

CHAPTER 5

BIO-PHYSICAL CONDITIONS OF THE STUDY AREA

Bio-physical conditions are very important for land use planning and land development to identify the suitability of land use for crops production, natural resource conservation and management. This chapter presented bio-physical conditions of the study area such as Digital Elevation Model (DEM), slope and biophysical such as climate viability and land use type in 1990 that related to land use change in the study area.

5.1 Digital Elevation Model (DEM)

Digital Elevation Model or DEM is a spatial data to represent geographical characteristics by using height of terrain from mean sea level; DEM can be created from contour line, topographic map and geodetic survey, for the study area DEM data was obtained from national geographic department as Luang Prabang provincial DEM and subset by study area boundary, this DEM data is range between 270-562 meters from mean sea level (Figure 5.1).

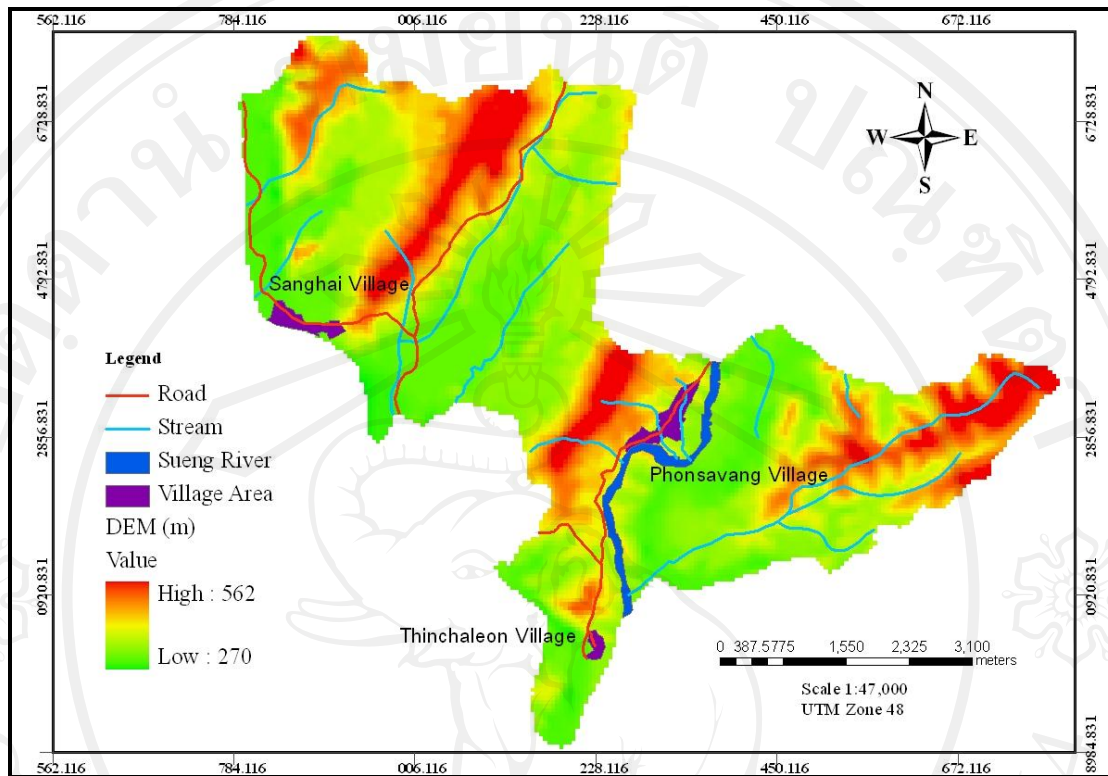


Figure 5.1 DEM map of the study area

5.2 Slope

Slope or gradient is one of a spatial that describes its steepness, incline or grade; a higher slope value indicates a steeper incline to represent the characteristics of terrain which has the unit in degree or percent. The slope map was created from DEM data. According to geographical characteristics of Lao PDR, slope can be categorized into 5 levels ranged from 0-12%, 13-36%, 37-45%, 46-60% and more than 60% (Table5.1) with identification of land use type by each slope level.

