Chapter III

Research Methodology

This chapter is devoted to methods and materials which have been used in the study. The chapter discusses detail on surveillance and monitoring systems, sample selection and conducting field survey.

Gazipur district with an area of 1,741.53 sq km, is bounded by Mymensingh and Kishoreganj districts on the north Dhaka, Narayangonj, Narsingdi districts on the south, Narsingdi on the east, Dhaka and Tangail districts on the west. Annual average temperature maximum 36 °C and minimum 12.7 °C; annual rainfall 2376 mm. Total land under cultivation 1,25,287.53 hectares, fallow land 16,935.35 hectares; single crop 34.84%, double crop 50.76%, treble crop 14.40%, land under irrigation 41.18%. Out of total cultivable land 1, 25,287.53 hectares, rice covered 87,873 hectares (BBS, 2004).

The comparison of the three types of farmers using different farming practice for surveillance method would be done by a proven scientific model, which is multiple regression models. The benefit-cost ratios also prove the importance of choosing right way of surveillance method and monitoring system. Pest infestation rate highlighted which one is more applicable for sustainable farming, and for next generations healthy and fresh environment. Though from earlier studies we know IPM is best suited for surveillance but farmers choice of adoption depends much more on several socio-economic and bio-physical factors. To determine of that adoption multinomial logistic model is best one as because the choice of farming practices is more than two, i.e. IPM, Non-IPM and contact farmers practices for surveillance method.

3.1 Research Procedures

The study has used field survey of individual farmers as well as household of them. The field data were gathered by using pre-structured close ended questionnaire (Appendix 1). The comparison of three different monitoring had been done by certain indicators. Eventually village immersion shows the frequency of the farmers type in this village who undergo the right way of monitoring in their respective fields.

3.2 Field and Household Survey

IPM farmers are adopting IPM practices in their crop field for last 5 years. Traditional farmers never undergo IPM practices. Their management and pest control system in rice plant is mainly depending on pesticides. Contact farmers are a bit different of these two groups. Basically they are contact farmers in large scale. For pest control system they did not depend on any of two practices earlier been mentioned. Basically their pest control system depends on the guideline of their owners. They may either use biological pesticides or synthetic pyrethroids in seasonal and location basis.

The study had been conducted within two villages consisting 125 households. Among these traditional farmers are 50, IPM farmers are 50, and contact farmers are 25. The survey household farmers are within two villages in mixed forms. The variability would be higher among these three groups by taking data regarding information of farming system, monitoring, and land survey, etc. Village emersion will be conducted by sketch a diagram of original village picture. It will be shown all available position of farmers household, watershed, field situation, irrigation source, market, river basin, communication system of farm to market and various agricultural activities other than crop.

The present method of surveillance is to compare the recent one by IPM farmers monitoring and traditional one and also with the above visual scale. Again the following spatial (Table 3.1) help to improve the surveillance and forecasting by comparison specially IPM and Non-IPM practices. Data will be taken by the following spatial point for comparison of monitoring systems.

Table 3.1 Comparison of monitoring system

Variables	IPM Practices	Non-IPM Practices	Contact-farmer Practices
Number of farm and HH surveyed	50	50	25
Crop	Rice	Rice	Rice
Types of insect pest	-	-	-
Number of insect pest counted in a week	-	-	-
% of infestation	-	-	-
Number of crop field visit by farmers in a week	-	-	-
Ratio of pest and defender (natural enemy) in crop field	-	-	-
Current farming practices	-	-	-
Cost of production	-	-	-
Labor forces engaged	-	-	-

i)labour for land preparation. ii) for irrigation iii) for intercultural operation iv) for harvesting			
Measures taken to control pest	Cultural/Mechanical/ Biological/Chemical	Cultural/Mechanical/ Biological/Chemical	Cultural/Mechanical/ Biological/Chemical
Historical profile of production (at least past 7 years of farming system trend)	-	-	-
Achievement (Benefit-cost ratio)			

In the above table data had been collected from questionnaire from farmers household and field survey. It had been collected from existing crop with similarity of 3 different groups. Same crop helps to compare the real pest status and economic threshold level.

