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Crop Production And Pest Management Practices On Rice and Vegetable Fields

Md. Ismail Hossain
Bangladesh Agricultural Research Institute

Gerald Shively
Purdue University

IPM CRSP
Office of International Research and Development
1060 Litton Reaves Hall
Virginia Tech
Blacksburg, VA 24061-0334

 Correspondence regarding this paper should be directed to Dr. Md. Ismail Hossain, Principal Scientific Officer, Agricultural Economics and Statistics Section, BARI, Gazipur, Bangladesh; email: ipmcrsp@bdonline.com.
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Abstract

This paper reports data on the pest management practices used by rice and vegetable farmers in Bangladesh. Data come from a 1998/99 survey of four villages situated within the urban belt of Dhaka city. The survey describes farm characteristics, prevalent cropping patterns and cultivation methods, and farmer knowledge of pests and diseases. Patterns of input use and economic returns associated with agricultural and non-agricultural activities are also reported.

1. Introduction

Economic returns from rice and vegetable production are greatly influenced by damages from insects and diseases. Damages in turn are highly dependent upon quality of pest management practices.[1] The relationship between pesticide application and pest control can be problematic however. Misspecification of pesticides, incorrect timing of application, or insufficient dosages can result in high pesticide costs with little or no appreciable reduction in target pest populations. Judicious use of pesticides is also important because some pesticides are known to have detrimental impacts on ecosystem and farmer health (Antle and Pingali 1994). In some cases, it is even possible that farmer health damages from pesticide exposure can completely offset pesticide-induced gains in agricultural productivity (Rola and Pingali 1993). These issues are of particular concern in Bangladesh, where growth in pesticide use during the past two decades has been especially rapid (GOB/MOA 1995a).

The purpose of this paper is to describe patterns of pesticide use in a peri-urban farming community in Bangladesh. The present study was undertaken as a part of a USAID-funded research project on integrated pest management (IPM). In this paper we seek to establish a baseline understanding of the socio-economic factors that influence pest perceptions and pest management practices. These descriptive results can be used to compare practices of different

[1] In this paper we use the term “pesticides” to refer to the broad class of agricultural chemicals that includes insecticides, fungicides, herbicides, molluskacides, and rodenticides.

sites, and thereby strengthen planning and targeting of extension and training efforts. We expect the results can also be of use when retrospectively assessing the impacts of an ongoing IPM project. A companion paper (Hossain, Shively, and Mahmoud 2000) presents results from a more detailed study of the determinants of pesticide use in the same sample of farmers.

2. Background

Several Government and non-government studies have taken place assessing current status of pesticide use and its effects in Bangladesh. A study by Ministry of Agriculture reported that pesticide residues in 11% of water samples exceeded WHO guidelines (GOB/MOA 1995b). In addition to the possible impacts of pesticides on water quality, pesticide residues on crops pose risks to consumers. It has been widely observed that the scope of growth in Bangladesh agriculture through growth in food grain is limited (e.g. Mahmud, Rahman, Zohir 1994). Further intensification of rice and wheat production may precipitate a shift toward more chemical-intensive production practices. Furthermore, potential future growth in agriculture will also come about through crop diversification, specifically diversification into intensive production of vegetables instead of food grains. Growth in vegetable exports may be limited by cost considerations and – in the case of European and North American markets – pesticide residues. Under these circumstances, inefficiency in pest management can hamper the export of agricultural products and future growth in the agricultural sector as a whole.

Agriculture in Bangladesh has improved steadily throughout the last two decades through the adoption of modern technologies (Dorosh 2000). But the fact remains that agricultural technology is ever changing. In such a context it is highly likely that inefficiency is pervasive in pest management practices. Finding ways to reduce pest damage and increase farm income,

while at the same time minimizing use of pesticides, remains a significant challenge in Bangladesh as elsewhere.

