cost (Tk.); and TVC = Total variable cost (Tk.);

Gross margin, GM = GR – TVC;

Net return, NR = GR – GC;

Benefit cost ratio = Gross benefit/ Gross cost

In order to ascertain the extent of severity of constraints faced by the farmers in using IPM practices, Constraints Facing Index (CFI) was computed. For making rank order, CFI was computed by taking 13 selected constraints and by using the following formula:

$$\text{Constraint Facing Index (CFI)} = C_h \times 3 + C_m \times 2 + C_l \times 1 + C_n \times 0$$

Where,

C_h = Total number of responses indicating high constraint facing;

C_m = Total number of responses indicating medium constraint facing;

C_l = Total number of responses indicating low constraint facing; and

C_n = Total number of responses indicating no constraint facing.

The Constraints Facing Index of any constraint could range from 0 to 135, where 0 indicated no constraint and 135 indicated the highest constraint.

Results and Discussion

Socioeconomic characteristics of the sample farmers

Most of the IPM farmers (60.6 percent) are in young aged group while that of the Non-IPM farmers (91.7 percent) are in middle to old aged group. Average family size of the IPM farmers was 6.8 and that of the Non-IPM farmers was 7.4. About 40 percent IPM farmers completed their secondary education, while no Non-IPM farmers completed their secondary education. Major proportions of farmers are dependent on agriculture (84.9 percent of IPM farmers and 50 percent of Non-IPM farmers).

Average farm size of IPM farmers (2.5 acre) was more than that of Non-IPM farmers (1.6 acre). Major proportion of the income (76.7 percent) of IPM farmers comes from agriculture while that of (74.0 percent) Non-IPM farmers from petty business. 63.2 percent farmers had short term while 36.8 percent had medium term and nobody had long term training experience. It was found in the study areas that women are mostly involved in weeding, trellis making, harvesting and post harvesting activities in both cases of IPM and Non-IPM farmers. Highest proportion (54.6 percent) of IPM farmers belonged to frequent contact, while that of (50 percent) Non-IPM farmer's belonged to occasional contact. Most of the IPM farmers had participation for one to two years (45.4 percent), while most of the Non-IPM farmers had no participation (58.3 percent). Most of the farmers (36.4 percent) lately adopt IPM technologies within four or above years while only 9.1 percent farmers adopt very early (within 1 year). Based on the descriptive evidence emanating from this study, it was noticed that there were some variations in socio-economic characteristics of wax gourd, okra and papaya producers (Table 1). The above results indicate that the IPM practicing farmers were in better-off condition than that of non-IPM farmers in all of eleven socioeconomic characteristics.

Profitability of selected vegetables production

Estimation of different costs for both IPM and non-IPM vegetable growers

Table 2 shows that in case of IPM farmers, the human labour costs of wax gourd, okra and papaya cultivation were Tk. 31143.6, Tk. 40990.9 and Tk. 27662.9, respectively, while for Non-IPM farmers, the costs of wax gourd, okra and papaya cultivation were Tk. 32574.9, Tk. 42542.9 and Tk. 26217.1, respectively. It was revealed from the table that human labour cost is the foremost cost item for both IPM and non-IPM farmers.

Table 1. Socioeconomic characteristics of the sample farmers

Characteristics	Category	IPM farmers (%)	Non- IPM farmers (%)
Age distribution (Basis of categories)	Young(up to 35)	60.6	8.3
	Middle (36 to 50)	33.3	75.0
	Old (above 50)	6.1	16.7
	Total	100.0	100.0
Family size	Small family (up to 4 members)	18.2	16.7
	Medium family (5 to 7 members)	51.5	33.3
	Large family (above 7 members)	30.3	50.0
	Total	100.0	100.0
Educational status	Illiterate	0.0	16.7
	Can sign only	9.1	16.7
	Primary	45.5	66.7
	Secondary	39.4	0.0
	Higher secondary	6.1	0.0
	Total	100.0	100.0
Occupational status (Primary occupation)	Agriculture	84.9	50.0
	Petty business	9.1	25.0
	Day-labour	3.0	0.0
	Driver	3.0	25.0
	Total	100.0	100.0
Different source of family income (Tk.)	Agriculture	76.7	51.1
	Livestock	5.3	0.0
	Fisheries	18.7	2.5
	Petty business	41.0	74.0
	Day-labour	1.1	3.0
	Driver	35.4	54.5
	Others	11.0	10.4
	Total	100.0	100.0
Training	Short term (up to 30 days)	63.2	-
	Medium term (31 to 60 days)	36.8	-
	Long term (above 60 days)	0.0	-
	Total	100.0	-
Extension media contact	Not at all	3.0	16.7
	Rarely	18.2	25.0
	Occasionally	24.2	50.0
	Frequently	54.6	8.3
	Total	100.0	100.0
Organizational participation	For 5 or more year	15.2	0.0
	For 4 year	9.1	0.0
	For 3 year	9.1	0.0
	For 2 year	21.2	0.0
	For 1 year	24.2	25.0
	For less than 1 year	0.0	16.7
	Not Involved	21.2	58.3
	Total	100.0	100.0
Innovativeness	Within 0 year	9.1	-
	Within 1 year	6.1	-
	Within 2 years	15.2	-
	Within 3 years	33.3	-
	Within 4 or above years	36.4	-
	Never used	0.0	-
	Total	100.0	-

