

Chapter IV

General Profile and Paddy Production System of Study Area

Paro and Thimphu are two of the five districts falling under the Western Region. Chukha and Samtse are located in the subtropical region while Ha falls under cold temperate to alpine agroclimatic zone. Paro and Thimphu are also one of the most developed districts in the country and have relatively easy access to wide range of economic and institutional facilities compared with other districts of the country.

4.1 Physical settings

The study area falls under the warm temperate region and extends from 2,120 to 4,572 meters above the mean sea level. The agricultural land runs along the main river valleys. The average monthly maximum temperature ranged from 13.7°C to 24.4°C in Paro and from 15.7°C to 27.9°C in Thimphu. The minimum temperature ranged from -2.84°C to 16.8°C in Paro and from -0.3°C to 17.8°C in Thimphu. The extreme cold temperature in winter, which extends from November to March limits crop intensification or double cropping. The extreme winter months are often accompanied by frosts that cause heavy frost injury to the standing crops and vegetables.

Rainfall is generally concentrated from the month of June to September. The average monthly precipitation ranged from 1.2 mm. to 427.3 mm. in Paro and 1.1 mm. to 221.3 mm. in Thimphu. The annual rainfall in Paro (952.7 mm) was more than Thimphu (709.7 mm). The relative humidity ranged from 75.4 percent to 85.4 percent and 63.5 percent to 80.3 percent in Paro and Thimphu, respectively.

Table 8. Average monthly temperature, rainfall and relative humidity of the study area, 2001

Month→	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Thimphu												
Temperature (°C) Max	15.7	16.7	19.6	22.7	24.8	27.1	27.7	27.9	26.8	24.4	19.8	16.1
Temperature (°C) Min	-0.3	0.3	4.2	8.8	12.6	16.8	17.8	17.5	16.3	10.8	4.5	-0.2
Rainfall mm	1.1	6.2	29.4	30.2	51.5	143.5	221.3	109.2	84.7	22.3	1.2	9.3
Relative humidity %	72.1	72.4	64.7	63.5	70.3	73.9	80.3	77.6	77.1	69.5	66.9	65.6
Paro												
Temperature (°C) Max	13.7	15.0	16.7	20.5	22.4	24.3	24.6	24.2	23.0	20.1	17.4	14.4
Temperature (°C) Min	-2.8	0.1	3.2	6.8	10.8	15.2	16.6	16.8	14.0	9.5	3.1	-1.9
Rainfall mm	2.2	5.8	14.0	34.9	70.9	70.9	240.7	427.3	184.8	58.0	8.5	1.2
Relative humidity %	76.5	79.7	78.7	76.2	79.7	80.5	83.7	85.4	81.2	79.7	75.4	76.1

Source: Agromet Section, Department of Research and Development Services, Ministry of Agriculture, 2002.

4.2 Demographic settings

The demographic information of the research area was collected from those farmers, who were the permanent settlers and devoted their full time to farming activity. The average size of sample households in the study area was about 3.3 persons per household, but the ratio of female to male was 1.4, signifying that the rural population is largely female and conforms to the general conclusion that women make up more agriculture labor force in the country.

The economically active age group (15-60 years) made up 75 percent, while the non-active age group (above 60 years) was 25 percent of the total sample households. The higher percentage of non-active members would further constrain the prevailing family labor shortage. The non-active household members (25 percent) generally contribute to

family labor force, but their productivity would be low in the harsh mountain environment (Table 9).

Table 9. Composition of labor force in the study area

Labor type	Paro		Thimphu		Both districts	
	Farming member		Farming member		Farming member	
	Number	%	Number	%	Number	%
Active (15-60 years)	234	71.8	161	80.1	395	75.0
Non-active (above 60 years)	92	28.2	40	19.9	132	25.0
Total farming member	326	100	201	100	527	100

Source: Survey, 2002.

The indication of aging agriculture is apparent from Table 10, where 28.3 percent falling in the age group of 46-60 years, would soon become non-active, while there would be hardly anyone below the age of 15 years, to take up farming activities because almost all the children go to school.

