Chapter 3

Study Area

3.1. Experimental site

Experimental data used for model calibration and validation were collected from Renewal Natural Resource Research Centre (RNR-RC) Bajo. It is one of the four regional RNR research centers under Council of RNR Research of Bhutan (CoRRB), Ministry of Agriculture.

RNR-RC, Bajo is located on the west-central part of the country under Wangduephodrang district, on the Wangdi- Shengana feeder road along the left bank of Tsang *Chhu* (river). It is situated at 27^0 29' N latitude and 89^0 54' E longitudes with an area of 26 ha, which is mostly irrigated terraced paddy field. It is about 2 km north of Wangdue town. It lies at an altitude of 1,200m-1,300m and has warm temperate-subtropical climate (Eguchi 1997). Fields are fairly flat compared to other adjutant area with 11% slope. It has slightly westerly aspect lying close to eastern wall of the valley, slightly shaded in the early morning. The centre is located entirely on the alluvial deposits of the Tsang *Chhu* (NSSC, 1998).

3.2 Study site (Lingmuteychhu watershed)

Study on resource utilization and yield gap in paddy was carried out in two villages of the Lingmuteychhu watershed which is located in the west central part of the country commonly known as Punakha-Wangdue valley. Watershed falls within the administrative boundary of three districts namely Punakha, Wangdue and Thimphu. It consist of seven villages- Lingmukha, Dompola, Nabchee, Omtekha, Matalumchu, Wangjokha and Bajothang. Lingmukha and Dompola villages are situated on the higher elevation ranging from 2,170m to 2,100m on the northern part

of the watershed (Figure 3.1). Nabchee with an altitude ranging 1,600m to 2,000m is situated on the east central part of the watershed. Remaining four villages are situated within the elevation of 1,600m to 1,200m in the southern part of the watershed. Study was conducted in Omtekha and Wangjokha village.

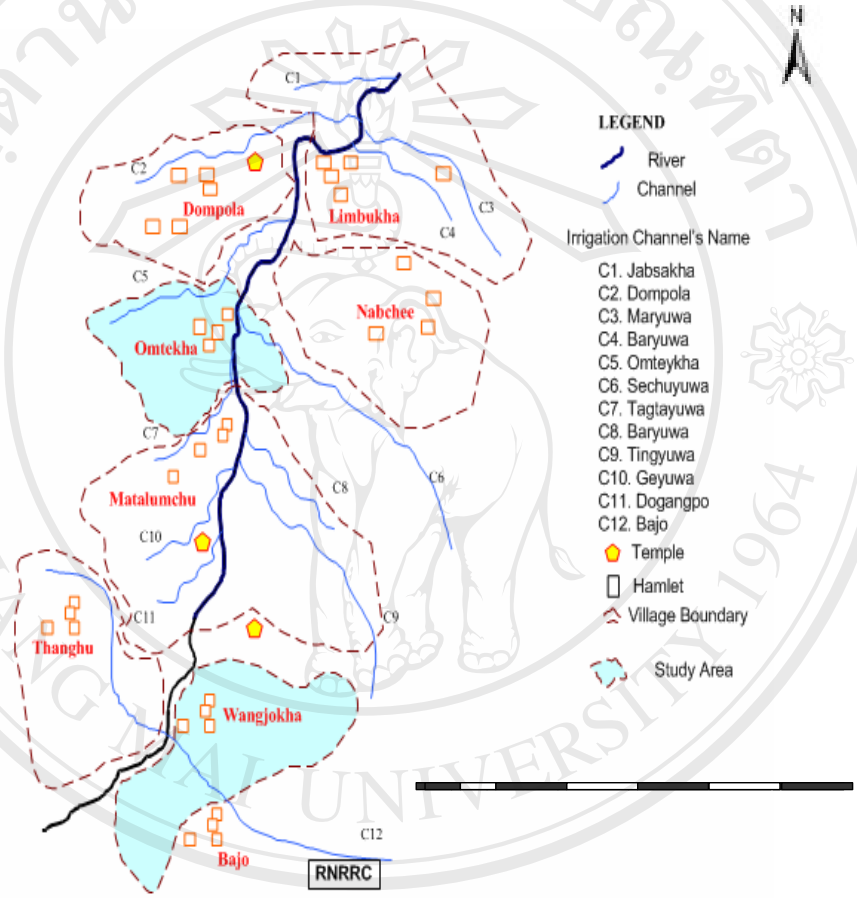

Figure 3.1: Lingmuteychhu watershed and villages. (Source: RNR-RC, Bajo 2004)