3. Data and methodology

Data come from two Union Parishads, namely Kashimpur and Konabari under Joydebpur Thana in the district of Gazipur. Kashimpur union parishad was within a BADC pilot area and Konabari union parishad was outside the BADC pilot area. Four villages were considered for the study, two of which were within Kashimpur area and two within Konabari area. The Kashimpur villages are Enayetpur and Barenda-Noyapara. The Konabari villages are Aahaki and Joyertek. Lists of farmers were collected from Union Parishad offices and the study villages. A total of 300 farmers, 75 from each village, were randomly selected to constitute the sample. Pre-tested survey instruments were used for the collection of data. Data were collected between December 1998 and March 1999. Descriptive statistical methods were used to analyze the survey data, including the computer-based statistical package SPSS.

4. Findings

We present our findings in three main sections. Section 4.1 reports the main characteristics of the sample farms, including patterns of income and credit use. Section 4.2 reports patterns of cultivation and land use. Section 4.3 summarizes pest management practices, including knowledge of insects and diseases, and methods of control.

4.1 Characteristics of sample farms.

The average age of farmers in sample was 42 years. Average age for Noyapara at 35, was significantly below average ($P<.0001$). About 54 percent of sampled farmers had education from

class-I to class-X. Only 5 percent had education above secondary level. Approximately 41 percent of farmers reported no education. In Enayetpur, Ahaki and Noyapara average education was 4 years; In Noyapara it was 2 years. On average, sample farmers had 22 years of experience in agricultural activities. Average experience ranges from 17 years to 26 years across villages. Noyapara farmers had the lowest average experience. In the entire sample of 300 farmers 9 percent reported having received training on rice production and 17 percent reported having training on vegetables. Comparing across villages, there have considerable differences in the number of farmers receiving training for rice and vegetable. More farmers in Enayetpur and Barenda-Noyapara had training on vegetables than in the other two villages. Farmers reporting any sort of training, either in rice or vegetable, ranged from 19 to 48 percent. Patterns suggest farmers from Enayetpur and Nayapara received more exposure to training facilities compared with the other villages. But only 3 percent of farmers in the sample reported that extension personnel had visited their crop fields two times per month in Kharif-I, one time in Kharif-II, and two times in Rabi season.

Patterns of farm size, land ownership and cultivation are provided in Table 1.We found significant differences in average area cultivated for the four villages. The average sizes (in acres) were 1.6, 0.7, 1.6 and 1.8 for Enayetpur, Noyapara, Ahaki and Joyertek respectively (see Table 1). From Table 1 we also observe that all these four villages consist of mainly either high or medium high land areas. Low land area is almost non-existent in these villages. An implication is that the four villages are highly suitable for vegetable production.

Local markets were the major selling places for rice. More than 90 percent of rice farmers reported selling their product within the distance of one kilometer of their farm. Major outlets for rice sales were bepari (55%) and wholesaler (26%). Local markets were also the major marketing outlets for vegetables (reported by 70 percent). About 25 percent of the farmers also

sold vegetables directly from their fields. Major outlets for vegetables were bepari (74%) and consumers (21%).

Total annual incomes of sample farmers were calculated. Average income ranged from a low of 24,986 Tk/year in Barenda-Nayapara to a high of 61,755 Tk/year in Joyertek. Sources varied, and included agriculture, business, livestock, and poultry. On average, about 86 percent of total earnings in the sample came from agriculture. Of this, 27 percent came from rice, 1 percent from homestead vegetables, and 58 percent from field vegetables (Table 7). Input costs for cultivation averaged Tk 3436, Tk 307 and Tk 1460 per hectare respectively for insecticides, fungicides and labor. Non-agricultural sources of income constituted approximately 25 percent of total household income.

Use of credit was limited in the study areas. Only 4 percent of farmers reported that they had obtained credit from non-institutional sources like friends, neighbors, moneylenders and cooperative society. None of them took any institutional credit.

