# Chapter III

## Study Area

This chapter is devoted to elaborate description of the study area. It provides information in some details to better comprehend and understand the biophysical, cropping systems and socio-economic aspects of the research site.

### 3.1 Background and location

Guma *geog* is located on the right bank of Puna Tsangchhu river. It is located in West-central district of Punakha (Figure 8). The *geog* has 310 households. The *geog* has fairly good access to infrastructure and services (Punakha Dzongkhag, 2002). The *geog* has an area of 33.95 $km^2$. The altitude ranges from 1,220 to 2,800 m above sea level. The study area is in the Universal Transverse Mercator (UTM) zone number 45 N with the $87^o$ E as the Central Meridian.

The agricultural land within the *geog* boundary not only belong to people of Guma *geog*, but also belong to people of Kabjisa and Talo *geogs* of Punakha district and Bap *geog* of Thimphu district. Some people from these other *geogs* also live in Guma *geog*. The *geog* is further subdivided into six *chiwogs* or villages. The six *chiwogs* under Guma *geog* are: Lhakhu, Dochukha, Zamdongkha, Pakcheykha, Khuruguma and Wolakha.

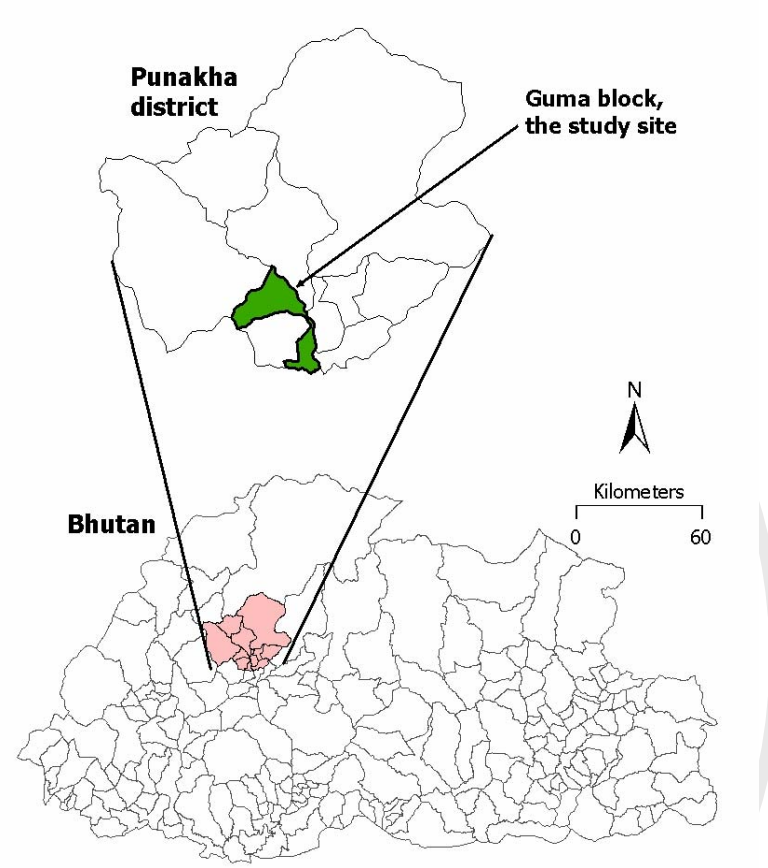


Figure 8. Location of Guma block
(Source: GIS Unit, PPD, MoA, 2005).

### 3.2 Infrastructures and institutional facilities

The most of the development infrastructures pertaining to Punakha district head quarters are located in the *geog*, so question of lack of access to infrastructures and facilities do not arise except for some households living in the far-flung village of Pakcheykha. Most households have relatively easy access to public services like health, education, communication, bank, market, safe drinking water and irrigation. There are a number of schools offering classes, two up to higher secondary level. Facilities like electric power, telephone, internet and television have reached the *geog*. A motorable road run through the *geog* and most household have easy access to it as demonstrated in Figure 9.