3.2.1 Geographical features

Watershed stretches between $27^0$30' to $27^0$35' N latitude and $89^0$53' to $89^0$58' E longitude (NSSC, 1999). It covers about 3,340 ha (33.4 km^2) of land. It is roughly oval in shape and with long axis oriented NNE-SSW. The axis stretches about 10.5 km and widest part is across Dompola village which is about 4 km.

3.2.2 Major soil types

Watershed predominantly has shallow and deep brown sandy loam, which covers 65% of the total area. Other soil types like sandy loam and clayey cover 20%, 11% respectively. Four percent have other soils types like silty clay, silty loam, loamy sand, sandy clay loam etc. Considering that the sandy loam type of soil is predominant in the watershed, the water retention capacity is also low, thereby leading to higher water consumption at transplanting (Brand and Jamtsho, 2002).

Soils in Wangjokha is grey to dark grey in color, texture varies from loam to sandy clayey loam. Lands in this area have 12% slopes, with good drainage. Similarly Omtekha soils are grayish brown to dark brown in color; texture varies from sandy loam to loam to clayey loam. Land in Omtekha is steeper than Wangjokha with slope ranging from 30% to 40%.

3.2.3 Climate

There was no meteorological station established in the watershed area and the nearest available station was located in RNR-RC- Bajo, which is roughly at an aerial distance of 0.5 km. Its data are thought to be the nearest match for Wangjokha and Omtekha. In the study areas summers are warm during which temperature ranges from 16^0C to 32.5^0C while winters are extreme with temperature dropping below zero degree. June, July and August are the wettest months and the average total annual rainfall recorded was 655 mm.

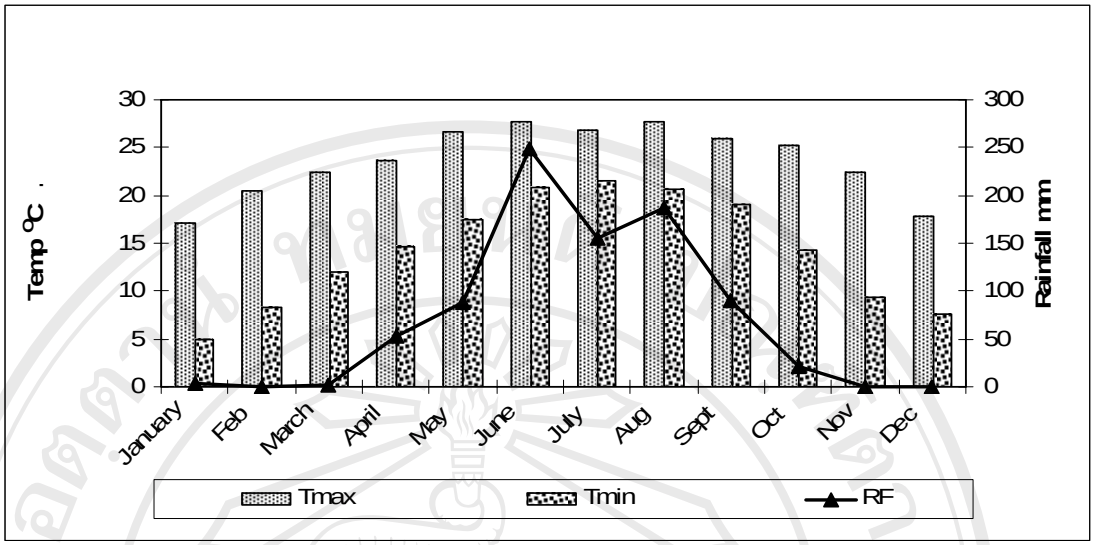

Figure 3.2: Average temperature and rainfall for 1993-2002, RNR-RC, Bajo (Source: Meteorological Unit, Council of RNR Research of Bhutan, 2004)

