CHAPTER 4

Physical Characteristics of Longan Production System in Phrao District

4.1 Base Map Data

In order to develop the basic spatial database concerning the area in which longan was being produced, it was necessary to use Geodatabase to display the data. The collected spatial data were represented in the forms of a point, a line, a polygon, and a raster. These data help improve and correct the presentation of the data so that the final information is not only accurate but also current by state-of-the-art techniques. All improved data were collected from many sources, including the research sites around Phrao District. In the past, some of the basic data were stored in Geodatabase (or Shape file), some data in Indian 1975 projection system, and some in WGS84 projection system. Afterward, all of the data collected from those sources were combined into WGS84 through the Datum Transformation method. Through this process, the data were standardized and designated as WGS84 Zone 47N. Figure 13 displays this data-improvement process.

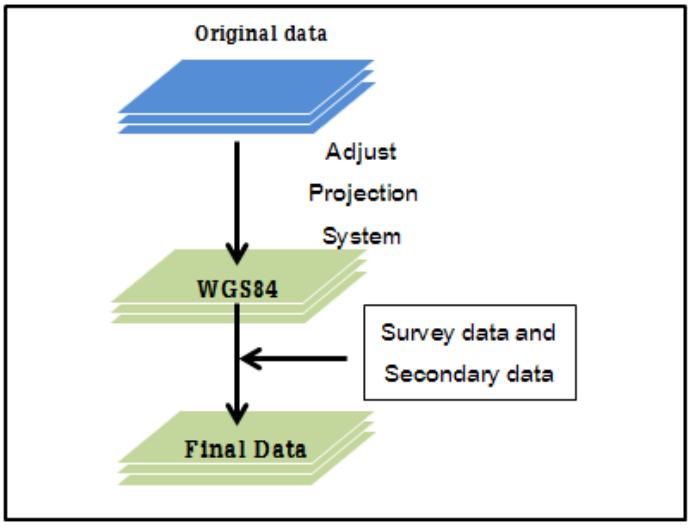

Figure 13 The steps taken to collect, import, and improve the basic database.

After the improvement process was completed, the next step was to take the refined database and create a Personal Geodatabase by using the program ArcCatalog (ESRI inc). The data were separated into six groups for easy management and indexing. The following are those six groups:

1. Admin Boundary: This group consists of the information collected on the district boundaries and the tambon boundaries. These data are used to create an attribute table, which will make it easier to improve and update the data as necessary.
2. Base Maps: This group consists of information concerning Contour Line, Stream Line, Transportation, as well as important data on key locations such as villages, etc.
3. Irrigation Data: This group consists of information concerning the irrigation areas, irrigation points, bodies of water, and locations of wells (well points).
4. Land Use: This group is a collection of all the data on the usage of the land in the year 2010. A map was created to designate what areas of the land were used for what purposes as well as to aid in choosing future uses of the land.
5. Soil Series: This group contains spatial data concerning the soil series, such as the soil's properties, fertility, and structure, etc. An attribute table was created to represent all of these data.
6. Raster Data: This group contains DEM (Digital Elevation Model) maps and Hillshade images.

All of these data were put into a Geodatabase, a type of GIS (Geographic Information System). The ArcCatalog program was used to complete the transformation of these data. This spatial database was key to analyzing proper locations for planting longan trees.

Figure 14 displays the structure of this basic database. It is a Geodatabase in GIS:

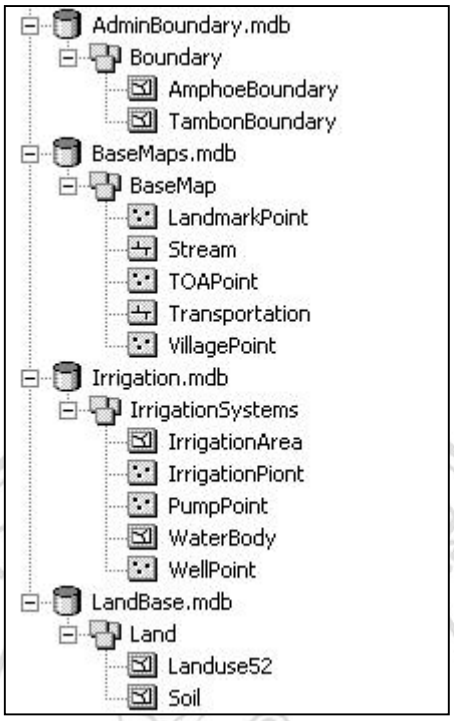

Figure 14 The appearance and organization of the Geodatabase in GIS

Each layer of data in the Shape file was improved and recompiled into the Geodatabase. Figures 15-1 to 15-6 are the improved layers of the Shape file.