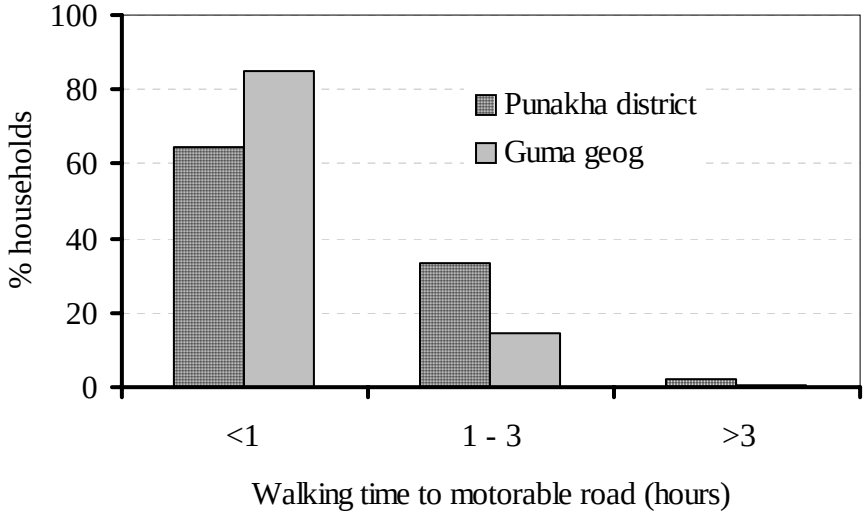


Figure 9. On foot access to motorable road by hours.
(Source: MoA, 2002).

The *geog's* agriculture, livestock and forestry Extension Agents (EAs) are attached to the district administration offices of the concerned sectors unlike other *geogs* where they have either combined RNR centers or separate offices for the three EAs. The staff are responsible for carrying out RNR technology dissemination and development activities in the *geog*.

**3.3 Climate**

The study area falls under the dry sub-tropical agro-ecological zone of broad national classification. It basically has sub-tropical climate with dry winters and wet summers. Summers are hot with temperature reaching over 30 degree centigrade. Winters are dry and windy with occasional frost in the morning. Mean annual rainfall ranges from 500 mm to 1,500 mm (Punakha Dzongkhag, 2001). The patterns of average rainfall and mean temperature on a monthly basis are shown in Figure 10 and based on 30 years average up to 2005. Rainfall pattern is mono modal occurring mainly from the months of May to September with the maximum rainfall concentrated in the month of July.

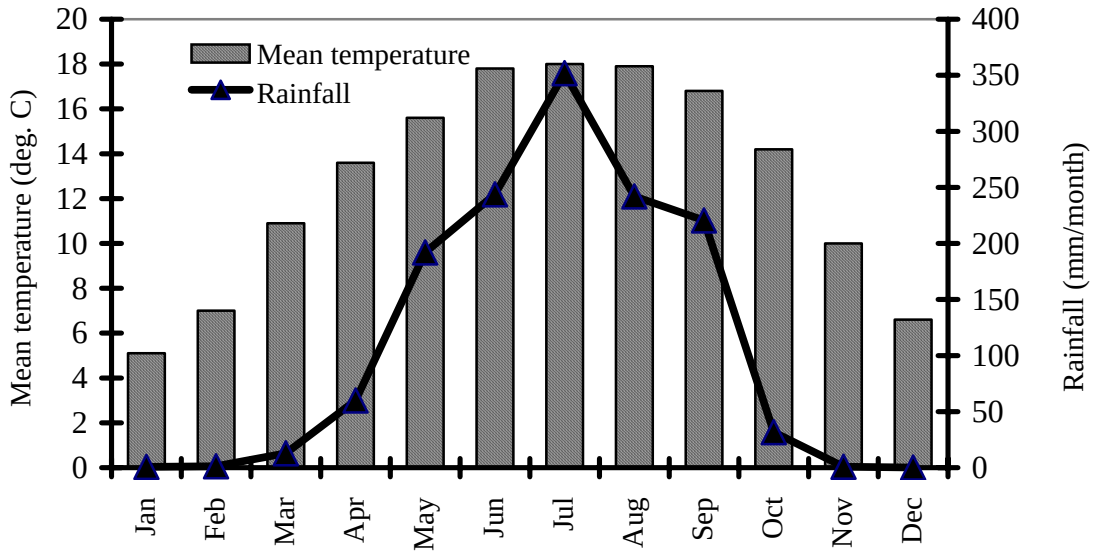


Figure 10. Average monthly rainfall and temperature
(Source: Agro-meteorological Unit, Council of RNR Research of Bhutan, 2005).

Due to the warm summer temperatures, evapotranspiration can exceed precipitation at any time of the year. However, soil moisture replenishments in the rainy season are sufficient to support rainfed farming (BSSP, 1999b).