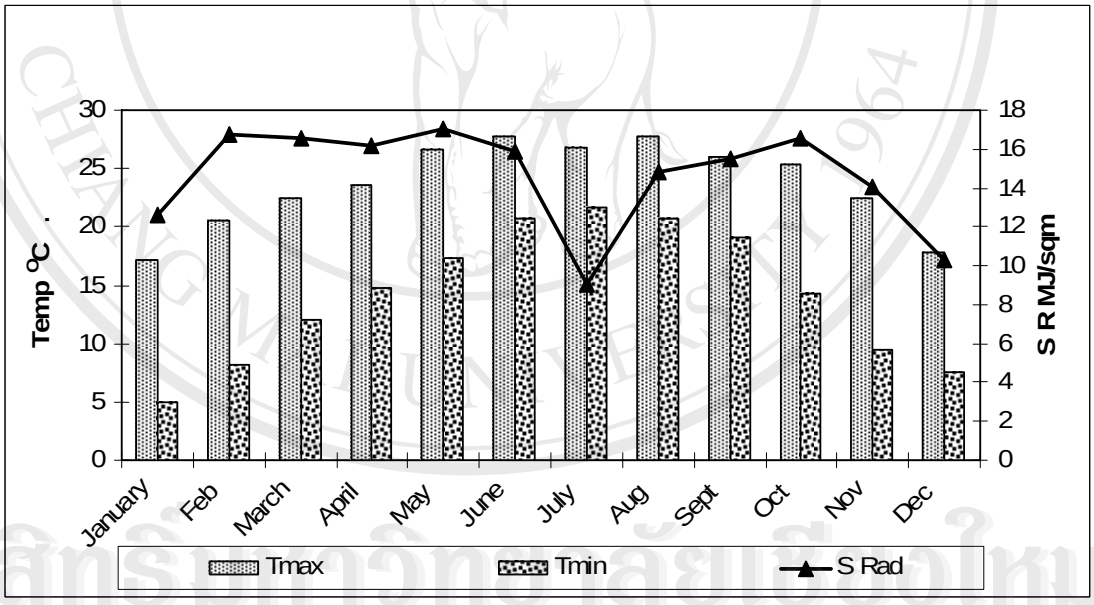

Figure 3.3: Average temperature and solar radiation for 1993-2002, RNR-RC, Bajo. (Source: Meteorological Unit, Council of RNR Research of Bhutan, 2004)

3.2.4 Land use

Watershed is characterized by mountainous terrains and elevation ranges from 3,040m to 1,300m. Based on the altitude the watershed can be divided into three main zones corresponding to vegetative type and farming activities (Gurung, 2004), 59% of total area falls above 2,000m which is mostly vegetated by broadleaf forest and rice-potato based farming system and consist of two villages (Limbukha and Dompola). Another 29 % area between 1,600m to 2,000m corresponds to a transitional zone between broadleaf and coniferous and only one village (Nabchee) fall under this zone. Crops predominantly grown in this village are maize and vegetables. Remaining 12% area below 1,600m to 1,200m is vegetated with coniferous forest and rice based farming system. This zone consist of four villages namely Omteykha, Matalumchu, Wangjokha and Bajothangu.

Table 3.1: Land use types in Lingmuteychhu watershed.

District	Village	Altitude	Grazing land	Forest	Irrigated rice land	Rainfed crops	Total farm land	Percent irrigated farmland
		m		----------ha----------				%
Punakha	Limbukha	2,170	64	801	34	12	46	74
	Dompola	2,100	1	316	4	2	6	67
	Nabchee	1,870	0	439	1.5	6	7.5	20
	Omtekha	1,600	19	129	42	8	50	84
Thimphu	Matalumchu	1,500	95	659	58	2	60	97
	Wangjokha	1,300	0	0	40	0.5	40.5	99
Wangdue	Bajothang	1,300	0	0	0.5	6	6.5	8
Total			179	2,344	180	36.5	216.5	

(Source: Field survey, 2004).