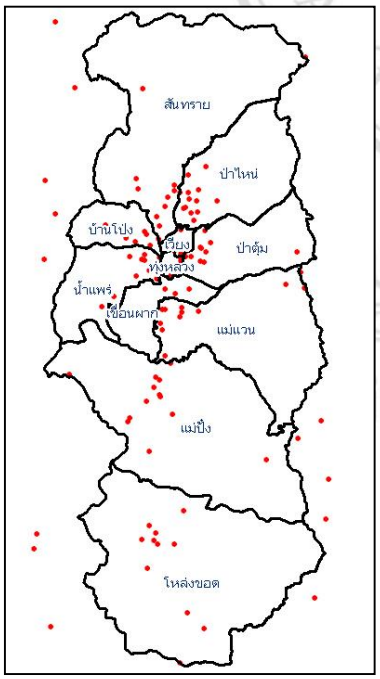

Figure 15-1 Village

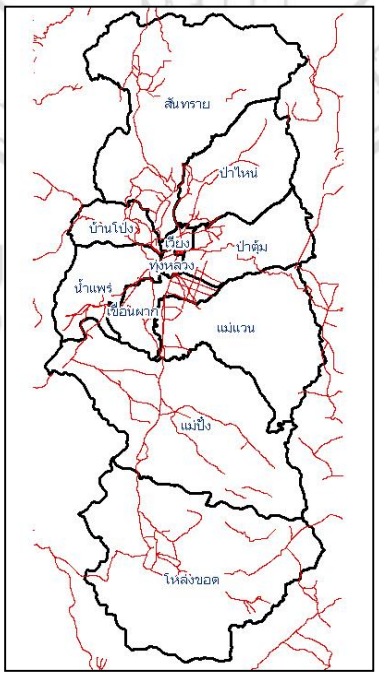

Figure 15-2 Transportation

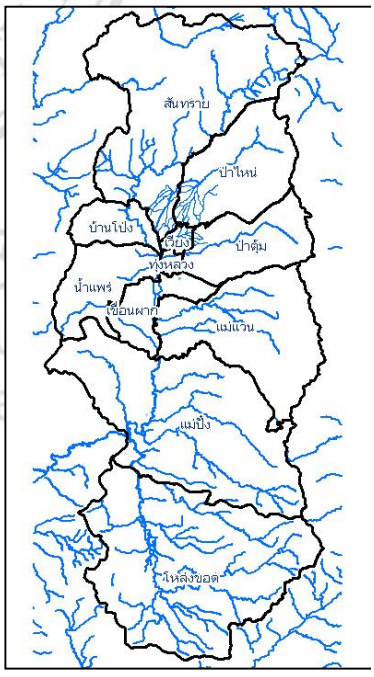

Figure 15-3 Streamlines

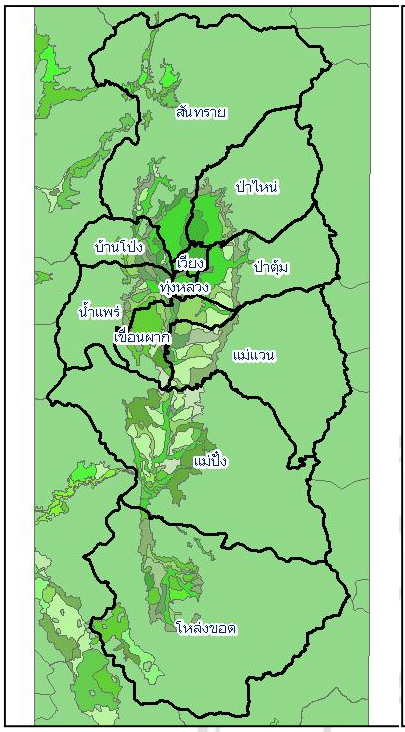

Figure 15-4 Soil Series

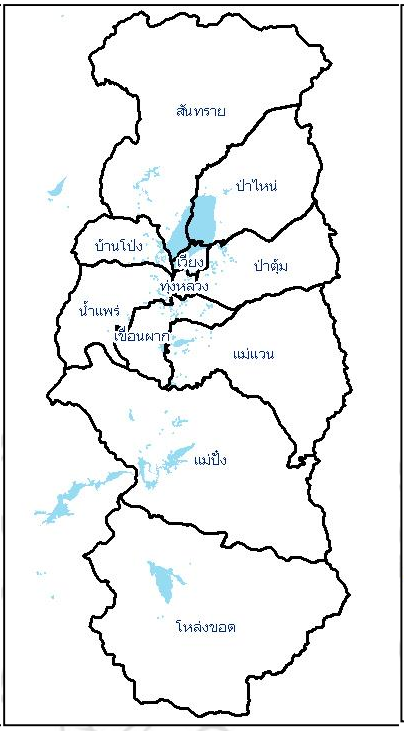

Figure 15-5 Irrigation Systems

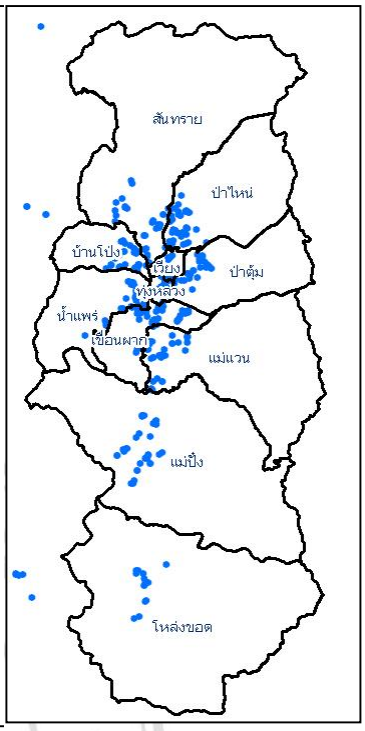

Figure 15-6 Well Locations

4.2 Land Use Map

Each District must have a particular land use map that details all required information on longan production systems at the field level, which is the purpose of this research. In order to create the land use map, it was necessary to use orthophotos level 1:4000 and had a resolution where each pixel represented a distance of 0.75 meters. Next these photos were compared to the year 2006 land use maps from the Land Development Department which have a higher resolution but the same ratio of 1:4000. The next step required the combination of the old and new data in order to improve and update the land use map. The data from the on-site research were also inserted into the updated map to complete the required field-level details.

