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Relative Profitability of IPM Technologies of Vegetable Cultivation in Bangladesh

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Abstract

The present study was carried out in Comilla, Jessore and Lalmonirhat districts during the period of 2003-04 to examine and compare relative profitability of IPM technologies over farmers' existing pest management practices. Cabbage and eggplant were considered with two technologies like the use of mustard oilcake and poultry refuse. Taking 100 farmers from each of the districts a total of 300 farmers were purposively selected. In compare to the prevalent use of costly insecticides, mustard oilcake and poultry refuse were found as less costly, effective and harmless (1.35 mt to 4.39 mt for cabbage and 1.58 mt to 2.27 mt for eggplant). Significant test between the experimental plots and those of the farmers indicated that IPM technologies performed much better results. However, farmers in the study areas showed much curiosity about mustard oilcake and poultry refuse. For successful and effective dissemination of IPM technologies, following works were felt necessary like demonstration trials, field days, training programs for farmers and extension workers, distribution of leaflets, and mass campaign for circulating the information regarding IPM as the most useful tools in pest management.

Keyword: *IPM, Cabbage, Egg plant, Cost and Return*

Introduction

Vegetables are very important group of crops and they constitute a major part of the diet contributing nutrients and vitamins. Through vegetables are grown all over the country, there has been deficiency of vegetables in Bangladesh, and the annual production is only 610 thousand tons (Anonymous, 2001). Bangladesh, farmers are producing more than 100 types of vegetables both in summer and winter seasons, some of which are exported to different countries especially to the ethnic group of people (Henneberry *et al.*, 2001). Insecticide-free vegetables are the crying demand for all types of people at home and abroad because these are immune from ecological imbalances, health hazards, etc (Paul, 2003). Briefly stated, the goals of IPM systems are to reduce losses in crop quality and yield caused by pests and to increase net profits to the producer. The IPM technologies cause minimal environmental damage and pose little or no risk to human health. The

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IPM involves selection, integration and implementation of pest control actions on the basis of predictable economic, ecological and sociological consequences Luckman and Metcalf (1975).

A primary focus of IPM is on conservation of the natural enemies to maintain insect and mite pests below economic thresholds (DAE, 1992). Where possible, selective pesticides are used that are least harmful to natural enemies. The study attempts to use the IPM technologies like the use of poultry refuse and mustard oilcake in the vegetable fields to control soil borne diseases. With this view in mind, the present study has been undertaken to determine the relative profitability of IPM technology and existing pest control practices.

Methodology

Five farmers were selected from each year to participate in testing the IPM-CRSP derived activities. Each of these farmers had one plot which was divided into two parts. Another 15 farmers were also selected with their own practice as control. A total of 300 farmers taking from each of Comilla, Jessore and Lalmonirhat were selected for the mentioned technologies and vegetables because of these three districts were intensive vegetable growing area and farmers of these areas were prone to use insecticides to manage pests. Essential information was collected through the use of interview schedules. The information related to the use of IPM technologies, farmers' perceptions, input-output and their prices and related constraints were recorded on a regular basis by the locally set enumerators. Before launching technology diffusion activities in the farmers' fields, the selected farmers as well as the enumerators were trained about the IPM technologies. Regional Offices in those areas and one vegetable scientist from Regional Agricultural Research Station (RARS) of the respective area were also taken for necessary help for data collection. The collected data were summarized and analyzed with the help of tabular methods using averages, percentages, ratios etc. The observed data on yield were analyzed by two factors Completely Randomized Design (CRD) and the treatment means were compared by Duncan's Multiple Range Test (DMRT); t-test was also used to find any significant differences of the means of yields of the experiments. An attempt was also made for the significance test for cabbage and eggplant yields among the treatments. The null hypothesis was made, Ho: There is no significant difference among the treatment means. The study was conducted during winter and summer season of 2003-04.