4.2 Cropping patterns and cultivation methods.

Main sources of irrigation water in the study area were deep tube wells and shallow tube wells for both rice and vegetable cultivation. Among the rice growers in all four villages, 40 percent and 27 percent of the farmers used deep tube well and shallow tube well respectively. Among vegetable growers in all four villages, 40 percent and 35 percent of farmers used deep and shallow tube wells respectively. Regarding the source of irrigation water, both rice and vegetable farmers reported cooperatives as their principal source of water (76 percent for rice and 77 percent for vegetables).

We observed 19 different cropping patterns in the study area. These patterns are listed in Table 2. The most prevalent were Veg-Veg-Veg, Fallow-Fallow-Rice, Veg-Veg-Rice, Veg-

Rice-Veg, Fallow-Veg-Veg, Veg-Fallow-Veg and Fallow-Rice-Veg. In addition to rice and wheat, 15 different types of vegetables were found to be cultivated during Kharif-I season. The important vegetables were lettuce, stem amaranth, gourds, cucumber, okra, salary, Chinese cabbage, bancin, yard long bean and brinjal. During Kharif-II farmers were found to be producing similar vegetables as in Kharif-I. Vegetables were grown most intensively during Rabi season. Farmers reported planting 21 types of vegetables during Rabi (Table 3). The most prevalent were potato, tomato, broccoli, radish, cauliflower, nila, pachli, in addition to all crops mentioned for Kharif-I.

In the study area the farmers were found to grow vegetables both in their homestead and fields. But where as all farmers (except for one in the village Enayetpur) produce field vegetables, only 64 percent of the households in the entire sample produce any homestead vegetables. We also observed statistically significant differences in mean values across villages. These mean values range from 18 percent to 100 percent, Noyapara and Ahaki being the lowest and highest respectively. Almost all the farmers in each village reported that they both consumed and sold vegetables from their field crops.

4.3 Pest management practices

The major reported types of insects inflicting rice were, stem borer, rice hispa, brown plant hopper and ear cutting caterpillar. Diseases reported to be prevalent included stem rot, tungru, sheath blight and bacterial leaf blight (Table 4a). For vegetables, caterpillar, aphids, ants, parasites, fruit fly and fruit and shoot borer were reported as major crop-damaging insects. The farmers reported virus, blight, mosaic, leaf curl, stem rot and leaf spot to be the major diseases harming vegetable crops (Table 4b).

Nearly all farmers in the sample were able to identify beneficial insects and animal, that is, organisms that were not harmful for the crops but rather helped the crops in different ways. Martin, stork, fork-tailed, frog, spider, magpie robin, and owl were frequently reported.

Farmers were asked whether they had experienced total crop loss during last five years due to insects or diseases. Only 4 percent of the farmers reported entire loss of the rice harvest; among vegetable crops, the figure was 8 percent. Farmers were asked to estimate average crop losses. Farmers estimated that about 24 percent of the total rice crop was lost due to insects whereas 14 percent was lost due to diseases. In the case of vegetables, 26 percent of the total quantity was lost due to insects, whereas 36 percent was lost due to diseases.

Sample farmers expressed a strong preference (94%) in favor of pesticides to control pest populations. When asked about the timing of pesticide application, about 50 percent reported first application to be after 45 days of planting; 32 and 18 percent of the farmers reported 20 and 30 days after planting, respectively, to be the first application day. Regarding frequency, most of the farmers (61%) were found to spray 2 times in the whole cropping period. Application by sprayer and application by mixing with fertilizer were found to be the principal means to apply pesticides on the field (Table 5a). Farmers reported use of eight types of pesticides in rice production (Table 5a).

In case of vegetables, farmers expressed a very clear preference (99%) in favor of using pesticides. Farmers reported use of twelve types of pesticides in vegetable production (see Table 5b). Forty-eight percent of farmers reported that the first application of any pesticide occurred within 15 days of planting; 31 percent reported application within 20 days. About 82 percent of the farmers mentioned that they used pesticides for vegetables up to three times with the help of sprayer (Table 5b).

There were some variations of the time of use of pesticides for both rice and vegetable in the study areas. In the case of rice, the majority of the farmers applied pesticides during the planting stage, the booting stage, and the early tillering stage (Table 6). A majority of the farmers were found to use pesticides during the planting stage (55%) followed by vegetation stage and fruiting stage (Table 6) for vegetables.