The 2006 land use maps from the Land Development Department show 39 types of land usage but without such detail as various small bodies of water, locations of small rice field, wells, and mixed fruit tree systems. Therefore, in order to improve the detail of the existing official land use maps, missing data were inserted into them using the digitization method through the ArcMap program. These improvements are displayed in Figure 16.

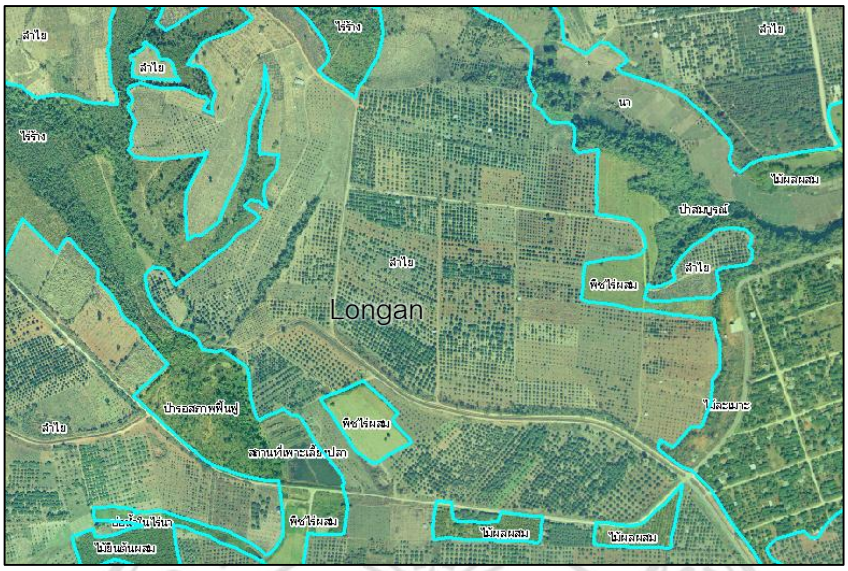

Figure 16 Improvement of a land use map.

There were many farms which had not been classified. These missing data were thus collected from the Chiang Mai Department of Agriculture. In the present research, it was observed that the popular fruit trees grown in Phrao District are longan and mango with a small extent of other varieties. A GPS was used to collect data throughout the research field and sample site. Then the location of each type of fruit being produced was designated on the land use map. Mango farms are mostly located in the northern area of the study site, that is, mostly in San Sai, Ban Nai, Ban Pong, and Nam Phrae sub-district. Longan is grown all over the studied area. The ground survey by the research in the field provided enormous useful information, such as the type and age of the plants as well as the locations of the farms. The data from each sampled location were combined with the data found in the ortho photos which enabled the comparison of the type of tree to the growth and age of its canopy. The information collected from the training site was a great help in labeling the images in the ortho photos. This will aid in processing the information seen in the photos. Next, the digitization method was used to create a boundary on the map which separates the longan farms from the mango farms. The age of longan trees was determined based on the size of tree canopies, since the two factors are directly related, as well as based on the primary data collected at each farm.

In order to determine where the boundary should be placed between the mango and longan plantations, a photo of the land taken in January was used. The photo clearly showed the mango trees in bloom so that it was easy to identify them. Figure 17 shows

that the two types of fruit trees can be easily told apart when the mango trees are in bloom.

Figure 17 The visual difference between longan and mango plantation on field.

The boundaries of longan and mango planted areas, and the age of longan trees in each field are shown in Figure 18.