Table 5.1 Introduction of land use by slope levels

Zone	Slope level	Identify land use by slope
1	0-12%	Land suitable for lowland rice paddy, aquaculture, forage crops, cash crops, fruit orchard, tree plantation and poultry.
2	13-36%	Land suitable for cash crops, fruit orchard, tree plantation and shortage fruit tree.
3	37-45%	Land suitable for cash crops, long term and short term for tree plantation and permanent fruit orchard.
4	46-60%	Not suitable land for crops due to soil fertile but suitable for forage crops in dry season for cattle, natural forest plantation to recover forest area and natural resource conservation.
5	>60%	Not suitable land for crops production and animal husbandry this area is should be for conservation to recover forest resource to protect soil and water resource

Source: Ministry of Agriculture and Forestry (MAF, 2003)

5.2.1 Distribution of land use type in the year 1990 in each slope class

According to (MAF, 2003) slope class of the study area was categorized into 5 levels with the ranged from 0-12%, 13-36%, 37-45%, 46-60% and more than 60% respectively. From slope analysis of the study area with land use type in the year 1990 is show in (Table 5.2 and Figure 5.2).

Table 5.2 Land use and land cover distribution on slope in 1990 (in ha)

Land use type	Percentage of Slope Level					Total
	0-12%	13-36%	37-45%	46-60%	>60%	
W	19.06	17.86	4.34			41.26
DF	706.78	285.34	120.29	23.23	2.64	1,138.28
MDF	741.97	482.86	230.75	56.54	6.63	1,518.75
Fa	57.49	83.91	46.86	11.11	0.72	200.09
UpF	152.30	94.49	46.04	6.31	1.16	300.30
LoF	26.34	18.38	12.30			57.02
Ur	12.71	1.53				14.24
Total (ha)	1,716.65	984.37	460.58	97.19	11.15	3,269.94
% of total area	52.50	30.10	14.09	2.97	0.34	100.00

Source: From data analysis

Note: W= Water, DF= Deciduous forest, MDF= Mixed deciduous forest,
Fa= Fallow, UpF= Upland field, LF= Lowland field, Ur= Urban,

It was found that land use type located in slope ranged between 0-12% consists of water bodies about 19.06 ha, deciduous forest 706.78 ha, mixed deciduous forest 741.97 ha, fallow 57.29 ha, upland field 152.30 ha, lowland field 26.34 ha and urban area 12.71 ha respectively.

Slope ranged between 13-36% composed of land use type of water about 17.86 ha, deciduous forest 285.34 ha, mixed deciduous forest 482.86 ha, fallow 83.91

ha, upland field 94.49 ha, lowland field 18.38 ha and urban area 1.53 ha. With the slope ranged between 37-45% was occupied 460.58 ha constituted 14.09% which included water 4.34 ha, deciduous forest 120.29 ha, mixed deciduous forest 230.75 ha, fallow 46.86 ha, upland field 46.04 ha and lowland field 12.30 ha.

Less of land use areas distributed on slope with the ranged between 46-60% and more than 60% total land use occupied 97.19 ha and 11.15 ha or just 2.97% and 0.34% that included deciduous forest 23.23 ha and 2.64 ha, mixed deciduous forest 56.54 ha and 6.63 ha, fallow 11.11 ha and 0.72 ha and upland field 6.31 ha and 1.16 ha respectively.