Most of the farmers, for rice (99%) and vegetable (94%), seemed to be in favor of the opinion that application of pesticides increases yield. Most related that they thought crop yields would have increased if pesticides had been used in the respective plots. Although pesticide use was not widespread in home gardens, more than 40 farmers used pesticides in their homestead vegetables. Most farmers (82%) reported that they alone made decisions regarding the purchase and use of pesticides. Farmers seemed aware of the usefulness of natural predators of harmful insects. All of them mentioned that observed insect infestations would have been larger in the absence of useful insects and animals. However, using multiple regression methods, Hossain, Shively, and Mahmoud (2000) argue that, controlling for farmer knowledge, experience and training, the most important factors explaining the level and intensity of pesticide use on rice and vegetable farms is the economic capacity to purchase cash inputs.

5. Conclusions and Recommendations

Based on the findings of the study, we can draw several conclusions:

1. Farmers in the study area are established in rice-based vegetable cultivation. They cultivate a wide range of vegetables. This area may have potential as an export zone for specialized crops, and may benefit from development programmes.

2. About 16 percent of the cultivated area was rented. This suggests a portion of the farmers may be poor. Renters were less likely to specialize in vegetable production. Use of credit among both rice and vegetable producers was limited.
3. The cropping patterns Veg-Veg-Veg, Fallow-Rice-Veg, Veg-Veg-Rice, Veg-Rice-Veg predominated in the areas. Vegetables appear to be important crops within different rice-based cropping patterns.

Nearly all farmers were found to be using pesticides in their crop fields. A wide range of pesticides, application schedules, and application methods were observed. A useful area for short-term training programmes for farmers could focus on identification of insects, diseases, pesticides and proper time and methods of application.

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Table 1. Land ownership and land types.

Land Ownership (Acre/farm)	**Enayetpur**	**Barenda-Noyapara**	**Aahaki**	**Joyertek**	**All**
Farm Size	1.60	.62	1.61	1.75	1.49
Area Cultivated (Own Land)	1.26	.34	1.43	1.44	1.12
Area Shared In	.17	.2	.08	.31	.18
Area Mortgaged In	.13	.15	.10	-	.1
Area Shared Out	.03	-	.16	-	.05
Area Mortgaged Out	.03	.01	.22	-	.06
Area Cultivated	1.55	.68	1.61	1.75	1.4
Land Type (%)					
High Land	92	3	32	83	52
Medium High Land	69	100	80	91	85
Medium Low Land	23	7	88	40	39
Low Land	-	1	-	-	.3

Table 2. Cropping patterns followed by farmers.

Cropping Patterns	Percent of Total Responses				All
	Enayetpur	Barenda-Noyapara	Aahaki	Joyertek	
Veg-Veg-Veg	36	36	14	7	23
Fal-Fal-Rice	8	-	26	24	14
Veg-Veg-Rice	12	9	7	6	9
Veg-Rice-Veg	2	9	-	24	8
Fal-Veg-Veg	11	12	3	3	7
Veg-Fal-Veg	8	9	2	8	7
Fal-Rice-Veg	2	9	-	18	7
Veg-G.M-Veg	-	-	26	-	6
Fal-Rice-Rice	5	2	-	7	4
Veg-Veg-Spices	3	-	2	-	2
Veg-F-Spices	3	-	-	-	1
Spices-Veg-Veg	3	-	-	-	1
Maize-Rice-Veg	-	4	-	-	1
Maize-Veg-Veg	-	3	-	-	1
Fal-M-Rice	-	-	5	-	1
Jute-F-Veg	-	-	2	-	1
Veg-Veg-Wheat	-	-	2	-	1
Fal-G.M-Veg	-	-	5	-	1
Others	7	7	6	3	5

Note: G.M=Green Manure

Table 3. Crops cultivated in Rabi.

