Chapter III

Research Methods

3.1 Scope and limitation of the study

Paddy production system in Bhutan has gained even more importance with the development of economy, as many people whose staple is traditionally wheat and maize based, are switching off their food habits to rice (Planning Commission Secretariat, 2002). It is recognized that the increase in demand for rice with the increase in per capita income and changing food habits has to come from vertical expansion of productivity per unit area, through intensive cropping and integrated management of pests and diseases (Renewable Natural Resources Research Centre-Yusipang, 2000). Since, crop intensification is limited by the adverse weather conditions of the study area, the major thrust has been on pest and disease management, especially, the rice blast.

Thinlay (1998) has conducted an exhaustive study on rice blast epidemiology and development of management strategies for resistance breeding and management in response to the 1995 blast epidemic and came up with a number of recommendations. Therefore, it is timely to study the status of these management technologies that are critical in determining the possibility of rice blast outbreak as the result of farming practices.

The findings of the study can only be generalized in the warm temperate high altitude regions of western Bhutan due to the difference in socio-economic, service and infrastrucural facilities with other rice growing regions of the country.

Though, the field survey was conducted few months after the paddy harvest, data collected from the sample households were based on farmers' recollection. All the farmers surveyed did not keep record of any farming activity. The limitation would have been overcome, if timing of fieldwork was synchronized with the paddy-cropping season

or had the study been conducted for the complete paddy-cropping season, where the researcher could directly observe activities and record first hand information of the farming systems.

3.2 Selection of study site

The Ministry of Agriculture has identified 4 warm temperate zones: Paro, Thimphu, Trashigang and Lhuntse as having the best natural potential for rice production (Department of Research and Development Services, 2001a), of which, two western districts of Paro and Thimphu were selected for the research. Rice is the main staple and source of livelihood of the people. Almost all the households are both directly or indirectly engaged in paddy production and severely hit by 1995 blast epidemic. They became the focus of research and extension in developing blast resistant varieties (Natural Resources Research Centre-Yusipang, 1999, 2000) and other management strategies. The choice of four blocks from each district is based on the agroecological zone and the prevalence of rice blast.

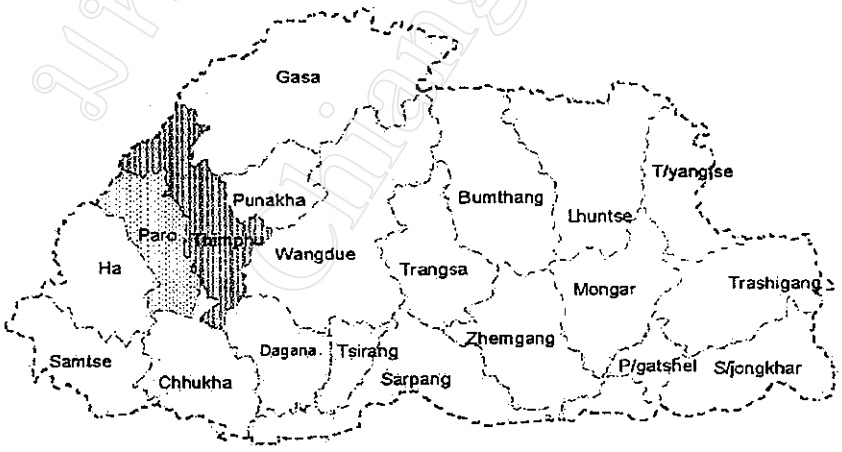

Figure 1. Administrative map of Bhutan showing the study area

3.3 Sampling technique

The sample households for the study were selected by using the multistage sampling technique. 4 districts identified by the Royal Government of Bhutan as having the best natural potential for rice production in the country were chosen at the regional level. From these 4 districts, 2 districts in the west were selected on the ground that almost all the households were traditionally paddy rice growers and their main staple, but where the threat from disease prevailed. Within the district, only those blocks that fell under the warm temperate region and prevalence of rice blast were selected. Under the selection criteria, 4 blocks from each district (Lamgong, Dopshari, Lugyni and Wangchang in Paro; and Chang, Mewang, Kawang and Geney in Thimphu) qualified for the study. A sample of 158 households were randomly selected as there were no distinction between the farmers growing local and improved varieties, except one block (Chang) in Thimphu, where almost all the farmers were growing only local varieties.