Findings and Discussion

Total cost of production of cabbage

Total cost of production of cabbage at Lalmonirhat was found higher in control plots (Tk. 55142/ha) than in the experimental plots (Tk. 44945/ha for MOC and Tk. 43442/ha for PR). The higher cost was due to the use of more labour, fertilizers, manners and insecticides (Table 1). Again in Comilla, the

farmers incurred higher costs in the control plots (Tk. 52679/ha) than in the experimental plots of mustard oilcake (Tk. 40085/ha), and poultry refuse (Tk. 45364/ha) mainly due to mire use of labour, fertilizers, manures, and insecticides. The reverse findings were observed in Jessore. The cost of cabbage production under farmers' practices was found lowest (Tk. 46875/ha) compared with the cost under MOC experiments (Tk. 47058/ha) and PR experiments (Tk. 46946/ha) (Table 1). This was due to lower use of inputs and irrigation in the control plot.

Table 1. Cost of production under cabbage (HYV) experiments

Cost Item	Comilla			Jessore			Lalmonirhat		
	MOC	PR	C	MOC	PR	C	MOC	PR	C
HL: Owned	4320	3710	8155	5500	5000	5750	5860	6120	9200
Hired	3332	5035	1819	4200	4700	5000	3210	3340	2300
Total	9460	7652	8745	9974	9700	9700	10750	9070	11500
AP: owned	1290	1080	1557	1400	1400	1400	1872	1872	1872
Hired	-	-	-	490	490	490	852	852	852
Total	1290	1080	1557	1890	1890	1890	2724	2724	2724
Power tiller (Hired)	787	1075	1037	4426	4426	4426	-	-	-
Seedlings	10237	10774	10327	4098	4098	4098	10700	10700	10700
Cowdung: owned	-	-	498	-	-	-	-	-	1292
Purchased	-	-	543	-	-	-	-	-	1093
Total	-	-	1041	-	-	-	-	-	2385
Poultry refuse	-	900	-	-	900	-	-	1500	-
Mustard oilcake	2400	-	-	3000	-	-	1875	-	-
Fertilizers: Urea	1935	2400	2871	2952	2952	2454	2259	1200	2670
TSP	3221	3528	6038	5415	4185	5040	3865	3305	4212
MP	2820	4600	3615	4300	4510	2620	3325	3425	4300
Zinc sulphate	-	-	-	560	560	-	1260	1260	-
Gypsum	-	-	1235	-	-	635	560	-	-
Hyper	-	-	294	-	-	-	-	-	1440
SSP	-	-	-	-	-	123	-	-	-
Borax	-	-	-	-	-	-	1280	-	-
Total	7976	10528	14053	13227	12207	10872	12549	9190	12622
Insecticides	-	-	2575(5)	-	-	1131(2.5)	-	-	5200(9)
Irrigation	4604	4604	4420	6557	6557	6557	2800	2800	2800
Land use cost	7000	7000	7000	6500	6500	6500	6500	6500	
Interest on operational cost	539	658	695	660	668	651	602	568	711
Total Cost (F+V)	40085	45364	52679	47058	46946	46875	44945	43442	55142
Total variable cost	33085	38364	45679	40558	40446	40375	38445	36942	48642
Total cash cost	26936	32916	34774	32998	33378	32574	30111	28382	35567

Notes: MOC = Mustard oilcake, PR = Poultry refuse, C = Control, HL=Human labor, AP=Animal power, FV=Fixed & Variable; Bracketed figures represent the percentages of total costs.

Yield performance of cabbage

On average, the yields of cabbage under mustard oilcake and poultry refuse experiments were found much higher (10-50%) than the control plots. The yield of cabbage under poultry refuse was found higher than mustard oilcake in all study areas (Table 2). It indicated that the vegetables under poultry refuse performed better than mustard oilcake. However, the yields under both of the treatments were found much higher than that of the control plots.