### 3.4 Land resources and uses

The land area of 5.66 km2 or 16.67% of the total *geog* area of 33.95 km2 is under agriculture. The remaining 83.43% is under forest cover that includes two types of registered forest in the name of households: *sokshing* and *tsamdrog*. Households have no legal right over the trees and land in these two categories of registered plots. Generalized land use map of the *geog* is presented in Figure 11. Natural vegetation cover is in chir pine, oak, scrub, natural pastures and so on. The agricultural lands are situated along the Puna Tsangchhu river valley. Lower flat lands are normally utilized for irrigated farming whilst the upper ones are used for rainfed farming to grow horticultural crops like orange and field crops like maize, barley and buckwheat.

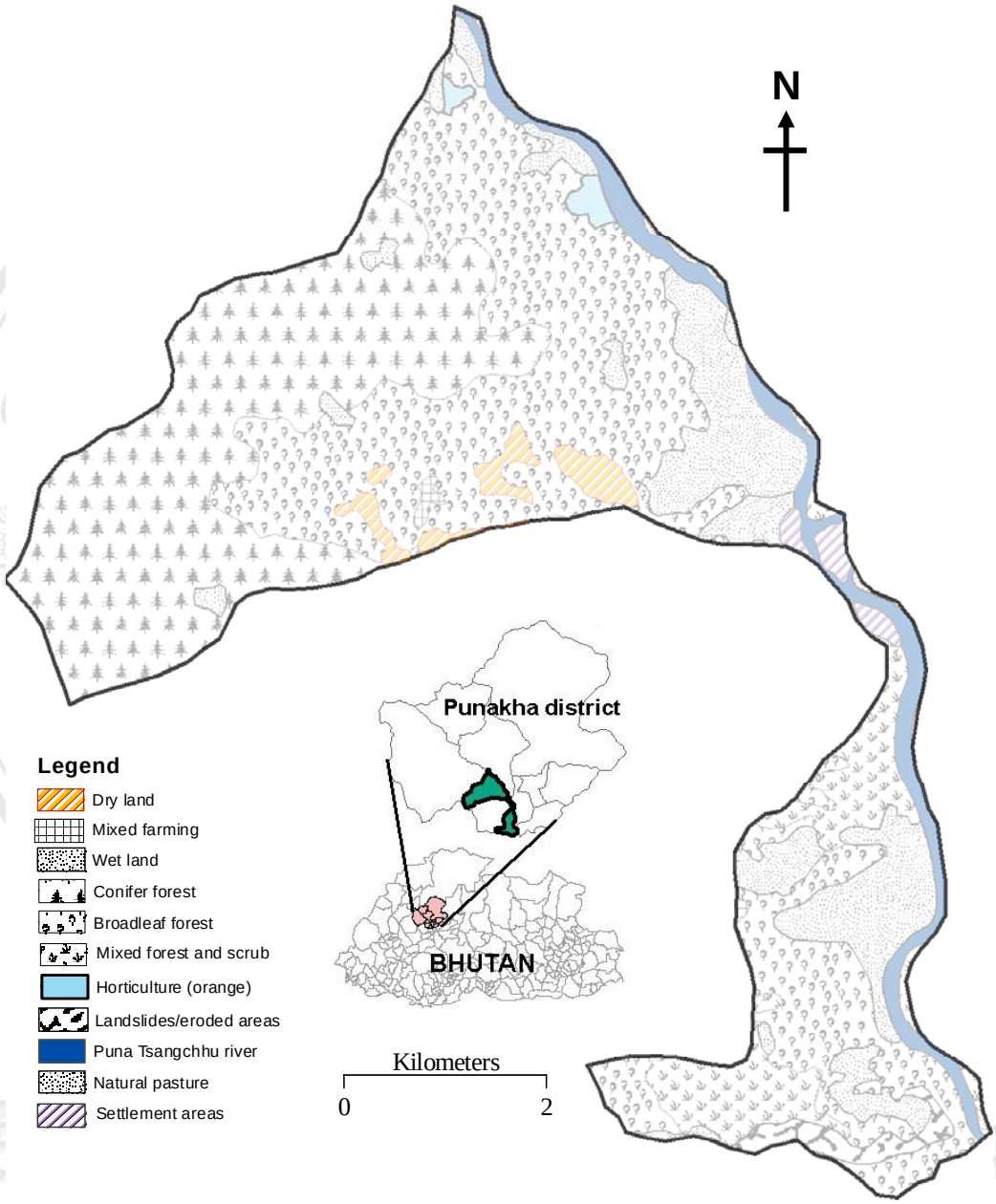


Figure 11. Land use map of Guma *geog*
(Source: GIS Unit, PPD, MoA, 2005).