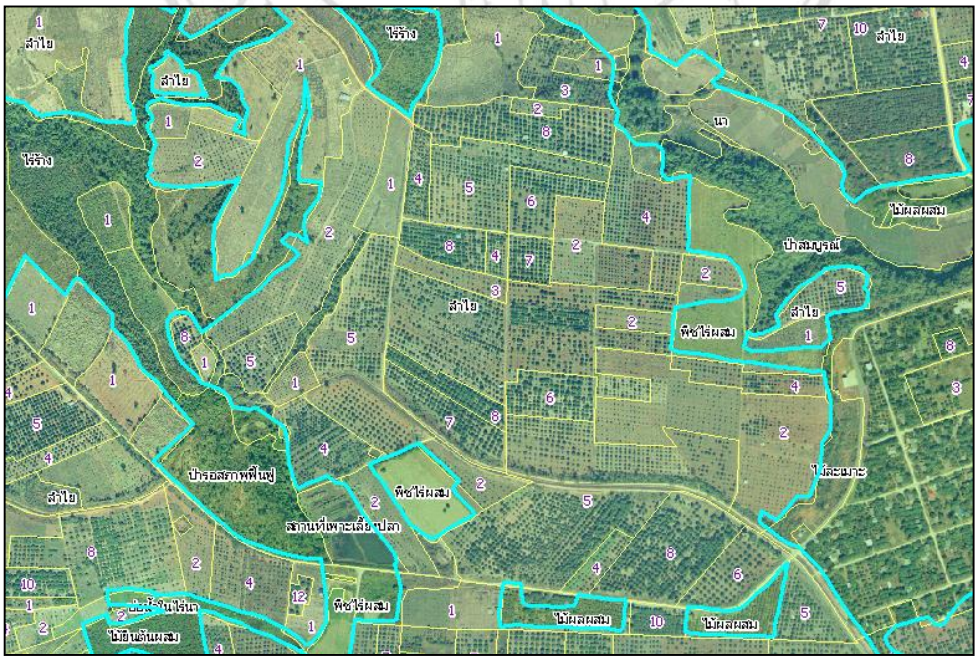

Figure 18 The results of the field research on the age of longan trees.

All of the steps taken in the field research resulted in the possibility to made improvements to the exiting land use maps. Additional details about the types of land utilization were inserted to improve accuracy and completeness of the land use maps. This enabled the development of a land mapping unit (LMU), which is useful for creating an effective longan production ecosystem.

4.3 Land Mapping Unit (LMU)

The LMU consists of the layered data including the land use maps, the irrigation systems area, and the percentage of land slope. Using spatial overlay analysis with the ArcMap program, the lands under longan were grouped based on their land slope and irrigation systems (Figure 19).

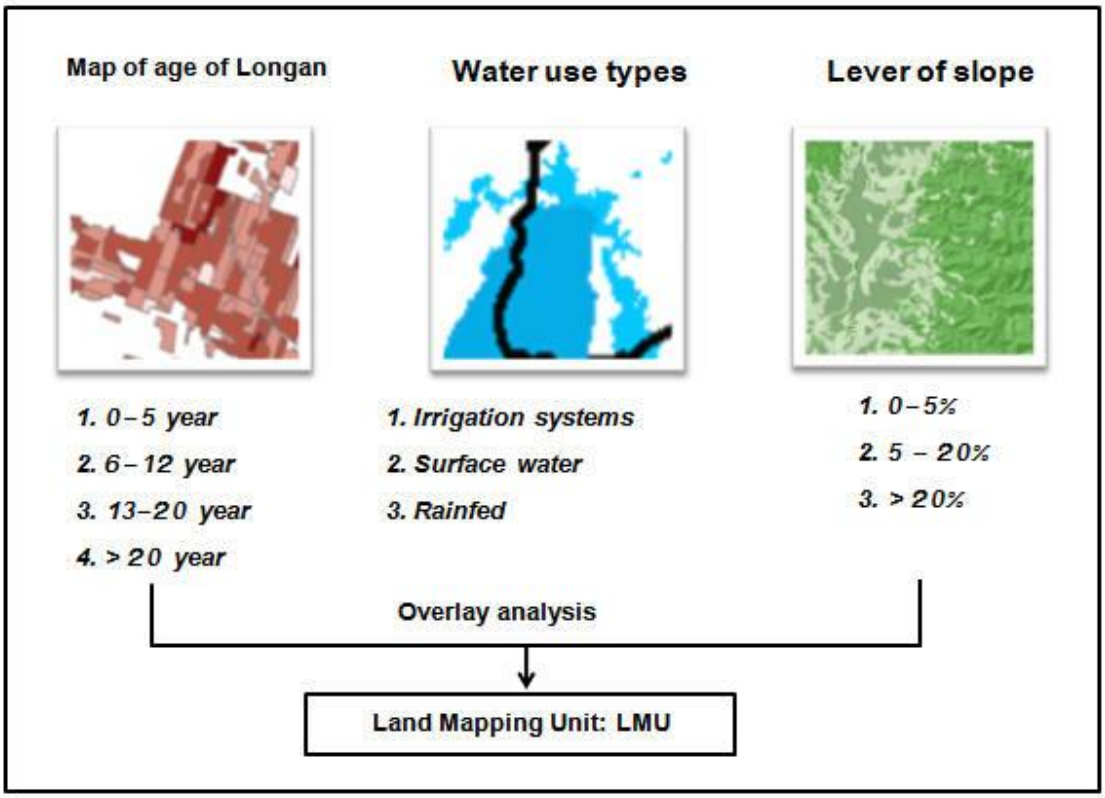

Figure 19 Framework for creating an LMU

4.3.1 Longan Orchards

The land use map was used to determine the total area in rai under longan production in the studied site, which was found to be 40,401 rai. This number is larger than that initially reported by the Chiang Mai office of the Department of Agriculture to

be 34,151 rai, based on the latter's field research and farmers' registration reports. Longan orchards can be distinguished into four groupings of age. Longan trees in each age group required difference crop care and management strategies depending on the stage of development. From interview with farmers, it was learned that longan trees do not require much attention for the first 5 years, but after that, more management is required, such as controlling the level of fertilizer application and the use of plant hormones. After 12 years, the farmers must begin trimming away the old branches of the matured trees, and the extent of agrochemicals application must increase until the longan trees past 20 years of age. At that point, the purpose of trimming changes toward encouraging the tree to bloom and produce more fruits. The details concerning the management of the longan trees determine which age group the trees are placed in for this study (Figure 20).