Table 10. Demographic characteristics of the sample households by age group

Age group (years)	Paro		Thimphu		Both districts	
	Farming member		Farming member		Farming member	
	Number	%	Number	%	Number	%
15-30	62	19.0	48	23.9	110	20.9
31-45	83	25.5	53	26.4	136	25.8
46-60	89	27.3	60	29.9	149	28.3
60+	92	28.2	40	19.9	132	25.0
Total farming member	326	100	201	100	527	100

Source: Survey, 2002.

Overt gender discrimination is relatively rare in Bhutan. Although, both male and female are equal in the eyes of Bhutanese law, there existed some inequalities in the past with regard to the difference in wages between the genders. Degenderization of the marriage and inheritance laws has made male and female equal, and the Royal Decree in 1993, established equality of wages between male and female labor (Planning Commission Secretariat, 2002).

The gender pilot study report (Planning Commission Secretariat, 2001) shows a 60:40 female/male ratio property ownership and most property in the rural areas were received through inheritance. The Planning Commission Secretariat (2002) accounts the customary right of inheritance by daughters based on the belief that women need more economic security to enable them to take care of their parents and raise children. The study also indicated that usually daughters inherited property, especially the eldest, who is by and large uneducated and stayed behind in the farm to look after the aging parents. Additional light is thrown on the above findings from field survey in the study area, which showed that in both the districts female-headed household dominated. Table 11 shows that 62.7 percent of the households were female headed as against the male-headed households of 37.3 percent.

Table 11. Composition of sample household head by gender

Gender	Paro		Thimphu		Both districts	
	Number	%	Number	%	Number	%
Male	36	39.6	23	34.3	59	37.3
Female	55	60.4	44	65.7	99	62.7

Source: Survey, 2002.

Bhutan made drastic improvement in adult literacy rate from 23 percent in 1983 to 54 percent in 1998, but indicated a distressing scenario of women's literacy rate as low as 20 percent (Planning Commission Secretariat, 2000b, 2002). However, the Planning

Commission Secretariat (2002) reports with an encouraging figure of 46 percent of the enrollment in the 2001 academic year, constituted of girls.

In spite of the good educational facilities in the study area, the sample households showed very low literacy rate, of which, 8.6 percent was female and 13.4 percent male. Hence, the flow of extension information in the villages through written mass media is limited and so any future attempts to disseminate technology should focus on audio-visual form of educational programs.

Table 12. Literacy of sample farming households in percentage

Gender	Paro			Thimphu			Both districts		
	Farming member			Farming member			Farming member		
	Total	Illiterate	Literate	Total	Illiterate	Literate	Total	Illiterate	Literate
	No.	----%----		No.	----%----	No.	----%----		
Male	143	89.5	10.5	81	81.5	18.5	224	86.6	13.4
Female	183	95.6	4.4	120	85.0	15.0	303	91.4	8.6

Source: Survey, 2002.

4.3 Socio-economic settings

The study area, in general, can be best described as the mixed small subsistence farming systems depending more on natural resources than the high external inputs of conventional agricultural systems of rest of the world. The main target of agriculture sector had been on enhancing the income and nutritional standards of the rural population in the 8th Five Year Plan (Ministry of Planning, 1996) and enhancing rural income and achieving national food security in the 9th Five Year Plan (Planning Commission Secretariat, 2002).

In recent years, Bhutanese farming has been progressively transforming from subsistence farming to market-oriented farming practices (National Environment Commission, 1998) and more so in the study area, as it has the advantage over rest of the country, especially, in temperate fruit production in terms of climate, infrastructure, institutional services and market.

4.3.1 Land holding

Despite, the increasing trend in cash crop oriented production systems; wetland farming still dominates the farming systems of the area, since, the farmers of this region place a very special importance to the traditional paddy production system. However, Table 13 shows that dryland and orchard dominate over the wetland production system in Thimphu, as non-farming private owners possess large areas of orchards. In addition to this, Geney, which is the rice blast hot spot, has a large proportion of dryland in the sparsely populated upper north.