The percentage distribution of the registered agricultural land into different land use types is shown in Figure 12. It is based on RNR census conducted in 2000 by

the Ministry of Agriculture (MoA, 2002). Irrigated land use known in Bhutan as *chhushing* or wet land occupies largest area, i.e., 70% followed by rainfed land use of *khamshing* or dry land with 16%. Other land uses are orchard, kitchen garden and *tseri/pangshing*. For the surveyed households; wet land, dry land, orchard, *sokshing*, *tsamdrog* and kitchen garden land uses occupy 61.1%, 28.0%, 4.8%, 4.6%, 0.5% and 1.0% of the area respectively, suggesting proportionate sampling representation.

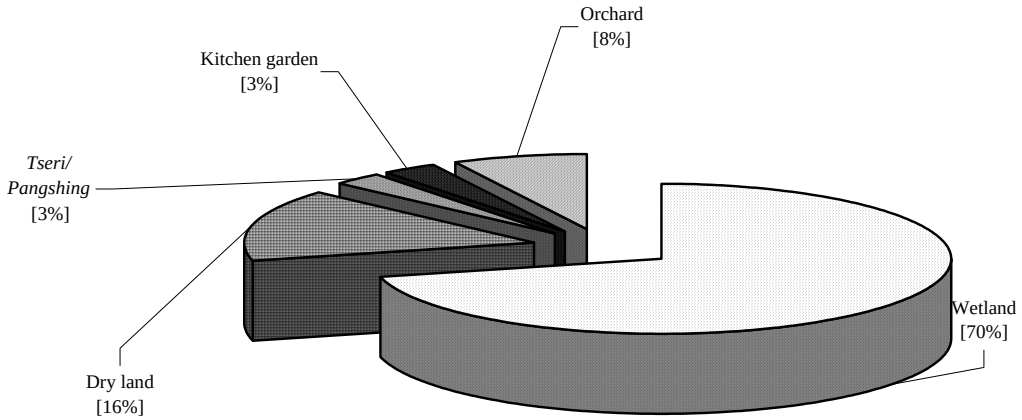


Figure 12. Percentage of land registered under different land use.
(Source: MoA, 2002).

There are many perennial streams flowing across the agricultural land in the study area. These streams provide irrigation water for the crops grown in wet land. Since the streams flow through the agricultural land irrigation channels are usually short and few, constructed to divert water to the required fields, otherwise irrigation water is directly taped from the streams to fields.

### 3.5 Cropping system

Rice, wheat, mustard, chili, beans and other different miner cereals and vegetables are normally grown in temporal sequence with rice in wet land fields and some crops like maize, beans and chili are also intercropped in dry land fields.

#### 3.5.1 Cropping sequence and calendar

In the past, single rice or rice-fallow cropping system was the most dominant cropping system. Due to development intervention rice-wheat, rice-mustard, rice-chilli and rice-vegetables cropping system is increasingly taking place not only the study area but in the whole of Punakha-Wangdue valley (Chettri *et al*., 2003) and the system is rice-based (Table 9). Rice is normally transplanted during the months of May, June and July and is harvested in October and November (Table 9). Wheat and mustard are grown only in parts of the fields and are sown after the harvest of rice. Some parts of fields are used for chilli, beans and other vegetables in the following year when the temperatures get warmer. The remaining fields are left fallow and are sometimes utilized for cattle grazing by those households with the shortage cattle feed for stall-feeding.

Table 9. Cropping calendar of Guma geog.

| Crops | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | | Nursery | | | | Transplant | | | | | Harvest | |
| Wheat | | | Harvest | | | | | | | | | Sow |
| Mustard | | | Harvest | | | | | | | | Sow | |
| Chili | sery | | Transplant | | | Harvest | | | | | | Nur- |
| Beans | | Sow | | | | Harvest | | | | | | |
| Other Vegetables | Grown throughout the year in small of land patches or in kitchen garden | | | | | | | | | | | |

(Source: District Agriculture Office, Punakha, 2005).