Table 2. Yields of cabbage under different experiments

Study Area	Crop	Yield (t/ha)		
		Experiment		Control
		Mustard Oilcake	Poultry Refuse	
Comilla	Cabbage (HYV)	55.26*(42)	58.00*(49)	38.84
Jessore	Cabbage (HYV)	65.00*(10)	66.00*(12)	59.00
Lalmonirhat	Cabbage (HYV)	74.00*(36)	81.34*(50)	54.30

** Significant at 1% level, Notes: Bracketed figures represent the percentages of increased yields over the controls*

The yields of cabbage under mustard oilcake and poultry refuse were found much higher than that of the control plots in the study areas. These higher yields resulted in higher gross return, gross margins, net return, and benefit cost ratio (BCR) than that of the control plots. The per hectare gross margin of cabbage varied from Tk. 14042 to Tk. 110180 under mustard oilcake, Tk. 14042 to Tk. 125048 under poultry refuse, and Tk. 9185 to Tk. 62148 under control plots. The highest net return was obtained in the poultry refuse plot of Lalmonirhat (Tk. 118548) compared to mustard oilcake plot (Tk. 103680/ha) and control plot (Tk. 55648/ha). Again in Jessore, highest net return was obtained in poultry refuse plot (Tk. 8494/ha) compared to mustard oilcake plot (Tk. 7542/ha) and control plot (Tk. 2685/ha). In Comilla, mustard oilcake plot produced higher net return (Tk. 85577/ha) than poultry refuse plot (Tk 68896/ha) and control plot (Tk. 51319/ha) (Table 3). The BCR (total variable cost basis) of cabbage varied from 1.35 to 3.87 under mustard oilcake, 1.37 to 4.39 under poultry refuse and 1.23 to 2.28 under control plots (Table 3). The farmers also received much higher return to labour per day (Tk 122 to Tk. 662) under the experimental plots than the control plots (Tk. 93 to Tk. 411) against the normal daily wage rate of Tk. 50. Return to irrigation per taka in vested varied from Tk. 3 to Tk. 46 under experimental plots and Tk. 2 to Tk. 23 under control plots (Table 3).

Table 3. Returns from cabbage (HYV) experiments

Cost Items	Comilla			Jessore			Lalmonirhat		
	MOC	PR	C	MOC	PR	C	MOC	PR	C
Cost (Tk./ha):									
Full cost (F+V)	40085	45364	52679	47058	46946	46875	44945	43442	55142
Total variable cost	33085	38364	45679	40558	40446	40375	38445	36942	48642
Total cash cost	26936	32916	34774	32998	33378	32574	30111	28382	35567
Yield (t/ha)	55	58	39	65	66	59	74	81	55
Gross Return (Tk./ha)	125662	114260	103998	54600	55440	49560	148625	161990	110790
Gross Margin (Tk./ha)									
Variables cost basis	92577	75896	58319	14042	14994	9185	110180	125048	62148
Total cash cost basis	98726	81344	69224	21602	22062	16986	118514	133608	75223
Net Return (Tk./ha)	85577	68896	51319	7542	8494	2685	103680	118548	55648
BCR:									
Variable cost basis	3.80	2.98	2.28	1.35	1.37	1.23	3.87	4.39	2.28
Cash cost basis	4.67	3.47	2.99	1.65	1.66	1.52	4.94	5.71	3.11
Return to labor (Tk./ha)	600	513	411	122	127	93	662	656	295
Return to irrigation (Tk.)	21	17	14	3	3	2	40	46	23

Notes: MOC = Mustard oilcake, PR = Poultry refuse, C = Control, FV=Fixed & variables

Test of overall significance for cabbage

An attempt was made for the significance test for cabbage yields among the treatments. The null hypothesis was made, Ho: There is no significant difference among the treatment. It was found that the estimated value of F with (2.36) df was 12.3881 which was greater than the tabulated value of F with same df at 1% level of significance. So, the value was highly significant and the null hypothesis might be rejected. It indicated that, there was a significant difference among the effects of the three technologies on the yields of cabbage (Table 4).