3.2.5 Cropping systems

Rice, wheat, potato, maize and different species of vegetables are grown by farmers in watershed mostly for their own consumption and very little is traded. Rice-based farming systems is common and followed by almost all the farmers in the watershed, except the Nabchee community which is maize-based as farmers in this village possesses more dryland. Out of total cropped area of 216 ha, high altitude rice accounts for 52% of the area followed by wheat, mustard, maize and potato (Gurung, 2004). Traditional rice with red pericarp is particularly grown at high altitude and is preferred for its special taste and social status. White rice varieties are preferred for making pop-rice and beaten rice. While rice is grown in all seven villages, potato is grown only in Limbukha village and mustard only in three villages located below 1,600m.

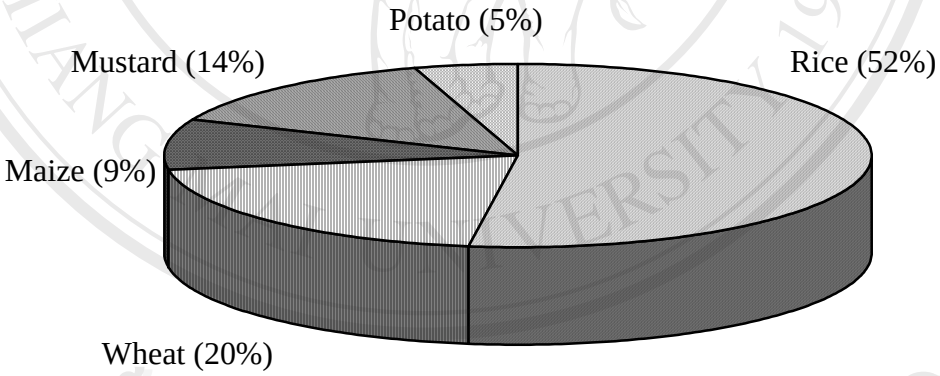

Figure 3.4: Crop types and share of cropped farmland (ha) in Lingmuteychu watershed during 2002 (Source: Gurung, 2004).

The main crop, rice is normally transplanted during the months of May, June and July and harvested in October-November. Wheat, generally grown for household consumptions and brewing alcohol is sown in November-December after the harvest of rice in part of the paddy fields. In lower altitude, after the rice, mustard is sown

from mid October to November and harvested during March–April. While, vegetables are grown in small area near the house through out the year (Table 3.2).

Table 3.2: Cropping Pattern of Omtekha and Wangjokha.

Crops	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rice		Nursery				Transplanting				Harvest		
Wheat			Harvest									Sowing
Mustard			Harvest						Sowing			
Potato			Planting				Harvest					
Vegetables	Grown through out the year in a small patches of land or in Kitchen garden											

(Source: Field Survey, 2004).

3.2.6 Demography

There were 162 households in Lingmuteychu watershed, out of which 43 households were found in Wangjokha and Omtekha. With an average household size of eight, there were total of 337 people residing in these two villages. Twenty six percent of the populations were below the age of 10 while eighteen percent were above 45 years (Figure 3.5). Out of 43 household, percentage of rich, medium and poor households were 30%, 33% and 37% respectively. Male to female ratio in the watershed is almost 1:1 (RNR-RC, 2002b). In both villages, high proportions of people have not attended school at all. Consequently, large proportions of population are engaged in farming.

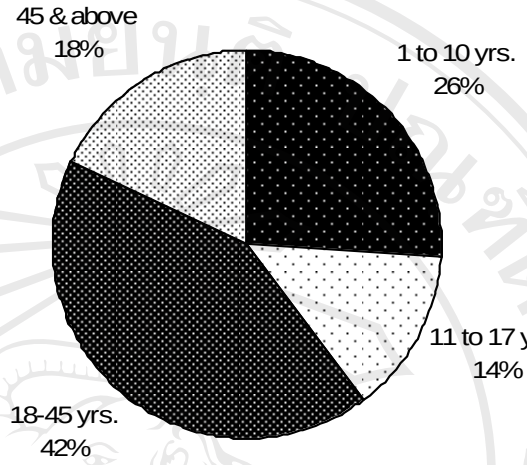

Figure 3.5: Age composition by percentage in the study area (Source: Field Survey, 2004).