### 3.5.2 Plant protection (PP)

At national level use of pesticides was on the increase until mid 1990s. Subsequent to that, there was some decline in the amount consumed as a result of; partial removal of subsidy on PP chemicals, removal of several hazardous chemicals off the market for environmental concerns, and introduction of Integrated Pest Management practices (MoA, 2002).

Percentage households using of pesticides for paddy in Punakha district and Guma *geog* is 7.3% at the district and 5.2% at the *geog* level. The usage on other crops is much lower. Use of herbicides, especially Butachlor, is increasing among paddy growers as availability of labor for weeding is decreasing. Most pesticides are used for paddy, wheat and chili in Guma (Figure 13).

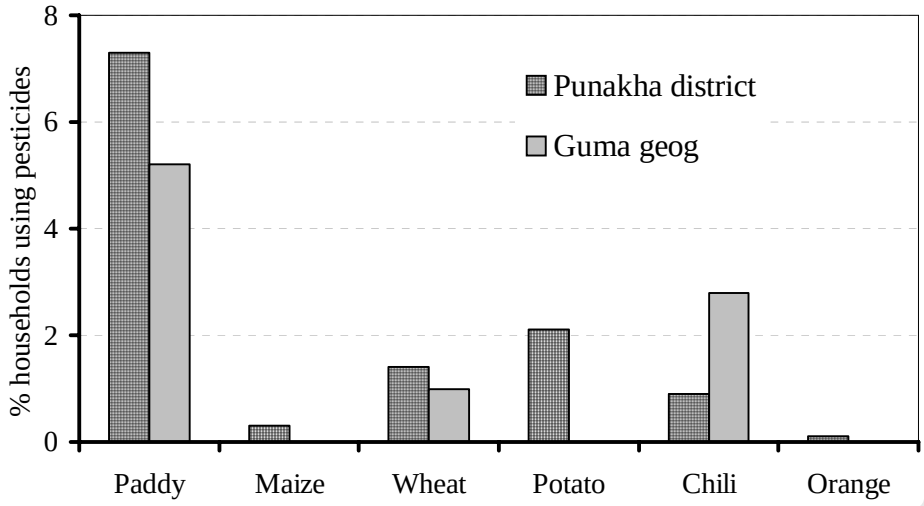


Figure 13. Percentage of households using pesticides.
(Source: MoA, 2002).

### 3.5.3 Soil fertility management

Land resources in Guma are more intensively cultivated than most of other *geog*s because most of the households access to motorable road and market being located within the *geog*. These conditions encourage farmers to intensify their production especially with the use of chemical fertilizers. The soil fertility management practices adopted by farmers are use of FYM and fertilizer, tethering livestock and burning trash in the fields.

FYM and fertilizers are two main sources of soil nutrients for the farmers. FYM is the single most important source of soil nutrients used in any crop to increase productivity. Unlike FYM, fertilizers are mainly restricted to crops with higher returns such as paddy, mustard, chili, beans, and oranges.

Percentage households using FYM is 94.10% at the district and at the *geog* level is slightly lower at 83.2% (Figure 14). Reasons for this, is demonstrated by the fact that 87.3% Guma farmers use urea as compared to 44% for the whole district. s*uphala* (15:15:15 or 17:17:17) usage is also higher in the *geog*.

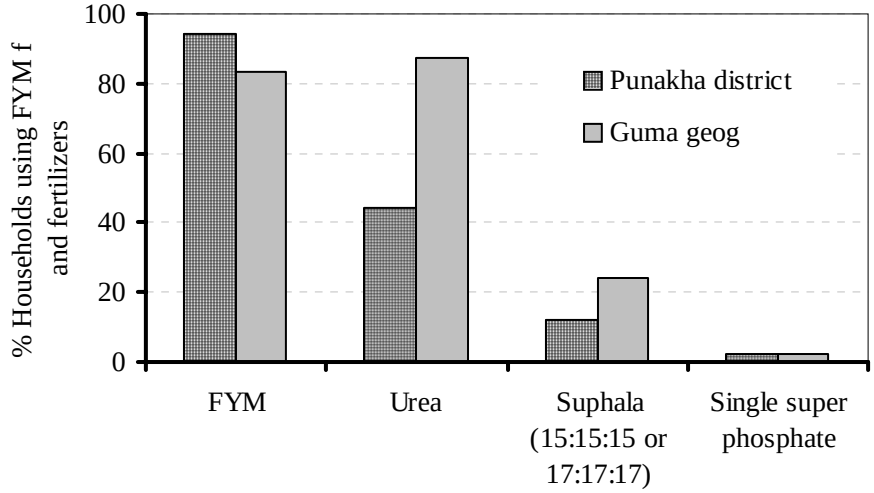


Figure 14. Percentage of households using FYM and fertilizers.
(Source: MoA, 2002).