Table 13. Operational agricultural areas under various land use types of the study area

Land use	Paro		Thimphu		Both districts	
	Area (ac.)	%	Area (ac.)	%	Area (ac.)	%
Wetland	1,811	49.1	681	30.8	2,492	42.3
Dryland	1,012	27.5	743	33.6	1,755	29.8
Orchard	793	21.5	738	33.4	1,531	26.0
Kitchen garden	70	1.9	48	2.2	118	2.0
Total area	3,686	100	2,210	100	5,896	100

Modified from the Ministry of Agriculture, (2002).

The average landholding was about 4 acre per sample household in the study area, but individually Paro district had an average land holding of 4.9 acre per sample household as against 2.7 acre per sample household in Thimphu district. On the whole, a

sample household owned 1.9 acres of wetland on average. The contribution of kitchen garden by area (0.1 acre per household) was not very significant as compared with other land use types, but it plays a significant role in supplementing the nutrition of the farming households of the small subsistence integrated farming systems in Bhutan. Wide varieties of vegetable, spices and fruits trees are grown in the small patch of kitchen garden that is generally located adjacent to the farmhouse.

Table 14. Size and percentage of landholding of the sample households

Land use	Paro			Thimphu			Both districts			
	Unit	Area	Average %	Area	Average %	%	Area	Average %	%	
Wetland	acre	215.6	2.4	48.3	76.8	1.1	42.4	292.4	1.9	46.6
Dryland	acre	105.9	1.2	23.7	60.3	0.9	33.3	166.2	1.1	26.5
Orchard	acre	114.5	1.3	25.7	37.2	0.6	20.5	151.8	1.0	24.2
Kitchen garden	acre	10.5	0.1	2.3	6.9	0.1	3.8	17.4	0.1	2.8
Total area	acre	446.5	4.9	100	181.3	2.7	100	627.7	4.0	100

Source: Survey, 2002.

4.3.2 Source of income

Food and Agriculture Organization's description of small subsistence or part commercial family farms predominating throughout South and South East Asia also puts Bhutan in this farm type. In such farming systems, the main operating objectives of family subsistence is pursued first by production of foodstuffs for consumption and of produce/materials for use on the farm, and second by generation of some cash income for the purchase of non-farm produce essentials (McConnel and Dillon, 1997).

Although, rice is the most important foodstuff supporting the household, surplus to family requirement is often sold to generate extra income (Ministry of Agriculture, 2002b), besides the cash income generated from other crops such as apple, vegetables,

potato and mushroom. Agricultural labor and work for the construction during the lean cropping season form small part of family earnings. According to the contribution of various crops and activities to family income (Table 15), rice was the main source of income accounting 69 percent of the sample households, followed by apple (48.7 percent), vegetables (24.7 percent), agricultural labor (17.7 percent), livestock (12 percent), potato (8.2 percent), while other sources contribution was negligible.

Table 15. Percentage of sample households' source of income

Income source	Paro (n=91)		Thimphu (n=67)		Both districts (n=158)	
	No. of HH reporting	% of HH	No. of HH reporting	% of HH	No. of HH reporting	% of HH
Rice	53	58.2	56	83.6	109	69.0
Vegetables	17	18.7	22	32.8	39	24.7
Apple	45	49.5	32	47.8	77	48.7
Potato	2	2.2	11	16.4	13	8.2
Mushroom	1	1.1	4	6.0	5	3.2
Livestock	13	14.3	6	9.0	19	12.0
Agricultural labor	23	25.3	5	7.5	28	17.7
Construction	4	4.4	1	1.5	5	3.2

Source: Survey, 2002.

Note: HH = Household

4.4 Institutional settings

Rural Bhutan consists of self-reliant and self-subsistent communities, possessing well-defined community based rules and institutions that facilitate the use of common resources and resolve conflicts. The architect of peoples' participation in the mainstream development activities has been His Majesty the King, ever since, his ascent to the golden

throne in 1974. The process of devolution and decentralization of administrative and political powers to the people was further enhanced, when His Majesty selflessly and voluntarily devolved full executive powers in June 1998 to the Council of Ministers, elected by the National Assembly (Planning Commission Secretariat, 2002).