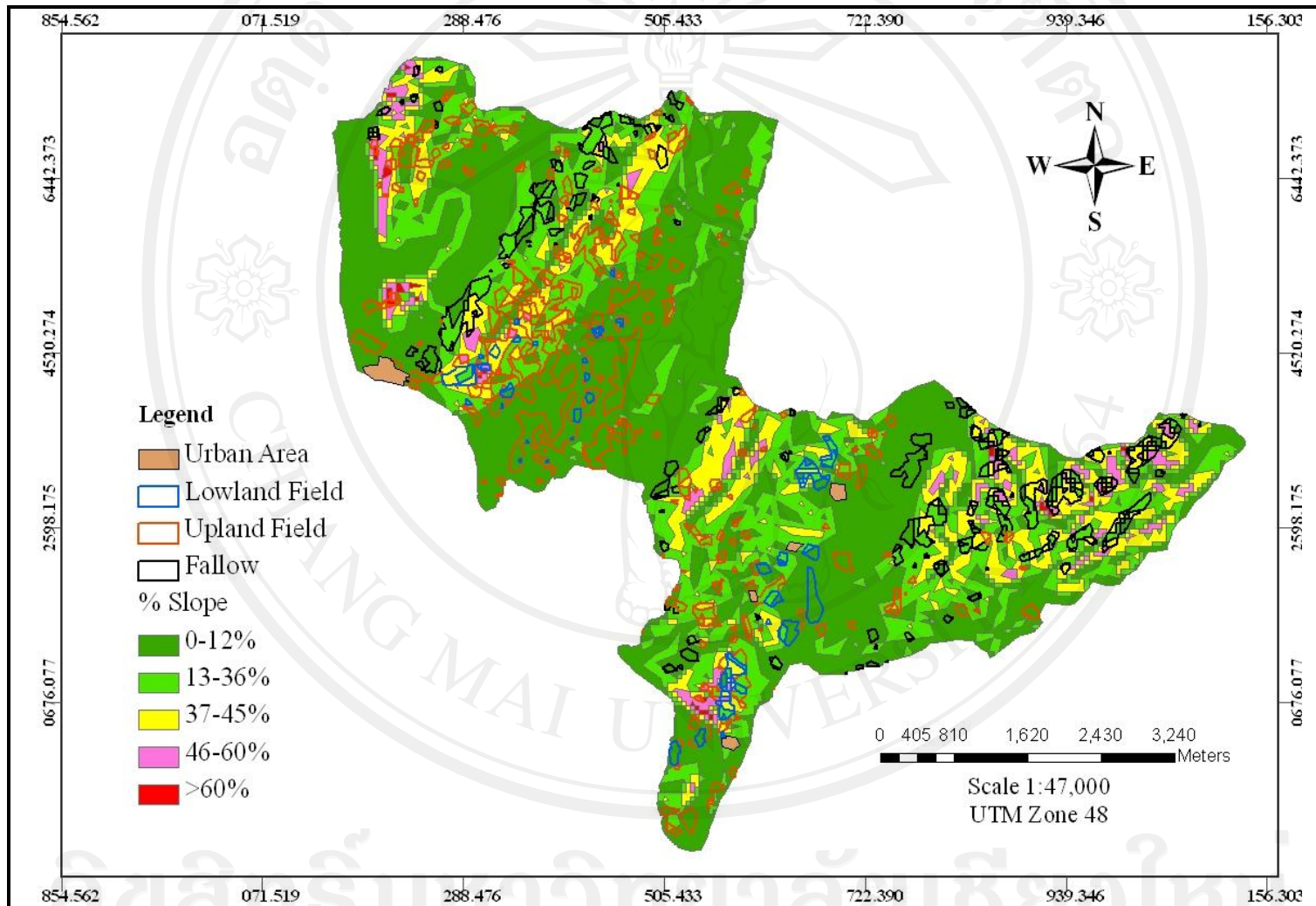


Figure 5.2 Main local inhabitants land use distribution on different slopes in 1990

5.2.2 Distribution of land use type in the year 2010 in each slope class

Result of 2010 slope analysis was also found that most types of land use were distributed on the slope range between 0-12%, 13-36% and 37-45%. In the year 2010 land use distribution on higher slope level at 46-60% seem to be increased as summarized in (Table 5.3).

Table 5.3 Land use and land cover distribution on slope in 2010 (in ha)

Land use type	Percentage of Slope Level					Total
	0-12%	13-36%	37-45%	46-60%	>60%	
W	24.83	25.57	7.29			57.69
DF	718.15	301.90	136.52	25.50	2.34	1,184.41
MDF	401.25	319.30	196.58	53.16	6.14	976.43
Fa	28.97	51.25	16.86	2.24	0.24	9.56
UpF	64.91	64.56	33.47	7.39	0.39	70.72
LoF	54.02	24.91	13.05	0.79		2.77
TP	329.18	131.24	45.37	8.90		14.69
MFO	57.26	46.12	7.65			11.03
Ur	37.88	19.84	4.92			62.64
Total	1,716.45	984.69	461.71	97.98	9.11	3,269.94
% of total area	52.49	30.11	14.12	3.00	0.28	100.00

Source: From data analysis

Note: W= Water, DF= Deciduous forest, MDF= Mixed deciduous forest, Fa= Fallow, UpF= Upland field, LF= Lowland field, Ur= Urban, TP= Teak plantation, MFO= Mixed Fruit orchard

Slope ranged between 0-12% has total land use areas occupied 1,716.45 ha or cover 52.49% which consists water 24.83 ha, deciduous forest 718.15 ha, mixed deciduous forest 401.25 ha, fallow 28.97 ha, upland field 64.91 ha, lowland field 54.02 ha, urban area 37.88 ha. While teak plantation and mixed fruit orchard that did not exist in 1990 have occurred in 2010 with occupied 329.18 ha and 57.26 ha respectively.