Table 10 provides further breakdown of urea and *suphala* fertilizers usage into different crops in the surveyed households (HH). Urea is applied by 88% of HH on rice as compared to 58.67% HH applying s*uphala* as the later is more expensive. Mustard being economically more important than wheat, 33.33% HH apply on mustard compared to 18.76% HH for wheat. Similar trend exists between beans and chili, later being economically more important.

Table 10. Percentage HH using fertilizers in different crops

| Crops | Urea | | *Suphala* | |
|---|---|---|---|---|
| | % HH | No. of HH | % HH | No. of HH |
| Rice | 88 | 66 | 58.67 | 44 |
| Wheat | 45.33 | 34 | 18.67 | 14 |
| Mustard | 42.67 | 32 | 33.33 | 25 |
| Citrus | 2.67 | 2 | 5.33 | 4 |
| Chili | 53.33 | 44 | 40 | 30 |
| Beans | 29.33 | 22 | 13.33 | 10 |

(Source: Survey, 2005).

### 3.5.4 Government support on chemical fertilizers

Chemical fertilizers are available from the Commission Agent (CA) based in the study area at Punakha proper. The system of CA was introduced in1989 to facilitate access of farm input especially fertilizers to farming communities. The transportation cost is borne by the Government as subsidy to the farming communities and the CAs get 10% of the value of input transacted to the farmers as the commission from the Government. Free transportation nullifies the distance differences in locations of the farming communities so that fertilizers are available at the same prices through out the country. This is an incentive to use fertilizers.

### 3.5.4 Crop yields and area

Paddy is the most important crop both in terms of acreage and production. Production figures alone would mask the details regarding yields and areas under cultivation and there is a need to dual into these parameters. The paddy yield is highest in Wolakha where the area in the lowest among the villages. Khuruguma has the largest paddy area (Figure 15). The yields and areas of wheat, mustard, chili and beans along with yields of oranges and number of trees under five *chiwogs* are given in Table 11 and data for Pakcheykha *chiwog* was not available.

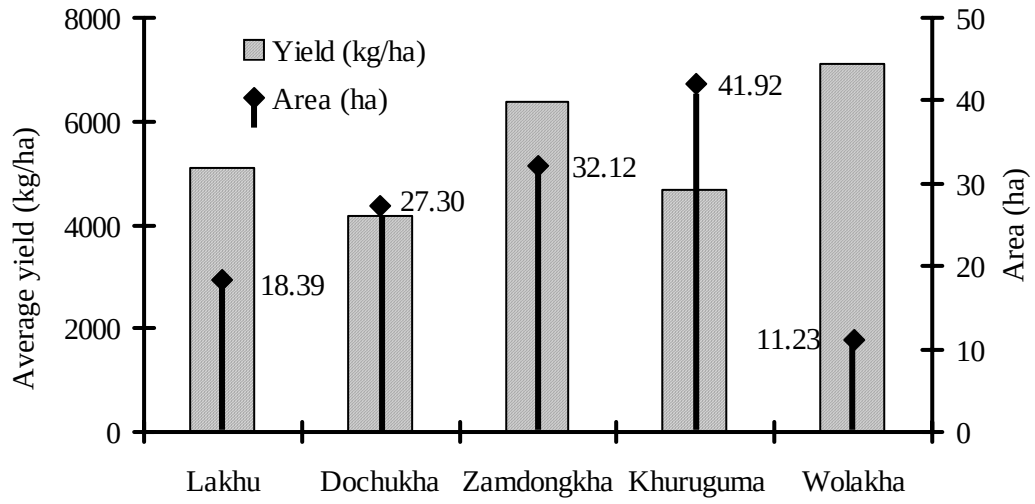


Figure 15. Average paddy yield and area of five *chiwogs.*
(Source: District Agriculture Office, Punakha, 2005).