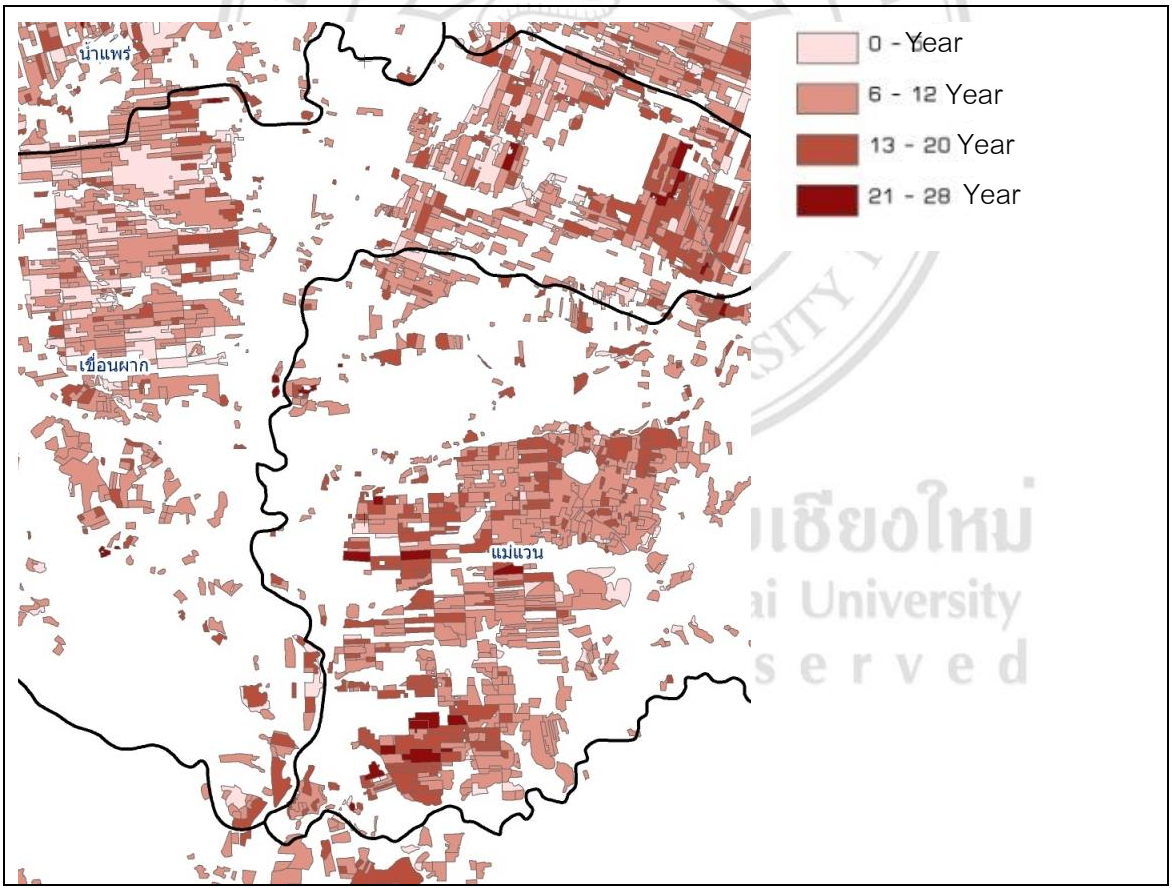

Figure 20 Longan orchards categorized by the four age groups.

Most longan trees in Phrao District fall into the age group of 6-12 years old, which is the average productive age of longan trees. At this stage of their development, the trees produce a lot of fruits. Altogether, there are 3,205 orchards in this District under longan trees. That is a total of 23,604 rai used. Furthermore, The most prevalent longan orchards are found in Kuan Phak, Mae Von, and Mae Pung sub-district. As for longan trees in the youngest group (0-5 years old), they are located in 691 farming sites covering with a total area of 6,153 rai. Young longan can be found all over the study site, but most densely in Kuan Phak and Pa Tum sub-district. Longan trees in third age group (13-20 years old) are found in 1,270 farming sites with a total area of 9,878 rai. They are spread throughout the areas of Mae Pung and Mae Van sub-district. In the final group are longan trees older than 20 years old located in 93 farming sites, coveing totaling 766 rai. They are found throughout the training site (Table 2)

Table 2 The Frequency and Area in each Age Classification of Longan Trees.

Code	Class of Age	Area (rai)	Frequency
1	0 - 5 years	6,153	691
2	6 - 12 years	23,604	3,205
3	13 - 20 years	9,878	1,270
4	21 - 30 years	766	93

4.3.2 Types of Watering

The collected layered data show the various types of watering used in Phrao District for the of longan production. From interview with grower, it was learned that most of them rely on rainfall, but some use irrigation to water their orchards while others use wells to access groundwater. Still others utilize water bodies of around their farming sites by pumping from medium sized or small reservoirs, or construct their own ponds, or simply use the rural community's public water supply, or even use water coming down from the mountains, etc. All these sources of water for farming were distinguished into three types of watering method: 1) irrigation systems, 2) mountain water supply or water bodies, and 3) and groundwater. The on-site findings on water sources were incorporated into the map of longan production areas, as shown in Figure 20. All other areas besides those shown in Figure 21 rely on rainfall.