The decentralization policy has enhanced the democratic powers, social responsibilities, transparent processes, and structures of villages and communities to make decisions at the grass-root level. The rural development plans and programs are decided and formulated by the stakeholders that bring the rural peoples' problems, issues and needs closer to their situations and aspirations. The main institutions responsible for these processes are the *Gewog Yargye Tshogchung* (GYT) or Block Development Committees (established in 1981) and *Dzongkhag Yargye Tshogchung* (DYT) or District Development Committees (established in 1991) that involve political, social and economic decision-making (Planning Commission Secretariat, 2002).

The village headman (*gup*), Block Development Committee representative of the village (*Tshogpa*) and the community as a whole, take accountability and ownership of block development activities. The provision is kept for the block to seek any administrative or technical back-up services from the district administration or other relevant organizations, whenever necessary.

4.4.1 Institutional facilities of the study area

All the blocks have easy access to public services such as health, communication, market, school, safe drinking water, irrigation and renewable natural resources services. Every block has Agriculture Extension Center and Livestock Extension Center or Renewable Natural Resources Center that provides extension services to the farming communities. Renewable Natural Resources Center is supposed to house all the Renewable Natural Resources Sector field staff of the block (Agriculture, Livestock and Forestry), but at the time of survey, only agriculture and livestock extension services were fully operational and well established. All four blocks in Thimphu district have

Renewable Natural Resources Centers, while all four blocks of Paro district have different Agricultural Extension Center and Livestock Extension Center.

4.5 Cropping pattern of the study area

The biophysical aspects of the region largely determine cropping pattern. In the wetland dominated farming system, the duration of crop is very crucial in determining the cropping pattern. The most commonly grown crops after paddy are wheat, barley, oats, potatoes and peas, whereas all types of vegetables are grown for home consumption and to earn extra cash income.

Over the years, due to farm labor shortage and animal depredation (Planning Commission Secretariat, 2002), many fields are left fallow in winter. The field survey shows that 36.7 percent of the respondents' fields were left fallow after harvest and the rest of the respondents cultivated winter crops after paddy harvest. When the individual district is taken into account, then more than half of the respondents (52.2 percent) in Thimphu kept their paddy fields fallow, mainly due to animal depredation. The major crops grown after the harvest of paddy were wheat and potato, which accounted for 42.4 and 29.7 percent of the household surveyed, respectively.

Table 16. Cropping pattern of the study area

District	Sample	Rice-Fallow	Rice-Wheat	Rice-Barley	Rice-Potato
	household				
	No.	-----% of households-----			
Paro	91	25.3	49.5	0.0	42.9
Thimphu	67	52.2	32.8	9.0	11.9
Total sample HH	158	36.7	42.4	3.8	29.7

Source: Survey, 2002.

In the wetland dominated farming system of the study area, paddy occupies a half of the year from May-June to October-November and the other half, which usually extends from October-November to May-June is occupied by other winter crops, such as wheat, barley, oat, peas and potato.

Cropping system	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Rice	Rice														
Rice-wheat	Rice						Wheat								
Rice-barley	Rice						Barley								
Rice-potato	Rice						Potato								

Source: Survey, 2002.

Figure 2. Dominant cropping pattern in the wetland-based farming system of the study area

4.6 Paddy production system of the study area

The paddy production system, is traditionally the most important farming system of the area and its importance is less likely to be impacted by the growing trend of cash crop production systems because farming households will not do away with their main staple food, that is, rice. The following sections will elaborate the position of paddy production system in the study area.

4.6.1 Importance

Rice is the preferred staple food for the Bhutanese, contributing 42 percent of the total cereal production of the country (158.64 million kilograms) produced from 47,000 acres of irrigated land (Ministry of Agriculture, 2002a). The country's per capita food availability of 2,500 kilocalories comprises of 75 percent cereals and 25 percent non-cereals that includes livestock products (Planning Commission Secretariat, 2002).

The importance of rice in Bhutan gained more focus, when the First Five Year Plan was initiated in 1961. Gorsuch (2001) asserts that in the 1960s, Bhutan produced as much rice as it consumed, but this self-sufficiency was the result of insufficient supply, not from a reflection of true demand. It could also be attributed to the limited access to rice and affordability of the people then, since the economy was just beginning to get monetized. Therefore, people had to do away with other grains, even though rice was the most preferred staple.