Slope ranged between 13-36% has total land use areas occupied 984.69 ha constituted 30.11% that included water 25.57 ha, deciduous forest 301.90 ha, mixed deciduous forest 319.30 ha, fallow 51.25 ha, upland field 64.56 ha, lowland field 24.91 ha and urban area 19.84 ha, teak plantation 131.24 ha and mixed fruit orchard 46.12 ha.

With slope ranged between 37-45% was 461.71 ha or occupied 14.12% included water 7.29 ha, deciduous forest 136.52 ha, mixed deciduous forest 196.58 ha, fallow 16.86 ha, upland field 64.56 ha, lowland field 13.05 ha, teak plantation 45.37 ha, mixed fruit orchard 7.65 ha and urban area 4.92 ha respectively.

Less of land use areas distributed on slope with the ranged between 46-60% and more than 60% have total land use 97.98 ha and 9.11 ha or cover 3% and 0.28% that included deciduous forest 25.50 ha and 2.34 ha, mixed deciduous forest 53.16 ha and 6.14 ha, fallow 2.24 ha and 0.24 ha and upland field 7.39 ha and 0.39 ha, lowland field 0.79 and teak plantation 8.90 ha respectively.

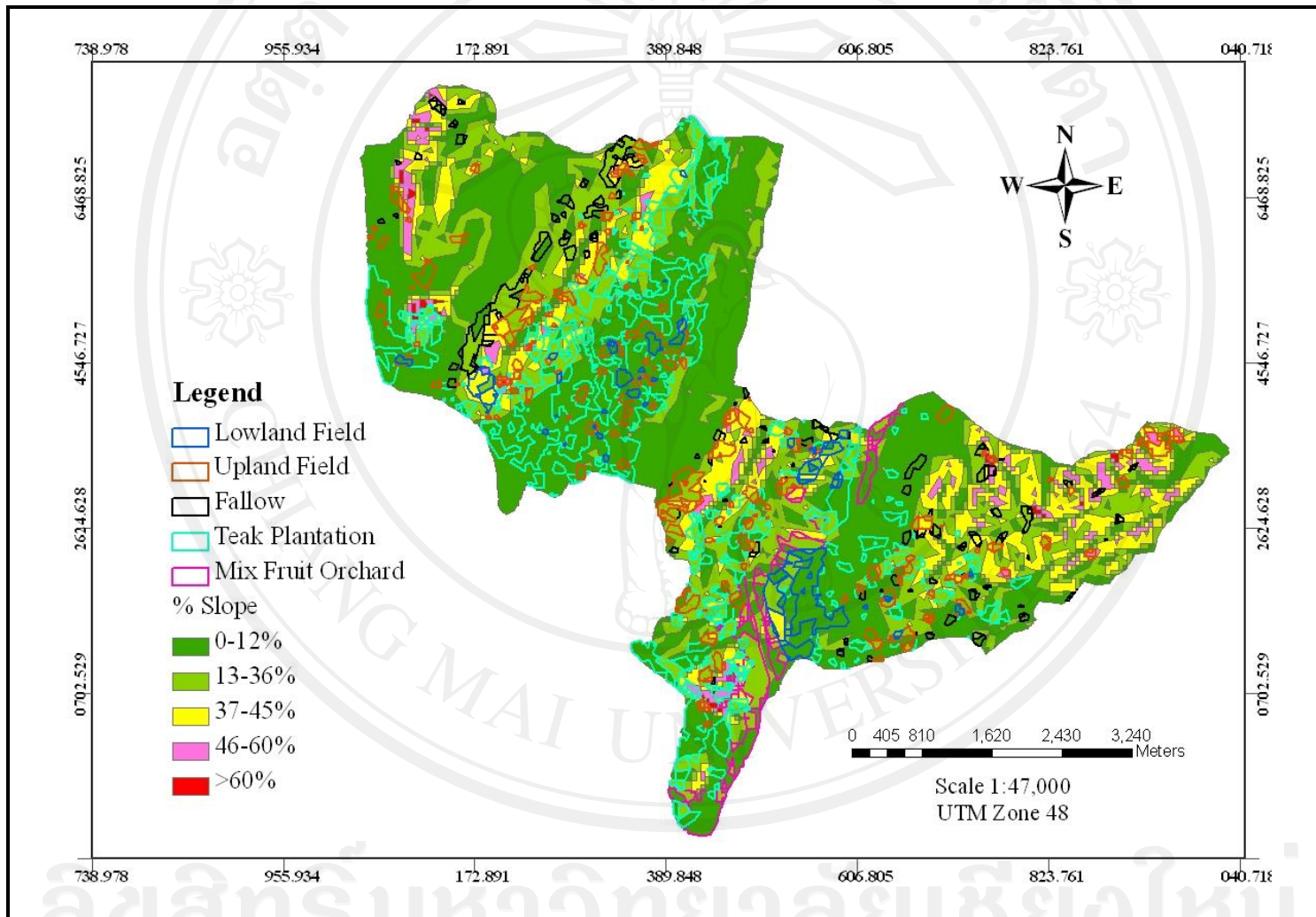


Figure 5.3 Main local inhabitants land use distribution on different slopes in 2010

5.3 Climate

