Chapter I

Introduction

1.1 Background

Bhutan is a small landlocked Himalayan country, bordered by the world's biggest and most populous countries of China (Autonomous Region of Tibet) in the north and India in the east, west and south with its lofty mountains sealing these boundaries. The geographic area of 46,000 square kilometers is almost entirely mountainous with the flat land limited to the broader river valleys. The elevation ranges from 200 meters above sea level at the southern foothills to over 7,000 meters above sea level in the north. Bhutan has three major landform features: the southern foothills, the inner Himalayas and the higher Himalayas (Central Statistical Organization, 2001) comprising of six distinct agroecological zones.

Bhutan can take pride of being the environmental leader and one of the ten biological hot spots in the world. While, other parts of the world are under the shadow of deteriorating environmental conditions, Bhutan at present has pristine environment amid the forest cover of 72.5 percent of the total land area that has rich biodiversity with high level of species, genetic and ecosystem diversity. Though, environmental conservation has always formed the core development strategy in five-year plan developments, the most imperative objective of the Royal Government of Bhutan has been ensuring sustained economic growth without undermining the natural resource base, rich cultural heritage, sovereignty and security of a nation-state (Planning Commission Secretariat, 2000a).

Under the dynamic leadership and enlightened policy of His Majesty the King, who advocates and selflessly pursues the uniquely Bhutanese concept of maximizing gross national happiness approach to development (Planning Commission Secretariat, 2000a),

Bhutan has laid strong foundation of long-term development with harmonious existence between the natural and human ecosystems against the backdrop of fragile mountain environment in the wake of modern economic development and challenges.

1.2 Agriculture

Agriculture dominates the country's economic activities and accounts for almost 34 percent of the real gross domestic product. It is the lifeline of the rural people as 79 percent of the population still lives in rural areas and absorbs 75 percent of the national workforce (Planning Commission Secretariat, 2002).

Table 1. Renewable Natural Resources statistics of Bhutan

Class description	Total area	
	km^2	%
Forest	29,045	72.5
Pasture	2,564	3.9
Agriculture	3,088	7.7
Horticulture	58	0.1
Total	33,755	84.2

Source: Ministry of Agriculture, 2000a.

It is estimated that about 47,000 acres of irrigated land is under paddy cultivation contributing to 42 percent of the cereal productions in the country (Ministry of Agriculture, 2002a). At the national level, dryland agriculture or cultivation of crops generally on unterraced land under rainfed condition is the most dominant land use (32.6 percent), followed by *tseri*, which is a form of shifting cultivation once every 4 to 6 years generally on the unterraced and steep land (28.6 percent). Wetland farming (cultivation of paddy in irrigated or rainfed terraced area) constitute only 12.6 percent.

Livestock and forest are also the indispensable and integral part of the subsistence form of agriculture.

Over the course of agricultural development in Bhutan, cereal production has remained a cornerstone of household food security among which, rice is the most important, in spite of many constraining factors such as the vagaries of nature, pests and diseases, high external inputs required as compared with other cereal crops, and rural-urban migration of agricultural labor force.

With the limited arable land (7.7 percent), Bhutan faces a daunting challenge in realizing its objective of food self-sufficiency and food security, where horizontal expansion of cultivable area is limited by treacherous terrain and hostile mountain environment. Expansion of the agriculture sector is, thus, highly circumscribed and the increasing population, though, low as compared to her South Asian neighbors, place unsustainable pressures upon the Kingdom's otherwise enviably intact natural resource base (National Environment Commission, 1998). Hence, the only scope to increase agricultural productivity is by adoption and generation of appropriate technologies and by overcoming the constraining factors of production such as socio-economic and physical elements.

1.3 Statement of problem

The Ministry of Agriculture has realized that the output of food grains, particularly rice has not kept pace with increasing demand for four main reasons (Department of Research and Development Services, 2001a; Planning Commission Secretariat, 2002):

i) Rapid growth in population,

ii) Emergence of an urban non-farming community,

iii) Rise in per capita food consumption, and changes in food consumption pattern, for example from maize and buckwheat to rice.