Table 11. Production data of wheat, mustard, chili, beans and oranges under five *chiwog*s.

| Crops | | Lakhu | Dochukha | Zamdong-kha | Khuru-guma | Wolakha |
|---|---|---|---|---|---|---|
| Wheat | Yield (kg/ha) | 855.61 | 703.89 | 729.71 | 415.38 | 659.78 |
| | Area (ha) | 6.26 | 2.88 | 5.49 | 4.04 | 2.49 |
| Mustard | Yield (kg/ha) | 421.68 | 467.93 | 482.76 | 645.72 | 320.61 |
| | Area (ha) | 1.72 | 2.17 | 2.62 | 8.86 | 3.54 |
| Chili | Yield (kg/ha) | 18661.24 | 14245.96 | 5552.34 | 7782.37 | 1853.25 |
| | Area (ha) | 3.51 | 3.45 | 2.70 | 0.39 | 0.06 |
| Beans | Yield (kg/ha) | 1635.51 | 3686.14 | 4223.53 | 7896.45 | 1853.25 |
| | Area (ha) | 2.11 | 0.51 | 0.37 | 0.19 | 0.02 |
| Citrus | kg/tree | 19.00 | 18.00 | 25.00 | 18.00 | 20.00 |
| | Trees (No.) | 859 | 816 | 1878 | 830 | 610 |

(Source: District Agriculture Office, Punakha, 2005).

**3.6 Livestock production**

Livestock forms an integral part of the farming systems and it plays a crucial role in the livelihood of the rural farming population not only within this *geog* but also at the national level. They provide sources for draft power, meat, dairy products such as milk, butter and cheese. Livestock is an important source of organic fertilizer in the form of FYM to replenish soil fertility. Cattle, horses, pigs, and poultry are the major livestock owned and reared by farmers.

Cattle are important livestock reared by most of the farmers (Table 12). Number of local, less productive breeds of cattle are increasingly being replaced by more productive improved cattle breeds. Many farmers stall-feed their cattle as a means to make FYM and while others practice free grazing methods. Some farmers graze in their *tsamdrog* or registered grazing land. Crop residues like rice straw are fed to cattle from crops component and cattle provide FYM to the crops. The sub-tropical pastures, napier grass, fodder trees and winter oats along with crops residues are important sources of livestock feed.

Table 12. *Chiwog*-wise livestock population of Guma.

| SN | *Chiwog* | Cattle (No.) | Horses (No.) | Pigs (No.) | Poultry (No.) |
|---|---|---|---|---|---|
| 1 | Lakhu | 218 | 7 | 41 | 382 |
| 2 | Dochukha | 155 | 0 | 26 | 254 |
| 3 | Zamdongkha | 240 | 17 | 63 | 442 |
| 4 | Pakcheykha[1] | - | - | - | - |
| 5 | Khuruguma | 220 | 9 | 52 | 372 |
| 6 | Wolakha | 170 | 0 | 48 | 313 |
| | Total | 1,003 | 33 | 230 | 497 |

[1] data not available

(Source: District Livestock Office, Punakha, 2005).

**3.7 Local institutions and decentralization**

Rural communities of Bhutan have well defined set of community rules and institutions that facilitate the use of common resources and resolved conflicts. The architect of people's participation in the mainstream development has been His Majesty the King of Bhutan. His Majesty the King started a gradual decentralization process in 1981 by establishing the Dzongkhag Yargay Tshogchungs (DYT) or District Development Committees to promote people's participation at the district level (Planning Commission Secretariat, 2002).

A decade later, His Majesty established the *Geog Yargay Tshogchung* (GYT) or the Block Development Committee. GYT is the decision-making unit at the grassroots level to promote socio-economic development strategies and programs based on communities' needs and aspirations. It is involved in making political, social and economic decision-making at the geog level (Planning Commission Secretariat, 2002). The geog plans for the Ninth Five Year Plan period across Bhutan was formulated by the people and they are responsible for implementing the plans after the enactment of the Geog Yargay Tshogchung Charthrim 2002.

The elected head of the *geog*, *Gup* chairs GYT meetings whose members are *Mangmi* (deputy head), *Tshogpas* (village representatives). The GYT and community as a whole, take responsibility, accountability and ownership of all *geog* development activities. Administrative and technical back-up support and services are provided by district administration and *geog* based staff like RNR extension agents and head teacher of the local school.