The study area is located in a transitional climatic zone where the rainy season start from April to October alternates with one dry season start from November to March. The weather data reported here is based on information obtained from Provincial Meteorological Station (PMS) which are the nearest stations around the study area. Like the regional climatic situation, the local climate is also subjected to a period of drought experienced since the 1992s. The long-term (1990-2010) mean annual rainfall of the area is 1,390.8 mm (Figure 5.6).

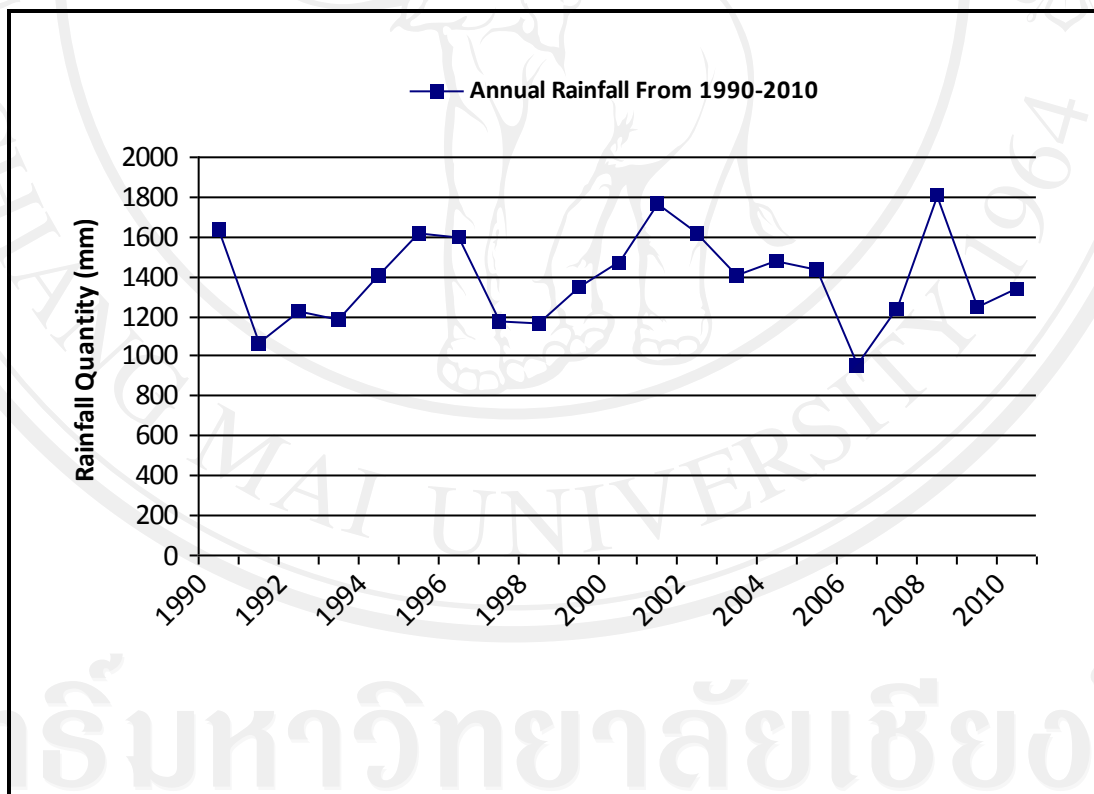


Figure 5.4 Average annual rainfall cover the study area between 1990-2010

Source: Provincial Meteorological Station (PMS)

Rainfall shows large seasonal variability. The area has a bimodal rainfall pattern, with the small rains occurring from March to May and the main rains from June to September. Based on the long-term data, the annual rainfall is received during the main rains, which is when cropping normally takes place. The highest rainfall was recorded in the year 2008, where the annual rainfall was 1,809.5 mm, much higher than the average. The small rains could sometimes be erratic but there is no cropping during this period, except it is important for softening the land which will facilitate land preparation in addition to growth of some grasses for livestock.