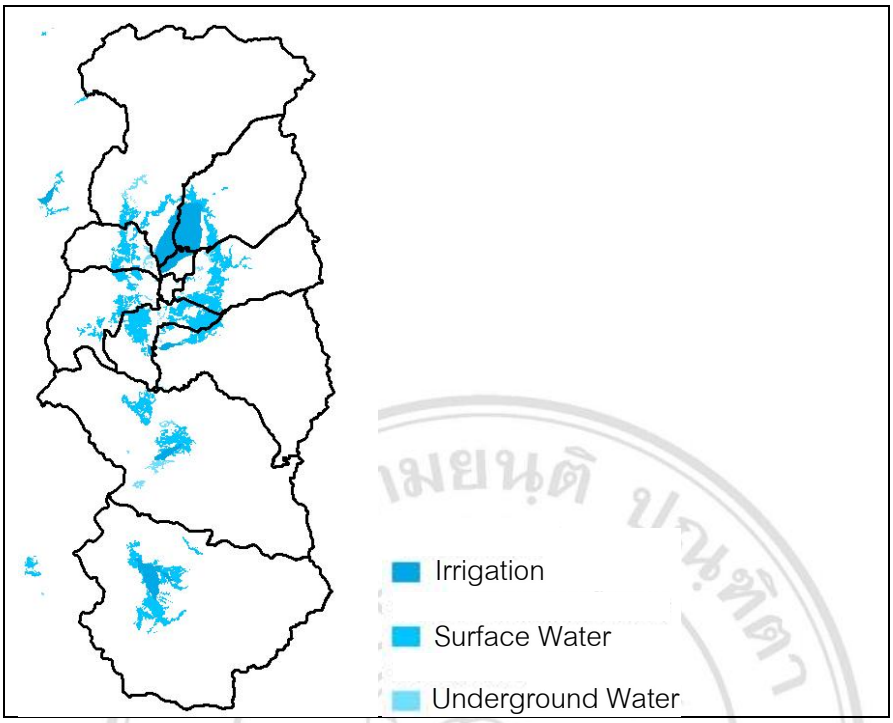

Figure 21 Water source for longan production.

According to the map in Figure 21, most of the irrigation systems are used in flat areas. These systems are also used for rice paddies and second crops. These areas are mostly found in the north of the training site. In total, the irrigation systems serve 17,224 rai of farm lands. Areas that use water from the mountains or water bodies or any size of well are found throughout the training site but especially in uplands. Surface water source is very important for longan production because a total of 46,934 rai of longan area depend on it. Areas that use groundwater are scarce, only total extent of 3,917 rai (Tables 3).

Table 3 The Frequency and Area of Different Water Source.

Code	Water Source	Area (rai)	Frequency
1	Irrigation	17,224	106
2	Surface Water and Water Bodies	46,934	208
3	Groundwater	3,917	31

4.3.3 Land Slope

A slope map was created based on a Digital Elevation Model of the land (DEM). The slope map was divided into three groups: gentle slope (0-5%), medium gradient

slope (5-20%), and steep slope (more than 20%). Slope is a key factor in managing the physical landscape for longan production (Figure 22).

Phrao District predominantly has land with slopes greater than 20% with a total of 1,042,928 rai. Most areas of this type are under forest leaving only a small portion available for farming. Land with slopes in the range of 5-20% covers 140,295 rai of Phrao. Most areas of this slope type are used for agricultural purposes, such as the production of fruit tree and various crops. Other areas are used for housing. Land with slopes less than 5% is used for rice fields and fruit production, as well as housing. This type of slope covers an area of 114,800 rai (Table 4).

Table 4 Slope class and area.

Code	Slope Class	Area (rai)	Frequency
1	0 - 5%	114,800	304
2	5 - 20%	140,295	747
3	More than 20%	1,042,928	184