**3.8 Demography**

The average family size in the 75 surveyed households is 8.32 persons. The figure is quite high as many households consist of extended families with as high as 16 persons but small families consisted of as low as 2 persons. The pattern of employment is presented Table 13. Percentages of people in farming, off-farm activities and schools are 45.93%, 25% and 29.07%, respectively. A large chunk of population is in educational institutes as students.

Table 13. Pattern of employment in the survey area.

| *Chiwog* | Off-farm (No.) | Farming (No.) | Students (No.) |
|---|---|---|---|
| Dochukha | 31 | 46 | 31 |
| Khuruguma | 13 | 27 | 23 |
| Lakhu | 33 | 81 | 40 |
| Pakcheykha | 13 | 20 | 11 |
| Wolakha | 4 | 9 | 3 |
| Zamdongkha | 29 | 43 | 35 |
| Total | 123 (25.00%) | 226 (45.93%) | 143 (29.07%) |

(Source: Survey, 2005).



Percentage respondents reporting the farm labor trend as, increasing, remaining constant and decreasing within last five to 10 years are: 29.33%, 33.33% and 37.33%, respectively. A higher percentage of respondents reported decrease in the farm labor. About 46 % of the people are in farming and scenarios on labor

availability suggest that there is a general decline in labor force across the *geog* compared to five to 10 years ago.

Figure 16 shows that 18% of the surveyed population is illiterate. Maximum people have undergone primary schooling at different level, one has to be cautious about the interpretation as anyone who studied from class one to six are grouped into this category and 3% of the people are in tertiary education.

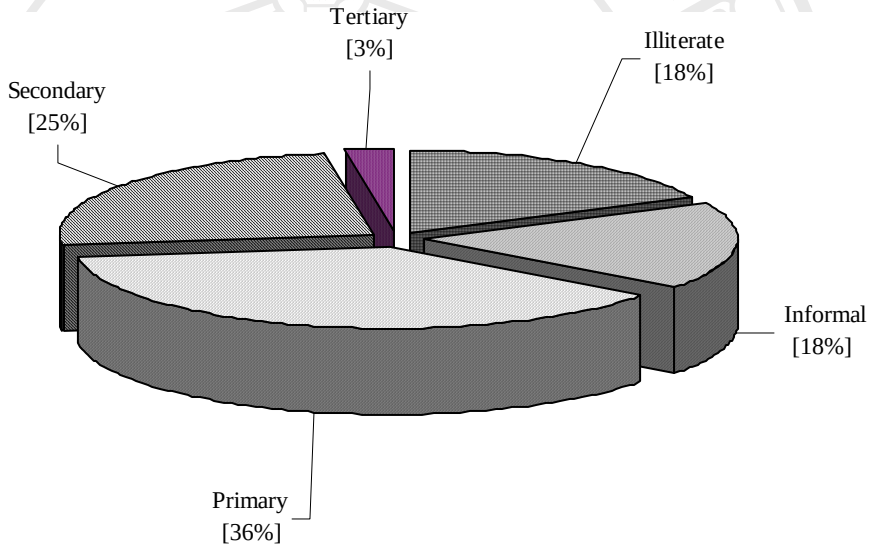


Figure 16. Pattern of education in the surveyed households.
(Source: Survey, 2005).

**3.9 Land man ratio**

The average land holding is 1.30 ha per household, but there is high variation in holding sizes from 0.06 to 9.96 ha. The land categories of *sokshing* and *tsamdrog* are not included as these land categories have user rights only and no legal ownership lie with the farmers. The high variation is also found in family size with 2 to 16 persons per household averaging at 8.32 persons per household. The average land to man ratio is 0.16 in the studied households. From looking at the land man ratios of six villages, we can see that Dochukha have highest pressure of population with lowest

ratio, Zamdongkha has least pressure and other villages similar or for Lakhu same as the average ratio (Table 14).

Table 14: Land-man ratio.

| | Dochukha | Khuruguma | Lakhu | Pakcheykha | Wolakha | Zamdongkha |
|---|---|---|---|---|---|---|
| Area (ha) | 14.66 | 11.19 | 30.28 | 9.50 | 3.96 | 27.88 |
| Population (heads) | 139 | 79 | 192 | 65 | 24 | 124 |
| Land man ratio | 0.11 | 0.14 | 0.16 | 0.15 | 0.17 | 0.22 |
| *n* | 16 | 8 | 24 | 6 | 4 | 17 |

(Source: Survey, 2005).