Table 4. Test of significance among the treatments of cabbage

Source	df	Sum of squares	Mean squares	F-value	Probability
Place (A)	2	1330265.288	665132.644	124.4704	0.0000
Treatment (B)	2	132397.154	66198.577	12.3881	0.0001
AB	4	9687.857	2421.964	0.4532	
Error	36	192373.313	5343.703		
Total	44	1664723.613			

Duncan's Multiple Range Test (DMRT) for cabbage

It was obvious from the DMRT that both poultry refuse and mustard oilcake plots displayed significantly better performance than the control plots (Table 6). So, both the treatments can be recommended as an effective IPM practice. But considering the input cost, it could be recommended that poultry refuse as the best IPM practice, since poultry refuse was relatively cheaper and gave relatively higher yield than mustard oilcake.

Table 5. Test of significance between the treatments MOC and PR of cabbage

Treatment	Mean yield (kg/ha)	DMRT
Poultry refuse	65324.31	A*
Mustard oil cake	63731.29	A*
Control	52302.21	B

** = Significant at 1% level of probability*

Note: Any two means having a common letter is not significantly different at the 5% level of significance

Total cost of production of eggplant

The total cost of production of eggplant in Comilla was found higher in control plots (Tk. 5651/ha) than the experimental plots (Tk 45181/ha for PR on full cost basis). The higher cost was due to the use of more fertilizers, manures, insecticides and irrigation (Table 6). Again in Jessore, farmers incurred higher costs in the control plots (Tk. 39327/ha) than the experimental plots of mustard oilcake (Tk. 37896/ha) and poultry refuse (Tk. 35478/ha) mainly due to more use of labour and insecticides in the control plots. In Lalmonirhat, the cost of eggplant production under farmers' practices was also found higher (Tk. 39009/ha) than the cost under MOC experiments (Tk. 36641/ha) and PR experiments (Tk. 35212/ha). This was due to the use of more fertilizers and insecticides in the control a plot (Table 6). Similar findings were reported by Alam *et al.* (2003).

Table 6. Cost of production under eggplant experiments (Tk./ha)

Cost Item	Comilla (HYV)			Jessore (LV)			Lalmonirhat (HYV)		
	MOC	PR	C	MOC	PR	C	MOC	PR	C
Human labor: Owned	8646	9580	6525	6800	6800	7100	6920	6920	6440
Hired	2641	3753	3007	2250	2250	2400	800	800	720
Total	11287	13333	9532	9050	9050	9500	7720	7720	7160
Animal power: Owned	-	-	-	1400	1400	1400	1805	1805	1805
Hired	1600	1760	1600	560	560	560	840	840	840
Total	1600	1760	1600	1960	1960	1960	2645	2645	2645
Power tiller (Hired)	1989	1634	1577	-	-	-	-	-	-
Seedlings (Purchased)	6425	6117	6588	1563	1563	1563	5400	5400	5400
Cowdung: Owned	1950	980	1961	-	-	-	-	-	1500
Purchased	650	667	4071	-	-	-	-	-	1550
Total	2600	1647	6032	-	-	-	-	-	3050
Poultry refuse	-	1554	-	-	1500	-	-	1550	-
Mustard oilcake	2592	-	-	2400	-	-	2400	-	-
Ash	-	-	157	-	-	-	-	-	-
Fertilizers: Urea	2679	2145	2655	3024	2604	2334	2388	2292	2604
TSP	2764	3477	4037	3500	2338	4662	3058	2666	3058
MP	2780	3292	4230	4000	4100	1670	3230	3230	3095
Zinc sulphate	-	-	-	-	-	-	350	350	-
Gypsum	-	-	-	-	-	-	308	308	1920
Hyper	-	-	-	-	-	-	-	-	-
SSP	-	-	-	-	-	-	-	-	-
Borax	-	-	-	-	-	-	350	350	-
Total	8223	8914	10922	10524	9042	8666	9684	9196	10677
Insecticides	-	-	8387(15)	-	-	5222(13)	-	-	2400(6)
Irrigation	3057	3260	4268	5556	5556	5556	3300	3230	3320
Land use cost	7000	7000	7000	5600	6500	6500	6500	6500	6500
Interest on per. capital	408	415	606	343	307	360	336	315	373
Total Cost (F+ V)	45181	45634	56512	37896	35478	39327	36641	35212	39009
Total variable cost	38181	38634	49512	31696	28978	32827	30141	28712	32509
Total cash cost	27177	27659	40420	22853	20471	23967	21100	19692	22666