Source: Field survey, 2016

The average power tiller cost was Tk. 2666.7 for all IPM farmers that constitute 3.1% of total cost of vegetable production whereas for non-IPM it was estimated at Tk. 2704.8 which constitute 2.7% of total cost of vegetable production. The average seeds/ seedlings cost of Okra was more for IPM farmers (Table 2). The average manures and fertilizers cost between two groups of farmers were not significant. Among the selected three vegetables, pheromone trap is used in case of wax gourd. Number of pheromone trap used per acre is 22. Thus, the cost of pheromone trap was Tk. 1081.9 for per acre production of wax gourd.

Table 2. Per acre production cost of vegetables for both IPM and Non-IPM farmers (Taka)

Cost items	**Wax gourd**		**Okra**		**Papaya**	
	IPM	**Non-IPM**	**IPM**	**Non-IPM**	**IPM**	**Non-IPM**
Labor cost	31143.6	32574.9	40990.9	42542.9	27662.8	26217.1
Power tiller	2285.7	2285. 8	2285.7	2400.0	3428.6	3428.6
Seed/seedling	657.1	657.1	3542.9	857.1	4342.8	4342.9
Bamboo	4733.3	15142.9	0.0	0.0	15892.8	17142.9
Cow dung	4997.1	5371.4	8285.7	9714.3	7357.2	7428.6
Urea	3908.0	4677.7	1388.6	1600.0	4118.6	4114.3
TSP	1639.2	1952.0	967.5	1382.9	7400.0	7385.7
MOP	1161.2	1328.6	1302.9	1500.0	3657.2	3750.0
Gypsum	362.2	428.6	434.3	628.6	717.8	742.9
Boron	2904.0	2388.6	1672.0	1508.6	1186.4	1382.9
Zinc	1312.5	1248.6	954.8	920.0	603.8	722.9
Manures and Fertilizers	16284.2	17395.4	15005.7	17254.3	25040.9	25527.1
Pheromone trap	1081.9	0.0	0.0	0.0	0.0	0.0
Insecticide	0.0	12169.1	108.6	11232.0	3928.6	15714.3
Fungicide	1542.9	1872.0	1608.5	1872.0	1560.0	1950.0
Irrigation	3411.4	3085.7	4457.2	3428.6	3385.7	3428.6
Interest on operating cost	1817.6	2262.3	2785.1	3341.2	4616.6	5393.2
Land use cost	5714.3	5714.3	9523.8	9523.8	11428.6	11428.6
Total costs	77462.6	93159.5	80308.2	92451.9	101287.5	114573.2

Source: Authors' estimation based on field survey, 2016.

The average insecticides cost was nearly 10 times more for Non-IPM farmers. The average fungicides cost was Tk. 1570.4 for all IPM farmers whereas for non-IPM it was estimated at Tk. 1898.0 which occupied 1.8 % and 1.9% of their respective total costs. The land use cost was same for both IPM and non-IPM farmers but it is different for three selected vegetables. It was estimated at Tk. 5714.3 for wax gourd, Tk. 9523.8 for okra and Tk. 11428.6 for papaya production which covered 10.3% and 8.9% of total costs of production for IPM and non-IPM farmers, respectively. Per acre total costs of wax gourd, okra and papaya production were Tk. 77462.6, Tk. 80308.2 and Tk. 101287.5, respectively for IPM farmers. The corresponding costs were Tk. 93159.5, Tk. 92451.9 and Tk. 114573.2, respectively for non-IPM farmers. However, average total costs were Tk. 86352.8 and Tk. 100061.5 for IPM and non-IPM farmers, respectively (Table 2). It is clear from the table that the cost of non-IPM farmers was higher than that of IPM farmers.

Profitability Analysis

IPM farmers receive more gross returns and gross margins in case of all crops than non-IPM farmers (Table 3). In case of IPM farmers, net returns of wax gourd, okra and papaya cultivation were Tk. 88967.9, Tk. 123427.5 and Tk. 300426.2, respectively, while for non-IPM farmers, the respective figures were Tk. 72440.6, Tk. 101886.5 and Tk. 232854.8 (Table 3). Net returns of IPM farmers were higher than that of non-IPM farmers which is also supportive to the fact that IPM farmers are more efficient than the non-IPM farmers. In case of IPM farmers, per acre benefit-cost ratios of wax gourd, okra and papaya cultivation were 2.2, 2.5 and 4.0, respectively, while for non-IPM farmers, the respective ratios were 1.8, 2.1 and 3.0. It indicates that though both of the groups are in profitable condition, IPM farmers are more profitable than non-IPM farmers.