Crops	Percent of Total Responses				
	Enayetpur	**Barenda-Noyapara**	**Aahaki**	**Joyertek**	**All**
Lettuce	8	3	1	-	3
Amaranth	1	-	2	1	1
Gourd	12	9	15	20	14
Cucumber	1	2	1	1	1
Cabbage	3	7	7	1	5
Bancin	3	4	3	-	3
Chinese Cabbage	9	9	2	-	5
Red Amaranth	1	4	4	9	5
Salary	4	3	1	-	2
Indian Spinach	5	4	1	3	3
Bean	11	5	11	15	10
Potato	4	1	2	6	3
Tomato	3	10	9	4	6
Brocoli	3	2	1	-	2
Capcicum	6	2	2	-	2
Radish	7	11	8	11	9
Cauliflower	-	7	-	4	3
Nila	-	2	-	-	1
Pachli	3	2	2	-	2
Brinjal	-	2	2	6	3
Green Pepper	3	4	9	6	5
Boro Rice	9	2	13	10	8
Others	4	5	4	3	4

Table 4a. Insects and diseases found in rice plots.

Insects/Diseases	Percent of Total Responses				
	Enayetpur	**Barenda-Noyapara**	**Aahaki**	**Joyertek**	**All**
Insects					
Stem borer	39	30	30	39	34
Leaf hopper	4	28	2	-	8
Rice hispa	26	25	30	3	21
Brown plant hopper	-	-	-	54	14
Ear cutting caterpiller	2	17	27	1	12
Rice caterpiller	10	-	-	2	3
Rice bug	7	-	9	1	4
Gall midge	2	-	-	-	1
Case worm	10	-	2	-	3
Diseases					
Blast	9	-	9	-	5
Bacterial leaf blight	-	4	30	-	9
Tungro	9	-	31	63	26
Sheath blight	20	-	28	-	12
Stem rot	49	93	-	-	35
Ufra	4	-	-	-	1
Fungus	3	-	-	35	9
Others	6	3	2	2	3

Table 4b. Insects and diseases found in vegetable plots.

Insects/Diseases	Percent of Total Responses				
	Enayetpur	**Barenda-Noyapara**	**Aahaki**	**Joyertek**	**All**
Insects					
Caterpillar	49	31	21	22	30
Fruit Fly	5	-	22	-	7
Parasites	26	23	4	-	13
White Ants	-	-	24	-	6
Leaf Hopper	2	-	-	-	1
Cut Worm	7	-	-	3	3
Aphids	4	26	14	24	17
Fruit & Shoot Borer	4	5	-	-	2
Ants	-	9	9	47	16
Cricket	-	3	6	-	2
Others	3	3	-	4	3
Diseases					
Virus	44	85	-	-	32
Blight	13	5	41	24	20
Mosaic	11	-	-	49	15
Wilt	1	2	-	7	3
Foot Rot	2	4	13	-	5
Stem Rot	2	1	44	-	11
Leaf Curl	-	-	-	7	2
Anthracnose	3	-	-	-	1
Leaf Spot	22	2	2	12	10
Others	2	1	-	1	1

Table 5a. Preventive measures followed for insects/diseases in rice plots.

	Enayetpur	Barenda-Noyapara	Aahaki	Joyertek	All
Pesticides					
Basudin	58	28	-	30	29
Melathion	9	7	3	16	9
Diazinon	6	23	87	36	38
Furadan	3	8	-	-	3
Meltok	10	-	-	7	4
Dusban	4	13	-	3	5
Nogos	4	16	-	1	5
Dimacron	6	-	10	5	5
Other	-	5	-	2	2
First Application of Pesticides after Planting (%)					
After 20 Days	18	9	6	96	32
After 30 Days	12	60	-	-	18
After 45 Days	70	31	94	4	50
Other Applications (%)					
After 60 Days	87	57	80	-	56
After 75 Days	13	43	20	100	44
Total Spraying (no./crop)					
1 Time	36	4	8	38	22
2 Time	60	85	40	60	61
3 Time	4	11	52	2	17
# sprays/crop	3	2	2	2	2
Method of Use of Pesticides(%):					
Sprayer	43	70	-	32	36
Mixed with Soil	-	5	52	-	14
Mixed w/ Fert.	57	25	-	68	38
Hand Throwing	-	-	48	-	12

Table 5b. Preventive measures followed for insects/diseases in vegetable plots.