Note: F+V= Fixed + Variable, MOC = Mustard oilcake, PR = Poultry refuse, C = Control, Bracketed figures represent the percentages of insecticides to total cost.

Yield performance of eggplant

On the average, the yields of eggplant under mustard oilcake and poultry refuse experiments were found much higher (31-61%) than the control plots. The yields of eggplant under mustard oilcake and poultry refuse were found higher in Jessore and Lalmonirhat (Table 7).

Table 7. Yields of eggplant under different experiments

Study Area	Crop	Experiment Yield (t/ha)		Control Yield (t/ha)
		Mustard Oilcake	Poultry Refuse	
Comilla	Eggplant (HYV)	8.41* (61)	8.30* (59)	5.22
Jessore	Eggplant (LV)	5.50** (31)	5.83** (39)	4.20
Lalmonirhat	Eggplant (HYV)	8.44* (5)	8.83* (57)	5.63

** Significant at 1% level, ** Significant at 5% level*

Notes: Bracketed figures represent the percentages of increased yields over the controls

Returns from eggplant

The yields of eggplant under mustard oilcake and poultry refuse were found much higher than that of the control plots in the study areas .These higher yields resulted in higher gross return, gross margins' net return and benefit cost ratio (BCR) than that of the control plots. The per hectare gross margin of eggplant varied from Tk. 18104 to Tk. 49907 under mustard oilcake, Tk. 23492 to Tk. 49020 under poultry refuse, and Tk. 4973 to Tk. 9561 under control plots (Table 8). The per hectare net returns of eggplant in Comilla was found higher in the mustard oilcake plot (Tk. 42907) compared to poultry refuse plot (Tk. 42020) and control plot (Tk. 632). In Lalmonirhat, highest net return per hectare was found in poultry refuse plot (Tk. 25903) followed by mustard oilcake plot (Tk. 21407) and control plot (Tk. 3061). Again in Jessore, per hectare net return of eggplant was higher in the poultry refuse plot (Tk. 16992) followed by mustard oilcake plot (Tk. 11604), but negative net return was found in the control plot which was Tk.1527/ha (Table 8). It happened due to higher costs incurred in farmers' practices due to more cost of insecticides and labor use. Further, the farmers normally don't consider the land cost in their practices. However, if land cost was not considered, then they could get benefits from the practices. The BCR (total variable cost basis) of eggplant varied from 1.58 to 2.31 under mustard oilcake, 1.81 to 2.27 under poultry refuse and 1.15 to 1.29 under control plots (Table 8). The farmers also received much higher return to labor per day in the experimental plots (Tk. 185 to Tk. 294) than the control plots (Tk. 83 to Tk. 100) compared to the normal daily wage rate of Tk. 50. The farmers also received higher return to irrigation per taka invested in the experimental plots (Tk. 4 to Tk. 45) than the control plots (Tk. 2 to Tk. 23).