In the above spatial section types of pest means different pest in different stage of plant growth, number of pest counted in a week means total number of insect pests found by the farmer in his field in a week, percent of infestation will be calculated by low, medium and high index. And number of crop field visit by the farmers in a week counted after second week of transplanting his crop. Ratio of pest and defenders will be helpful for calculating economic threshold level, and the real situation of farmers field for selecting the control measures. Current farming practices helps to find out the suitability of farming and sustainability of agricultural farming. Cost of production is one of the major things which will help to take right decision to farmers (whether IPM or Non-IPM). Historical profile of farming system and use of pesticides trend will be the guideline of indication how much infestation occurred by the specific practices. And at the end benefit–cost ratio will be helpful for taking major decision by the farmers.

3.2.1 Sampling Techniques

Two villages had been selected from one upazilla of Gazipur district for field survey. Thee different types of farmers were present in three villages at the same time. Among them in mixed way 50 IPM farmers, 50 traditional farmers, and 25 contact farmers were selected for collecting data with close ended questionnaire. The traditional monitoring systems parameters, IPM monitoring system parameters and contact farmers monitoring system parameters were shown in questionnaire. Benefit of improved monitoring system has been conducted through a series of mathematical equations.

3.2.2 Data Collection

3.2.2.1 Primary Data Collection

Major farming practices, monitoring systems, socio-economic and physical data related to surveillance including: number of defender (natural enemy), number of insect pest, frequency of crop field visit in a week, number of labour forces engaged per hectare, percentage of pest infestation, pesticide application time, time of field visit, household members of each farm families, and benefit-cost ratio were collected as primary time series data from field survey.

3.2.2.2 Secondary Data Collection

Our study had been focused on the trend of the rice insect pest infestation all over the rice growing area of Bangladesh and which districts are susceptible for specific pest infestation. The data from secondary source will be helpful at this regard because it contains ten years infestation record of the rice growing area of Bangladesh. From the Department of Agricultural Extension (DAE) the last ten years infestation record of major rice insect pests would be analyzed and spatially observed for future prediction and necessary action.

3.3 Data Analysis

To achieve the objective of the study multiple regression analysis to find out factors influence benefit-cost ratio and multinomial logistic regression for adoption of surveillance method in different socio-economic and bio-physical factors were used. The spatial analysis GIS would be used in secondary data to show the condition of major rice insect pests all over the country.

3.3.1 GIS Analysis

GIS can be considered as an effective database management system to inventory rice resource information on a spatial basis. However, the two main functions (analysis and inventory) should be associated properly in order to achieve the optimal use of GIS on rice. Damage caused by mis-forecast pests has been one of the most serious problems in rice cultural management.

3.3.1.1 Software

The rice insect pest information system had been developed by using ArcView 9.1, ArcInfo, Visual Basic 6.0, and Java. Operating system was used with Windows NT 4.0 server.

3.3.1.2 Data Acquisition

Basic Map	
Theme map	Administrative boundary map
Scale	1:600,000
Published year	2010
Rice Pest Data	
Surveyed sites	64 districts
Surveyed term	Year 1999 to year 2008
Data source	Department of Agricultural Extension, Bangladesh

3.3.1.3 Design Requirements

In preparation for developing rice pest information system, a list of requirements was created that would mimic the functionality provided GIS software. This was included in the following;

- Zooming in to smaller extent
- Zooming out to larger extent
- Zooming out to the full extent
- Panning (move)
- Identifying features on the map
- Finding/Searching for features on a map

- Displaying map labels
- Context sensitive on-line help
- Statistical analysis map
- Print
- Displaying map legend