Table 5. Selection criterion for the study area

Level	Site	Selection criterion
Region (Warm temperate)	4 districts (2 in East and 2 in West)	Best natural potential for rice production in the country
District	West (Thimphu and Paro)	Rice main staple and source of livelihood
Block	4 blocks each from Thimphu and Paro	Prevalence of rice blast and worst hit by the 1995 blast epidemic
Farm	91 farm households from Paro and 67 farm households from Thimphu	Randomly selected

3.4 Data collection tools

The study employed two methods of data collection: secondary and primary. Secondary data was used to define the nature of problem and opportunities in the study site, on which, the well-defined questionnaire for field survey was developed for primary data collection and subsequent analysis.

3.4.1 Secondary data

The source of secondary data included various publications such as journals, unpublished research works, literature, reports, proceedings, documents of the Ministry of Agriculture and other relevant ministries and organizations; key informants and personal observations. The virtue of being one of the extensionists of the region for over 3 years helped in getting the first hand knowledge and in depth understanding of the production systems of the region that eventually gave insight in designing the questionnaire for the formal survey method.

3.4.2 Primary data

Informal and formal methods were employed to collect primary data. Efforts were made to capture all the aspects of production systems to generate sufficient information and data required to address the objectives of the study.

Informal survey data was collected from extension agents, researchers, village leaders and elders to elucidate the general characteristics, problems and opportunities of the study area. The formal survey consisted of well-defined questionnaire that was pre-tested with 30 farmers with the aim to screen any unnecessary, sensitive information and issues; and above all to maintain consistency and quality of information generated for statistical analysis.

The main information required to meet the stated objectives of study included the following:

i) Number of recommended blast management technologies adopted and practiced by farmers under the category of chemical cultural and varietal practices were collected. The segregation of management technologies was necessary to capture different identities and entity of management strategies that were followed by the farmer as an individual component rather than the whole package.

ii) Chemical control included seed treatment and spraying of fungicides, either before or after the blast fungal infection. Cultural practices were further sub-divided into three main sub-headings of water, fertilizer, and straw and stubble management.

ii) The other information collected included productivity of varieties, cost of production of local and rice blast resistant varieties, and extension methods that were used as the tools in disseminating technologies to the farming communities.

3.5 Analytical methods

The general profile and paddy production systems of the study area were described from the information generated from biophysical and socio-economic survey and other relevant documents. This information was useful in understanding all the aspects of paddy production system and further defined the current farming practices and the path to technological awareness and adoption of blast management technologies.

Descriptive statistics were employed to determine farmers' knowledge, cultural practices, and decision criteria of adoption in blast management. Results of data collected from the sample households were coded, tabulated and analyzed by using Statistical Package for Social Science (SPSS), version 11.

The assessment of farmers' perceptions on the quality of control of rice blast management technologies was based on the method used by Bajgain (1993). The value of

1 to 4 was given to each item or technology, in which, the quality of control given by farmers as poor, fair, good and excellent were assigned the corresponding values of 1, 2, 3, and 4, respectively. The rank was then assigned on the magnitude of mean value.

Table 6. Values allocated to the quality of control

Attribute	Value
Poor	1
Fair	2
Good	3
Excellent	4

Mean value = Total value for each item/total number of respondents
Value = No. of respondents * corresponding value for the item
Total value = Sum of value of an item

The other tool used to analyze objective No. 2 was the index of acceptability of technology. The Food and Agriculture Organization (Hildebrand and Poey 1995, cited in Norman *et al.*, 1995) applied this method for analysis and evaluation of technology. The index of acceptability was calculated as follows:

$$I_j = \sum_i [C_i . A_i]$$

Where:

I_j = Index of acceptability for farmer j

C_i = Adoption of technology i (0 for non-adoption and 1 for adoption)