Table 8. Returns from eggplant experiments

Items	Comilla (HYV)			Jessore (LV)			Lalmonirhat (HYV)		
	MOC	PR	C	MOC	PR	C	MOC	PR	C
Cost (Tk./ha):									
Full cost (F+ V)	45181	45634	56412	37896	35478	39327	36641	35212	39009
Total variable cost	38181	38634	49512	31396	28978	32827	30141	28712	32509
Total cash cost	27177	24659	40420	22853	20471	23967	21100	19692	22666
Yield (t/ha)	8.41	8.3	5.22	5.50	5.83	4.20	8.44	8.83	5.63
Gross return (Tk./ha)	88088	87654	57144	49500	52470	37800	58048	61115	42070
Gross Margin (Tk./ha):									
Total variable cost	49907	49020	7632	18104	23492	4973	27907	32403	9561
Total cash cost	60911	59995	16724	26647	31999	13833	36948	41423	19404
Net Return (Tk./ha)	42907	42020	632	11604	16992	-1527	21407	25903	3061
Benefit Cost ratio:									
Total variable cost	2.31	2.27	1.15	1.18	1.15	1.15	1.93	2.13	1.29
Total cash cost	3.24	3.17	1.41	2.17	2.56	1.58	2.75	3.10	1.86
Return to labor (T/d)	294	250	100	153	183	83	185	208	93
RIPTI	17	16	3	4	5	2	9	11	4

Note: MOC = Mustard oilcake, PR = Poultry refuse, C = Control, and RIPTI= Return to irrigation Per Tk invested

Test of overall significance for eggplant

An attempt was also made for the significance test for eggplant yields among the treatments. The null hypothesis was made, Ho: There is no significant difference among the treatment means. It was found that the estimated value of F with 2 df is 9.9964 which was greater than the tabulated value of F with same df at 1% level of significance. So, the value was highly significant and the null hypothesis might be rejected. It indicated that, there was a significant difference among the effects of the three technologies on the yield of cabbage (Table 9).

Table 9. Test of significance among the treatments of eggplant

Source	df	Sum of squares	Mean squares	F-value	Probability
Place (A)	2	17197. 500	8598.750	96.5037	0.0000
Treatment (B)	2	1781. 408	890.604	9.9964	0.0004
AB	4	53.317	13.329	0.1496	
Error	36	3207.700	89.103		
Total	44	22239.925			

Duncan's Multiple Range Test (DMRT) for eggplant

It was obvious from the DMRT that both poultry refuse and mustard oilcake plots displayed significantly better performance than the control plots (Table 10). So, both the treatments could be recommended as an effective IPM practice. But considering the input cost it could be recommend that poultry refuse as the best IPM practice, since poultry refuse was relatively cheaper and gave relatively higher yield than mustard oilcake.

Table 10. Test of significance between the treatments MOC and PR of eggplant

Treatment	Mean yield (kg/ha)	DMRT
Poultry refuse	7610	A*
Mustard oil cake	7118	A*
Control	5948	B

** = Significant at 1% level of probability*

Note: Any two means having a common letter are not significantly different at the 1% level of significance.

Conclusions

Based on the findings of the study, the following conclusions can be drawn:

The farmers in the study areas benefited from the IPM technologies with higher yields (cabbage 10-50%, eggplant 31-61%) and higher returns (BCR 1.35 to 4.39) than the farmers' own practices. The technologies were found to be very promising and encouraging by the farmers. Therefore, the technologies should be disseminated to the farmers' fields through the involvement of extension personnel of DAE and NGOs.

For successful adoption of the technologies throughout the country, the availability of poultry refuse, mustard oilcake, and pheromone must be ensured in the farmers' fields.

For mustard oilcake, the cultivation of different HYVs of mustard should be increased in the country. The DAE efforts are very much needed for the purpose. These

efforts will help increase mustard oil on the one hand and the availability of oilcake on the other.

A mass campaign through TV, radio, leaflets and newspapers is needed to popularize the technologies and develop the awareness towards the consumption of insecticide-free vegetables. For the dissemination of the IPM technologies, regular field days and demonstration trials in the farmers' fields can be arranged with the involvement of DAE personnel, NGOs, and farmers. Training programs should be arranged for the farmers, extension personnel, and NGO officials for the effective dissemination of the IPM technologies.

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