In due course of planned development, food self-sufficiency as the main objective of agriculture sector evolved from the Fifth Five Year Plan (Chettri *et al.*, 1999) and vigorously pursued till the Eighth Five Year Plan with the explicit objective of achieving a minimum of 70 percent self-sufficiency in food grains (Ministry of Planning, 1996). However, the country's production could not keep pace with the increasing demand for rice and Bhutan had to import 38,000 tons in 2,000 to meet the demand brought about by rapid urbanization and expatriate workers, whose staple is rice, and also the change in diet of most Bhutanese from other staples to rice (Planning Commission Secretariat, 2002).

Although, the policy of self-sufficiency has shifted more toward national food security than food self-sufficiency in the Ninth Five Year Plan (2002-2009), the fundamental objective of the Royal Government of Bhutan to support the agricultural innovations as the means to elevate the production constraints has been the top priority. Rural people will have to increasingly rely on rice as the main staple and augment the

dependence on outside source by producing at least self sufficient for themselves. The increased production to meet the household objectives of self-sufficiency and the government's policy of food security cannot be achieved from the horizontal expansion of cultivated area, given the limited arable land of 3,088 square kilometer (7.7 percent), of which, only 12.6 percent is devoted to paddy cultivation. Therefore, the Ministry of Agriculture in pursuit of the above objective, has realized that, to achieve a minimum of 70 percent food grain self-sufficiency by the end of Ninth Five Year Plan, the target can only be achieved by increasing production per unit area. This calls for an orchestrated efforts and involvement of all the actors of the rice sub-sector (Department of Research and Development Services, 2001a, 2001b). Thus, the Ministry of Agriculture is focusing on rice potential areas to meet the objectives of national rice self-sufficiency level of 60 percent from increased domestic production through technological innovations. The technological innovations comprise of the use of improved varieties, fertilizers and by adopting the improved package and practices suitable for different agro-climatic zone and its effective dissemination (Department of Research and Development Services, 2001a, 2001b, 2001c).

4.6.2 Paddy cultivation in the study area

The warm temperate zone (1,800-2,600 meters above seal level) of the country has the best natural potential for rice production in the country and only four districts fall under this zone: Thimphu and Paro in the west; and Trashigang and Lhuntse in the east (Department of Research and Development Services, 2001a). Other rice growing areas fall under the dry subtropical (1,200-1,800 meters above seal level), humid subtropical (600-1,200 meters above seal level) and wet subtropical (150-600 meters above seal level). Wet subtropical zone has the largest rice area in the country (40 percent).

The farming system of study area is dominated by wetland cultivation (46.6 percent), followed by dryland (26.5 percent), orchard (24.2 percent) and kitchen garden (2.8 percent), which in itself explains that the farming system in the area is integrated, while

livestock is taken for granted that it is the part of every farm household system (Table 14). Table 14 also shows that the study area has an average wetland holding of 1.9 acre per household with 2.4 and 1.1 acre per household in Paro and Thimphu, respectively.

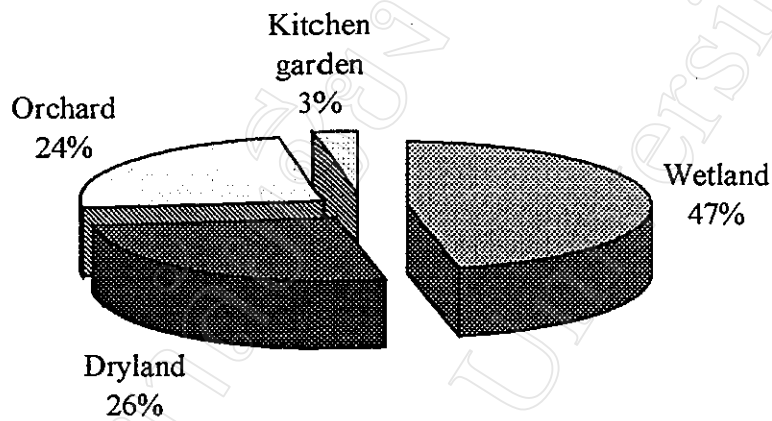


Figure 3. Land use types in the study area in percentage based on the sample survey, 2002