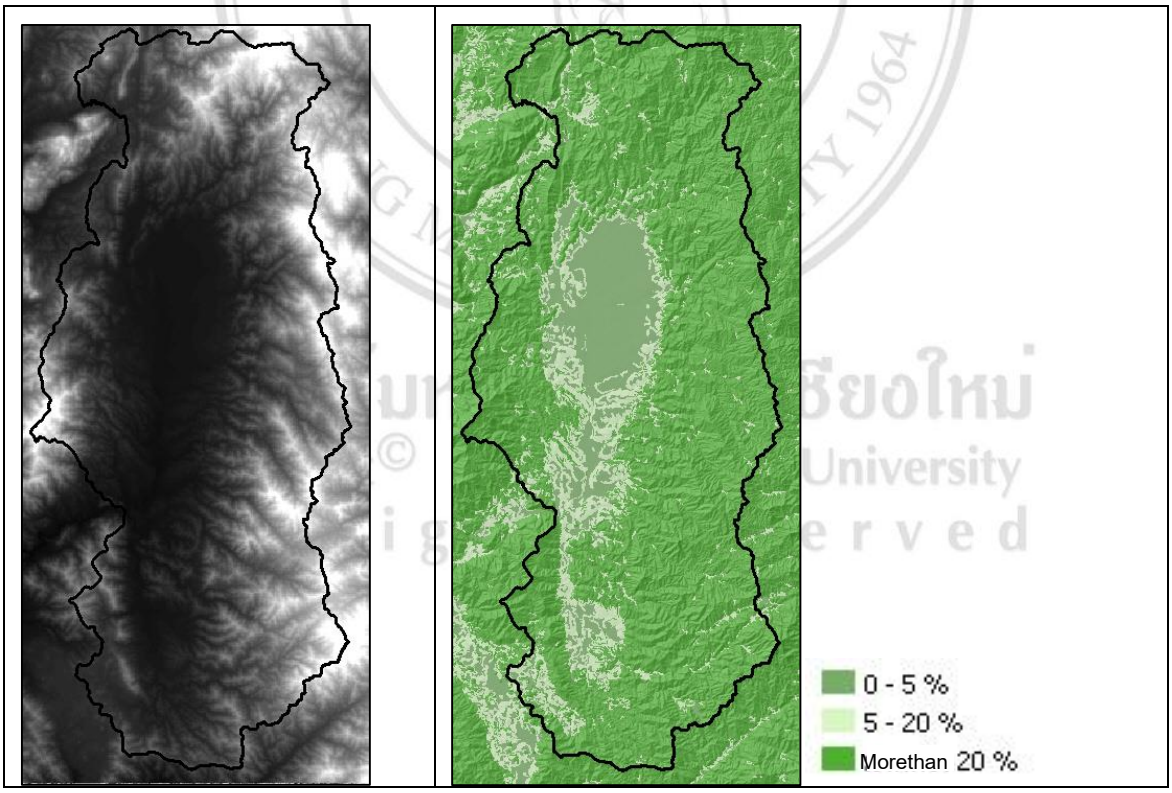

Figure 22 Digital Elevation Model (DEM) and slope map of the land.

4.3.4 Land Mapping Unit Map

Once all layered data were completed, they were used to create the Land Mapping Unit boundaries as shown in Figure 23.

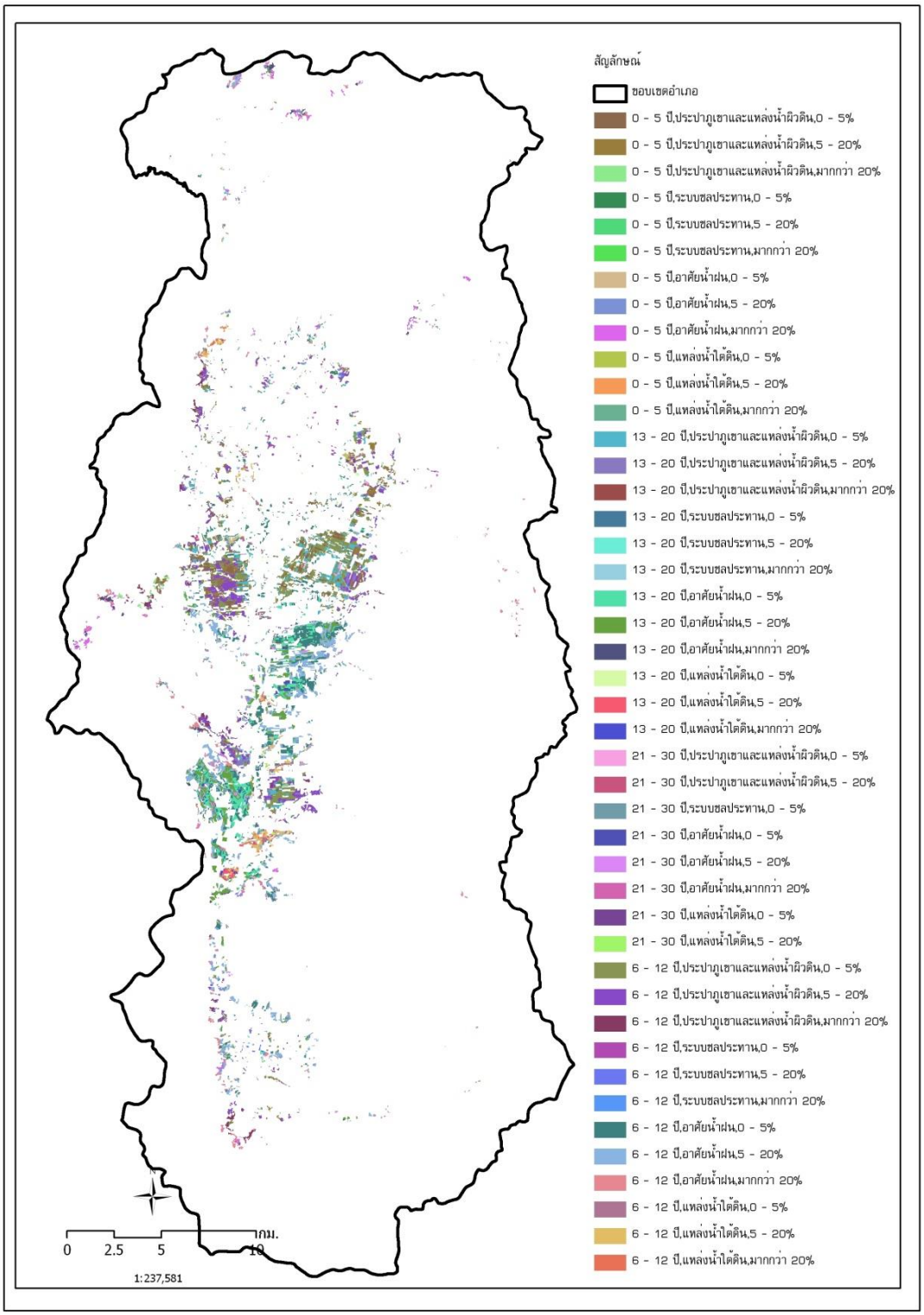

Figure 23 Land Mapping Unit Map (LMU).