The warm temperate region of the country has been identified as the niche for enhanced rice production; however, the major constraining factor to boost production in this region has been the threat from rice blast. In 1995, rice blast (*Pyricularia oryzae* Cavara) almost entirely wiped out the paddy production in 4 major rice growing western districts, of which, Paro and Thimphu were severely affected (Ministry of Agriculture, 1995).

Lack of blast resistant varieties has been identified as one of the key limiting factors to rice production in the high altitude temperate rice growing regions of the country (Renewable Natural Resources Research Centre-Yusipang, 1999). However, in the absence of resistant genetic lines, other cultural measures have been implemented to contain and prevent loss of rice from blast. Hence, in course of developing blast resistant varieties as the Ministry of Agriculture's long term strategy (Renewable Natural Resources Research Centre-Yusipang, 2000), the short term strategies of seed replacement, seed treatment with fungicides, chemical spray and other management practices are being advocated to contain the disease, where blast susceptible traditional varieties predominates.

1.4 Rationale

The devastation of 1995 caused by the rice blast epidemic prompted the Ministry of Agriculture to draw up the action plan that included improved nursery techniques, seed treatment, water and fertilizer management, and proper disposal of straw and stubble, which were extended through training of extension agents and farmers (Thinlay *et al.*, 2000). These activities were subsequently followed by on-farm trials and field days. In pursuit of addressing the foregoing issues, the research and extension became active partners in generating management strategies through various communication approaches. The policy makers, researchers and extensionists have, however, regarded technological packages as the potential strategy to manage pest rather than enhancing and

involving farmers in the overall pest management strategy and, therefore, it is timely to investigate these consequences.

This study will not estimate impacts and the returns to investments in research and extension on technology development and transfer because Bhutan compared with other rice-growing countries, has far fewer people and a smaller rice-growing area (Gorsuch, 2001). For that reason, the study will focus on the current technological practices on crop management and their consequences thereof to the rice blast. The ultimate goal is to help in determining potential impact of the current farming practices to rice blast management, thereby taking appropriate preventive and curative measures before an epidemic strikes.

Table 2. Overview of the rice blast epidemic in 1995

District	No. of farmers affected	Total area acre	Average severity %	Average yield kg/acre	Total yield (ton)
Paro	1,128	739	66	1,275	663
Thimphu	772	484	55	1,631	219
Punakha	337	131	20	1,605	66
Wangdue	341	175	19	1,720	142
Chukha	90	35	33		9
Others	290	235	*	*	*
Total	2,958	1,799	39		1,099

Adapted from the Ministry of Agriculture, 1995.

Others include Lhuntse, Trashigang, Mongar, Samdrup Jongkhar, Gasa, Chirang, Trongsa, Zhemgang, Dagana, Sarbhang and Samtse.

* Indicates that rice blast in those districts was not severe and therefore, yield loss assessment was not done.

1.5 Objectives

The objectives of this study are as follows:

1. To describe and analyze farmers' knowledge and cultural practices in rice blast management.
2. To evaluate the extent of adoption and decision criteria of farmers in rice blast management technologies.
3. To assess the profitability of rice blast management technologies.
4. To identify farmers' preferences for extension methods in rice blast control.

1.6 Usefulness of the study

The study will generate information about how farmers adopt technology in rice blast management so that the technologies can be tailored to their needs and conditions. Since, rice blast management is a complex mixture of socio-economic, physical and biological components of the rice farming system, the above information will facilitate in selection of appropriate and viable rice blast management strategies in conformity to farmers' situation. The evaluation of adoption of rice blast management technology will generate current scenario and decision criteria, which will fill the gap or incompetence between the stakeholders and fine-tune future strategy in development and transfer of technology in the context of local situation.

Identification of farmers' preferences for extension methods in rice blast management could possibly help in designing appropriate extension approach in blast and other related disease management.