A_i = Percentage of area planted with the new technology of the total area planted to that particular crop

Gross margin was used to compare the profitability of local and improved varieties, since breeding improved varieties for blast resistance has been the long-term goal of the

Ministry of Agriculture to fight against rice blast (Natural Resources Research Centre-Yusipang, 2000). It was also used to determine the profitability of adopting any of the recommended management technology on local varieties. In the analysis, fixed costs were ignored, since, by their nature, they had to be met whatever was produced or even if nothing was produced. Moreover, gross margin is appropriate for activities in the small subsistence farming systems without significant market interaction that will lead to qualitative assessment of profitable or not profitable (McConnel and Dillion, 1997).

As suggested by Turner and Taylor (1998), the comparative study was solely concentrated on the performance of enterprise relating to output and variable cost.

Gross margin per acre = Total revenue/acre (gross return) - Variable cost/acre

$$GM = TR - VC$$
$$= (\text{Yield/acre})(\text{Price/kg}) - \text{Variable cost}$$
$$= (Y)(p_y) - VC$$

Where:

Y denotes rice yield per acre in kg and p_y denotes rice price per kg in Ngultrum

Material cost = Cost of inputs (seeds, farmyard manure, fertilizer, pesticides, herbicides, hire charge for draft animal)

Total variable cost (TVC) = Material cost + labor cost

Returns to material cost = (Gross return - TVC except material cost)/total material cost

Returns to labor cost = (Gross return - TVC except labor costs)/total labor cost

The significance of the variables used for the analysis of gross margin was computed by using the following formula:

$$t = \frac{\overline{X} - \overline{Y}}{\sqrt{\frac{n_x s_x^2 + n_y s_y^2}{n_x + n_y - 2}} \times \sqrt{\frac{n_x + n_y}{n_x n_y}}}$$

The hypothesis for testing:

$$H_0: \overline{X} = \overline{Y}$$

$$H_1: \overline{X} \neq \overline{Y}$$

Where:

$\overline{X}$ and $\overline{Y}$ means of those sample households, who were categorized as non-adopters and adopters of blast management technology, respectively.

n_x, n_y and s_x^2, s_y^2 were the number of observations and variance of non-adopters and adopters, respectively.

To realize the objective number 4, the preference of extension methods was determined by using ranks and scores. The method of scoring was based on the case studies and theme papers associated with outputs from the Department for International Development-Funded Natural Resources Systems Program (Socio-Economic Methodologies Component), which was a collaborative project between the Social and Economic Development Department, Natural Resources Institute and the Statistical Services Center, the University of Reading.

Ranks and scores were allotted to farmers' and extension agents' preferences of extension methods. Only 4 items or extension methods were commonly used in the study site and so the respondents were asked to rank extension methods according to their preference from 1 to 4. Rank 1 being the most preferred and rank 4, the least preferred. A total score of 20 was allocated to the corresponding 4 ranks as shown in Table 7.

Table 7. Conversion table for ranks into scores

No. of items ranked ↓	Rank →	Conversion scale			
		1	2	3	4
4	Allocated score (x) →	8	6	4	2

Mean score = Sum of scores of the item ($\sum x$)/ Total number of respondents (n)

Where:

x = Number of respondents ranking * corresponding score of that rank

Statistical test to demonstrate differences amongst the farmers' and extension agents' preference was based on the approximation of chi-squared distribution (Abeyasekera, 2000). Friedman's test was applied to ranks given by the respondents (n) to each of the specified number of items, i.e., the extension methods (k).

First the sum of ranks was calculated, (R_j) for item j (j = 1 for individual farmer visit, j = 2 for on-farm trial, j = 3 for field day, j = 4 for farmers' training).

Second step used the Friedman's test statistic χ^2:

$$\chi^2 = 12/nk\,(k + 1)\sum [R_j - \{n\,(k + 1)/2\}]^2$$

Then the valued obtained (χ^2) was compared with tabulated values of a chi-squared distribution with (k-1) degrees of freedom to test the significance.