Table 3. Profitability of vegetables for both IPM and Non-IPM farmers

Items	**Wax gourd**		**Okra**		**Papaya**		**Average**	
	IPM	**Non-IPM**	**IPM**	**Non-IPM**	**IPM**	**Non-IPM**	**IPM**	**Non-IPM**
Yield (Kg/acre)	14514.3	13142.9	7408.6	7251.4	33476.1	34742.8	18466.3	18379.0
Price (Tk./kg)	11.5	12.6	27.5	26.8	12.0	10.0	17.0	16.5
Gross Return (Tk./acre)	166430.5	165600.0	203735.7	194338.3	401713.7	347428.0	257293.3	235788.8
Total variable cost (TVC)	21205.7	26393.6	19495.7	23388.4	26930.2	31460.2	22543.9	27080.8
Total Cost (Tk./acre)	77462.6	93159.5	80308.2	92451.9	101287.5	114573.2	86352.8	100061.5
Gross Margin (Tk./acre)	145224.9	139206.4	184240.0	170949.9	374783.5	315967.8	234749.4	208708.0
Net Return (Tk./acre)	88967.9	72440.6	123427.5	101886.5	300426.2	232854.8	170940.5	135727.3
Benefit Cost Ratio	2.2	1.8	2.5	2.1	4.0	3.0	2.9	2.3

Source: Authors' estimation based on Field survey, 2016.

On the basis of above results and discussions, it may cautiously be concluded that the cultivation of wax gourd, okra and papaya was profitable in both IPM and non-IPM based technology. However, IPM based cultivation was more profitable than that of non-IPM based cultivation. Thus, there is an ample scope to increase production of vegetables by using the existing IPM practices and also by implementing new suitable techniques.

Constraints Faced by the Farmers in Using IPM Practices

The computed CFI of the 13 problems ranged from 0 to 112 and has been arranged in rank order according to their constraint indices has been presented in Table 4. The table shows that lack of experienced trainer got the highest score and hence it was considered as the first ranked constraint among the statements. It was found that approximately 51 percent of the respondents faced high constraints with the total score of 112. The reason may be the lack of training facility in that area. Time consuming in mechanical control of pest got the second highest score and thus stood second in the rank order among the statements. Approximately 38 percent of the respondents faced high constraints with the total score of 106 (Table 4). Farmer felt that IPM is an intensive care production method as it required more time to control pest from the crop field. On the other hand, farmers considered that chemical pesticide works very rapidly and takes less time to control pest. Hence they found constraint to control of pest mechanically. IPM practice requires regular monitoring got the third highest score and thus stood third in the rank order among the statements. It was found that approximately 38 percent of the respondents faced high constraints with the total CFI of 105 (Table 4).

Table 4. Extent of constraints faced by the farmers in using IPM practice

Sl. No.	Constraints of farmers	Extent of Constraints				CFI	Rank order
		High	Medium	Low	Not at all		
1	Lack of knowledge about AESA	1	18	25	1	64	11
2	Lack of knowledge in using IPM	2	25	18	0	74	8
3	Doubt about the effectiveness of IPM practices	3	20	22	0	70	10
4	Expensive in using IPM practices	1	14	29	1	60	12
5	Absence of sufficient demonstration plots on IPM	3	29	13	0	80	6
6	Lack of resistant varieties	2	28	15	0	77	7
7	Time consuming in mechanical control of pest	17	27	1	0	106	2
8	IPM practice requires regular monitoring	17	27	0	0	105	3
9	Unavailability of organic fertilizer	0	10	33	2	53	13
10	Lack of training facility of IPM practices	15	29	1	0	104	4
11	Biased selection for training	2	23	19	1	71	9
12	Lack of experienced trainer	23	21	1	0	112	1
13	Lack of quality seed	5	33	7	0	88	5

Source: Authors' estimation based on field survey, 2016.

Farmers found that IPM was a laborious method because it required more labour to monitor the crop field regularly. Thus it created more production cost and they seemed it as a major constraint for IPM practices. "Unavailability of organic fertilizer" got the least score and thus stood last in the rank order among the statements. It was found that approximately 22 percent of the respondents faced medium constraints where 73 percent of the respondents faced low constraints and 5 percent of the respondents faced no constraints with the total CFI of 53 (Table 6). Farmer found it as the least problem because organic fertilizer was available in village. Organic fertilizer as plant and animal residues are available at the villages and it was less costly in comparison with the chemical fertilizers. Moreover, it is beneficial for sound health and does not create any environment hazard and it keeps environment balance.

Conclusion

Based on the descriptive evidence emanating from this study, it was noticed that there were some variations between IPM and non-IPM farmers groups in terms of socio-economic characteristics. The IPM farmers were in better-off condition than that of non-IPM farmers in all of eleven socioeconomic characteristics. Again, it could cautiously be concluded that the cultivation of wax gourd, okra and papaya was profitable in both IPM and non-IPM based technology. However, IPM based cultivation was more profitable than that of non-IPM based cultivation. Thus, there is an ample scope to increase production of vegetables by using the existing IPM practices and also by implementing new suitable techniques. Again, farmers in the study area expressed their opinion about several constraints they faced in using IPM practices. These obstacles hindered the economic progress of the region. Therefore, government as well as other related organizations should come forward and execute the suggestions to achieve self-sufficiency in food production and consumption as well.

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