	Enayetpur	Barenda-Noyapara	Aahaki	Joyertek	All
Pesticides Used (%)					
Basudin	4	2	7	3	4
Melathion	3	16	1	10	7
Diazinon	2	13	13	8	9
Furadan	6	5	-	-	3
Meltok	50	10	-	22	20
Dusban	19	14	30	22	21
Nogos	7	20	15	22	16
Other	9	20	34	13	20
First Application of Pesticides (%)					
After 15 Days	48	54	12	80	48
After 20 Days	13	30	76	3	31
After 30 Days	22	13	8	17	15
After 40 Days	17	3	4	-	6
Other Applications (%)					
After Every 7 Days	46	53	39	94	58
After Every 10 Days	46	34	50	4	33
After Every 12 Days	8	13	11	2	9
Total Spraying (no./crop)					
1 Time	38	17	2	9	16
2 Times	40	7	50	50	37
3 or more times	22	76	48	41	47
Method of Use of Pesticides (%)					
Sprayer	94	73	97	96	90
Mixed with Soil	4	1	3	4	3
Mixed with Fert.	-	4	-	-	1
Hand Throwing	2	22	-	-	6

Table 6. Stages of pesticide application.

Stages	**Percent of Farmers**				
	Enayetpur	**Barenda-Noyapara**	**Aahaki**	**Joyertek**	**All**
Rice					
Seedling Stage	8	-	-	-	2
Planting Stage	15	100	1	48	41
Early Tillering Stage	40	-	49	1	23
Late Tillering Stage	6	-	-	1	2
Flowering Stage	24	-	-	-	6
Vegetables					
Seedling stage	1	-	25	-	6
Planting stage	76	90	-	50	55
Fruiting stage	13	10	25	-	12
Vegetation stage	1	-	25	50	19
Flowering stage	9	-	25	-	8

Table 7a. Gross and net returns per HH from different crops in respective villages.

	Villages			
	Enayetpur	**Barenda-Nayapara**	**Ahaki**	**Joyertek**
Average Gross Returns (Tk/yr)				
Rice	20,566.7	8,117.6	19,515.5	23,962.2
Vegetable	14,729.7	18,740.1	20,910.1	30,352.9
Other Crops	1,250.0	-	1,496.7	2,880.0
All Crops	30,119.5	23,502.4	34,820.8	50,839.0
All Crops (Tk/Acre)	27,204.7	47,737.0	50,742.8	33,207.8
Average Input Expenditure (Tk/Acre)				
Fungicide	61.3	160.7	681.3	-
Pesticide	936.2	631.1	1,054.7	1,099.3
Cost of Labor	58.1	342.1	1.3	92.0
Total Cost	1055.7	1033.9	1737.3	1191.3
Average Net Returns (Tk/Acre)				
All crops	26,149.0	46,603.2	49,005.4	32,016.5

Table 7b. Agricultural and non-agricultural income (Tk/year)

	Villages			
	Enayetpur	**Barenda-Nayapara**	**Ahaki**	**Joyertek**
Agriculture	30,850.1	23,829.1	36,374.2	51,177.3
Non-Agriculture	14,519.8	1,156.7	14,686.2	10,577.6
Labor	880.0	1,000.7	3,333.3	5,946.7
Business	4,728.9	146.7	11,019.5	4,097.6
Dairy	693.3	266.7	1,365.3	333.3
Poultry	37.3	60.0	188.0	0.0
Fisheries	0.0	0.0	0.0	0.0
Other	8,910.9	9.3	333.3	533.3
Total Income	45,369.9	24,985.8	51,060.3	61,754.9