Latitude, altitude, winds and humidity, with varying magnitude have significant impacts on temperature conditions in Laos. The average temperatures are typically tropical and fluctuate. However, mean annual temperature for this period (1990-2010) was 25.3 °C all the year round. Maximum temperature of 23.9 °C and minimum temperature of 26.4 °C. Highest temperature was observed for the months of March, April, May and June. While the months November December and January had the lowest temperatures (Figure 5.7) shows average annual temperature recorded from 1990 to 2010.

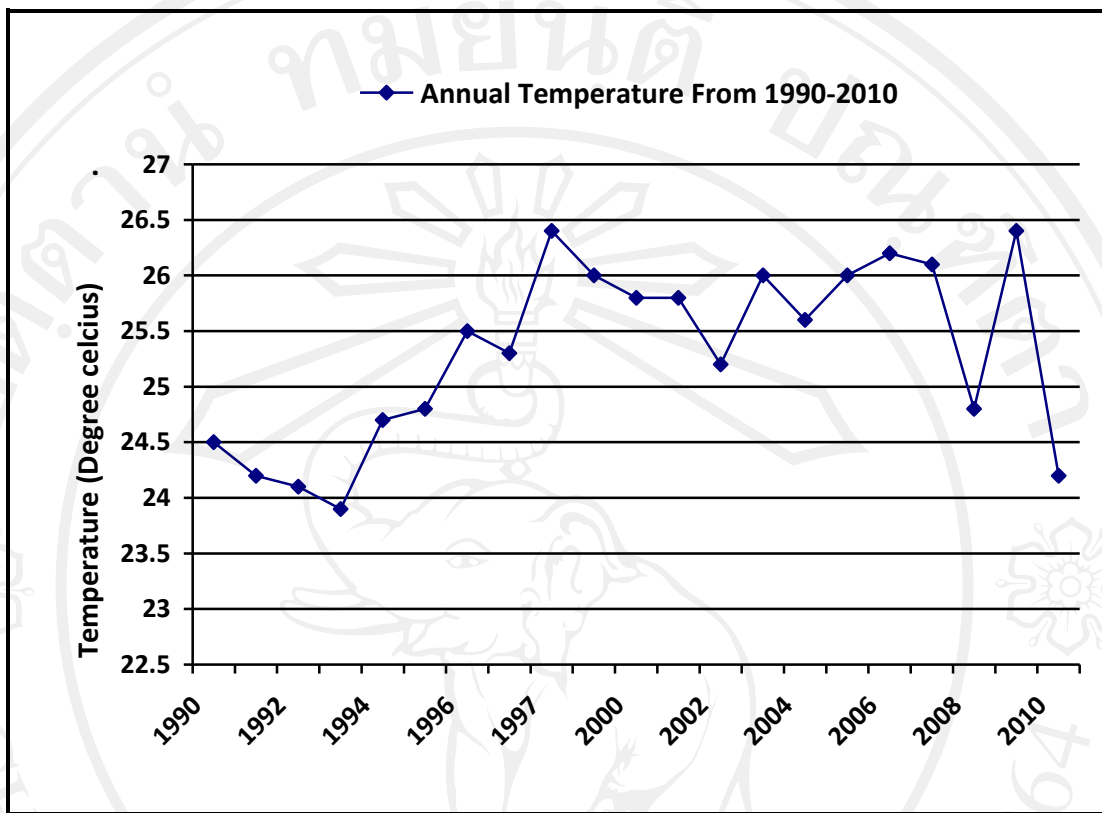


Figure 5.5 Average annual temperature cover the study area between 1990-2010

Source: Provincial Meteorological Station (PMS)

However, due to relief variability microclimatic differences are visible within the area limit. In other words, the relatively elevated of the northern part of the Lao PDR is comparatively wetter and cooler than the South. Due to the change of the climate and rainfall of the provincial of Luang Prabang, it might also be a change in rainfall and climate in the particular study area of the research. This change can lead to the agriculture system and land use changed into other activities.