4.6.3 Production and yield

The data base on crop acreage and production is weak at present that gives various estimates of rice area and production (Department of Research and Development Services, 2001b). The estimated national average of rice productivity is 0.97 ton per acre with the warm temperate high altitude at 1.25 ton per acre having the highest average yield compared with other agro-ecological zones such as dry sub-tropical mid-altitude (1.0 ton/acre), humid sub-tropical mid-altitude (0.88 ton/acre) and wet-subtropical low altitude (0.97 ton/acre).

The average yield of Paro and Thimphu is reported to range from 1.4-1.6 ton per acre with the potential of achieving 2.2 and 2.0 ton per acre, respectively, if improved varieties and better management are adopted (Department of Research and Development Services, 2001a). The total rice production of the sample households was 393.4 tons

produced from 273.3 acres with an average yield of 1.4 ton per acre (Table 17). Therefore, there is ample room of improving and increasing the present yield level to its potential productivity through technological innovations that includes adoption of improved varieties; nutrient, pest and weed management; providing improved and assured irrigation and substituting labor shortage through farm mechanization and labor saving farm implements and tools.

Table 17. Rice production, area and yield of local and resistant varieties of the study area, 2002

	Paro		Thimphu		Both districts		
	Local	Improved	Local	Improved	Local	Improved	Total
Production (ton)	74.4	212.8	47.8	58.3	121.8	270.6	393.4
Area (acre)	62.1	137.1	35.9	38.2	98.0	175.2	273.3
Average yield (ton/acre)	1.2	1.6	1.3	1.5	1.2	1.5	1.4

Source: Survey, 2002.

4.6.4 Production constraints

Constraints to production are inherent to all the production systems in the world and more pronounced and severe in the developing countries, where traditional subsistence farming systems persist. The expansion of arable land is beyond its scope in Bhutan. On the contrary, the pressure on relatively flat land for developing infrastructures like school, housing complex and township is increasing. Therefore, the increase in rice production is possible, only through increased productivity per unit area (Department of Research and Development Services, 2001a; Extension Division, 2001). It is recognized that the most important issues are varieties, weeds, diseases, irrigation, post harvest quantity and quality loss, and inflated production costs. More specifically, the constraints in paddy production have been yield loss due to rice blast and weeds; low yield as the consequence of poor pest and nutrient management; and high production and labor cost (Department

of Research and Development Services, 2001b). This means that the biophysical and socio-economic constraints to productions must be addressed, improved and solved.

The survey result on production constraints (Table 18) illustrates that pest and disease dominated over others. Incidence of pest and disease accounted about 59.5 percent, followed by high cost of inputs (37.3 percent). 20.9 percent of the sample households had labor shortage, especially during transplanting and harvesting, in which, the labor demand coincided with the critical labor requirement for everyone. Traditionally, transplanting and harvesting were adequately carried out by exchange of family labors, but with the advent of educational systems and economic development in the country, many literate and semi-literate people are progressively out of rural areas to work in other service sectors. Of late, rural urban migration of illiterate farmers has been creating a large vacuum in farm labor availability. Unavailability and untimely supply of inputs such as herbicides, chemicals fertilizers, pesticides, fungicides and improved seeds (15.2 percent); and crop damage by wild animals (8.2 percent) were some of the problems faced by the farmers of the study site. The sample farmers having paddy fields closer to thick forests have reported very high damage from wild animals such as wild boar and deer, at times requiring farmers to guard at night from their menace. However, majority of paddy farms of the study site were located near the farmstead, where damage by wild animals were non-existent or minimal.

Table 18. Paddy production constraints in the study area (n=158)

Statement of problem	No. of households	%
Labor shortage	33	20.9
Cost of inputs	59	37.3
Unavailability of inputs	24	15.2
Pest and disease	94	59.5
Crop loss to wild animals	13	8.2

Source: Survey, 2002.