3.2.7 Access and communication

The villages in Lingmuteychu watershed are linked by mule's treks and some villages by feeder road ensuring movement of goods and people (Figure 3.6). In 1996, 18 km long feeder road was constructed as a diversion from Wangdue-Shengana road which provided the watershed villages with an access to the nearby towns of Wangduephodrang and Punakha and ultimately to the national east-west highway. This motorable road had facilitated cash income generation from crops like potato, rice and vegetables. It had also helped in marketing animal products like butter and cheese. While the ground distance is approximately 11 km from Limbukha to Bajothangu, it takes 5-6 hours of walk up to Limbukha from Wangjokha. The motorable road had reduced travel distance to 1 hour thus helping farmers to market their agricultural products. At the same time, people could take materials in bulk at much cheaper cost and in shorter time. The electrification and installation of satellite

telephones in the watershed in 2003-2004 has further facilitated the overall socio-economic development of the community.

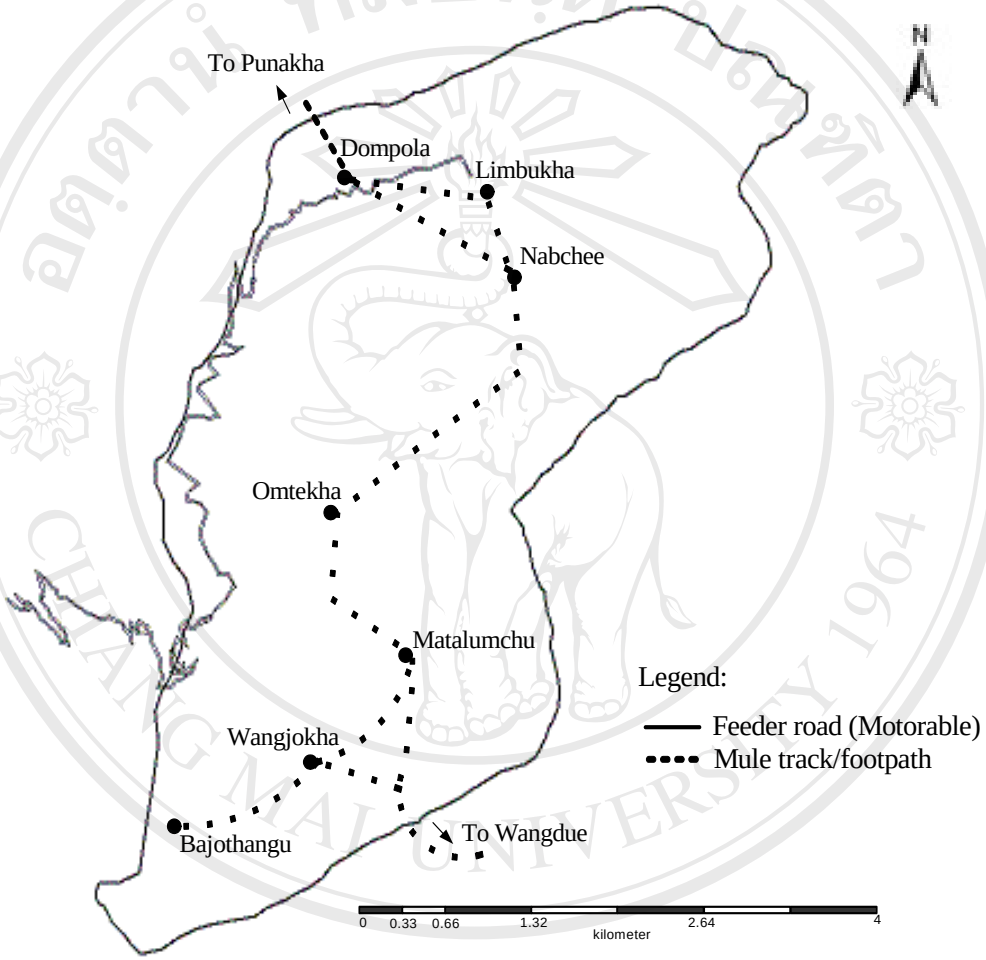

Figure 3.6: Sketch map of road and tracks in Lingmuteychu watershed. (Source: Gurung, 2004).