3.3.1.4 How to input Data

Existing Administrative Boundary Map

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Digitizing Map by Scanning

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1) Vectorization

⇓

2) Map Correction and Coverage Production

⇓

3) Label Input

⇓

4) Data Input

⇓

5) Integration of shape file & attribute data

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6) Map Compilation

3.3.2 Multiple Regression Models for Factors Influence Benefit-cost Ratio

Multiple regressions are one of the best analyses when number of independent variables is more than two. In our study independent variables that can influence benefit-cost ratio were nine in number. So, this method is best suited for analysis which variables influenced benefit-cost ratio and how it would be. The model is follows:

Model **Y=b0+b1x1+b2x2+b3x3+b4x4+b5x5+b6x6+b7x7.** ***Where;*** Y (Dependent variable)= Benefit cost b0= a constant Independent variable X1= Number of defender X2= Number of pest X3= Number of crop field visit by farmers in a week X4= Number of labour forces engaged/ha X5= Percentage of pest infestation X6= Pesticide application time X7= Area (m^2)	b_1= the coefficient of X1; b_2= the coefficient of X2; b_3= the coefficient of X3; b_4= the coefficient of X4; b_5= the coefficient of X5; b_6= the coefficient of X6; b_7= the coefficient of X7;

3.3.3 Multinomial Logistic Model for Adoption of Surveillance Method

The methodological approach chosen for the empirical analysis of socio-economic and physical factors influence on adoption of surveillance method is an explorative, econometric one. The multinomial logit model had been chosen for this study. The model makes it possible to study the identification of major socio-economic and bio-physical factors influencing on adoption of surveillance method in the context of individual farmer's data on multiple choice. In this study the dependable variables are assumed farmers' choice of adoption to be ranged from IPM, Non-IPM, and contact farmers' using of surveillance. (Non-IPM=1, contact=2, IPM=3).

Selected representative independent variables were including: number of pest, number of defender, number of crop field visit by farmers in a week, number of labour forces engaged/ha, percentage of pest infestation, number of pesticide application in one crop season, area of crop field (m^2), time of field visit, and number of household member.

The following model was applied to compute the probability of occurrence of surveillance method (X) rather than non-occurrence of adoption (0) from selected socio-economic and physical-driver variables. The specific form of logistic regression model use:

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}} \quad . \qquad (1.1)$$

A transformation of $\pi(x)$ that is central to this study of logistic regression is the logit transformation. This transformation is defined, in terms of $\pi(x)$, as

$$g(x) = \ln\left[\frac{\pi(x)}{1-\pi(x)}\right] = \beta_0 + \beta_1 x \quad .$$

The importance of this transformation is that g(x) has many of the desirable properties of a linear regression model.

In the logistic regression model the link function is the logit transformation

$$g(x) = \ln\{\pi(x)/[1-\pi(x)]\} = \beta_0 + \beta_1 x.$$

By simplification the multinomial logistic regression is

$=\beta_0+\beta_1 x_1+\beta_2 x_2+ \beta_3 x_3+\beta_4 x_4+\beta_5 x_5+\beta_6 x_6++\beta_7 x_7+\beta_8 x_8+\beta_9 x_9$ ***Where,***

β_0	= a constant **Independent variables,**	β_1= the coefficient of X_1
X_1	=Number of pest	β_2= the coefficient of X_2
X_2	=Number of defender	β_3= the coefficient of X_3
X_3	=Number of crop field visit by farmers in a week	β_4= the coefficient of X_4
X_4	=Number of labour forces engaged /hectare	β_5= the coefficient of X_5
X_5	=Percentage of pest infestation	β_6= the coefficient of X_6
X_6	=Pesticide application time (how many time)	β_7= the coefficient of X_7
X_7	=Area (m^2)	β_8= the coefficient of X_8
X_8	=Time of field visit	β_9= the coefficient of X_9
X_9	=Number of household member	

By the above GIS analysis, multiple regressions and multinomial logit model two objective of the study would be fulfilled. Analysis would be done according to same chronological way.