The LMU map only represents the land devoted to longan production. Altogether, there are 44 map units. However some of them were considered too small to be studied. All areas less than 100 rai were not part of this study. The information in Table 4 was used as a reference when the number and locations of farms to sample were chosen for this study. Out of the 44, only 18 map units were chosen in this study (Table 5).

Table 5 The area of each LMU.

No	LMU	Area (rai)	Frequency
1	0 - 5 years, surface water and water bodies,0 - 5%	1,683	278
2	0 - 5 years, surface water and water bodies,5 - 20%	1,589	237
3	0 - 5 years, surface water and water bodies, more than 20%	253	110
4	0 - 5 years, rainfall only,0 - 5%	659	259
5	0 - 5 years, rainfall only,5 - 20%	834	390
6	0 - 5 years, rainfall only, more than 20%	917	320
7	6 - 12 years, irrigation,0 - 5%	338	109
8	6 - 12 years, surface water and water bodies,0 - 5%	5,014	641
9	6 - 12 years, surface water and water bodies,5 - 20%	3,655	532
10	6 - 12 years, surface water and water bodies, more than 20%	724	166
11	6 - 12 years, groundwater,0 - 5%	676	120
12	6 - 12 years, groundwater,5 - 20%	683	110
13	6 - 12 years, groundwater, more than 20%	168	36
14	6 - 12 years, rainfall only,0 - 5%	5,194	1,218
15	6 - 12 years, rainfall only,5 - 20%	5,361	1,158
16	6 - 12 years, rainfall only, more than 20%	1,697	728
17	13 - 20 years, surface water and water bodies,0 - 5%	2,103	345
18	13 - 20 years, surface water and water bodies,5 - 20%	1,154	275
19	13 - 20 years, surface water and water bodies, more than 20%	101	70
20	13 - 20 years, groundwater,0 - 5%	165	48
21	13 - 20 years, groundwater,5 - 20%	246	39
22	13 - 20 years, rainfall only,0 - 5%	2,661	523
23	13 - 20 years, rainfall only,5 - 20%	2,748	428
24	13 - 20 years, rainfall only, more than 20%	524	162
25	21 - 30 years, surface water and water bodies,0 - 5%	138	22
26	21 - 30 years, rainfall only,0 - 5%	264	56
27	21 - 30 years, rainfall only,5 - 20%	162	53

4.4 Sample Site

4.4.1 Stratify Sampling

A sampling was conducted to collect data for developing a LMU map based on controlled variables. This sampling contained the farms selected in each target area for the purpose of interviewing the farmers who own longan lands. The interview questions were designed to focus on various factors which affect longan production. Totally 150 farmers were interviewed, and the number of selections for each map unit throughout the training site as a whole depended on the size of each map unit area or in other words, number of selected farms varied proportionally with the area extent of the map unit. It was also decided that no map unit would have less than 5 farms to be selected from it. The selections for this case study are shown in Table 6.

Table 6 Farms Selected from the LMU Map Units.

No	Details from LMU	Area (rai)	Polygon	Polygon Chosen
1	0 - 5 years, surface water and water bodies, 0 - 5%	1,683	278	6
2	0 - 5 years, surface water and water bodies, 5 - 20%	1,589	237	6
3	0 - 5 years, rainfall only, 0 - 5%	659	259	5
4	0 - 5 years, rainfall only, 5 - 20%	834	390	5
5	0 - 5 years, rainfall, more than 20%	917	320	5
6	6 - 12 years, surface water and water bodies, 0 - 5%	5,014	641	19
7	6 - 12 years, surface water and water bodies, 5 - 20%	3,655	532	14
8	6 - 12 years, surface water and water bodies, more than 20%	724	166	5
9	6 - 12 years, groundwater, 0 - 5%	676	120	5
10	6 - 12 years, groundwater, 5 - 20%	683	110	5
11	6 - 12 years, rainfall only, 0 - 5%	5,194	1,218	20
12	6 - 12 years, rainfall only, 5 - 20%	5,361	1,158	20
13	6 - 12 years, rainfall, more than 20%	1,697	728	6
14	13 - 20 years, surface water and water bodies, 0 - 5%	2,103	345	8
15	13 - 20 years, surface water and water bodies, 5 - 20%	1,154	275	5
16	13 - 20 years, rainfall only, 0 - 5%	2,661	523	10
17	13 – 20 years, rainfall only, 5 - 20%	2,748	428	10
18	13 - 20 years, rainfall only, more than 20%	524	162	5

A well-rounded sampling was taken in order to represent the entire area of the training site. The longan growers from these selected sites represented the overall status of longan fruit production. The locations of these selections are displayed in Figure 24.

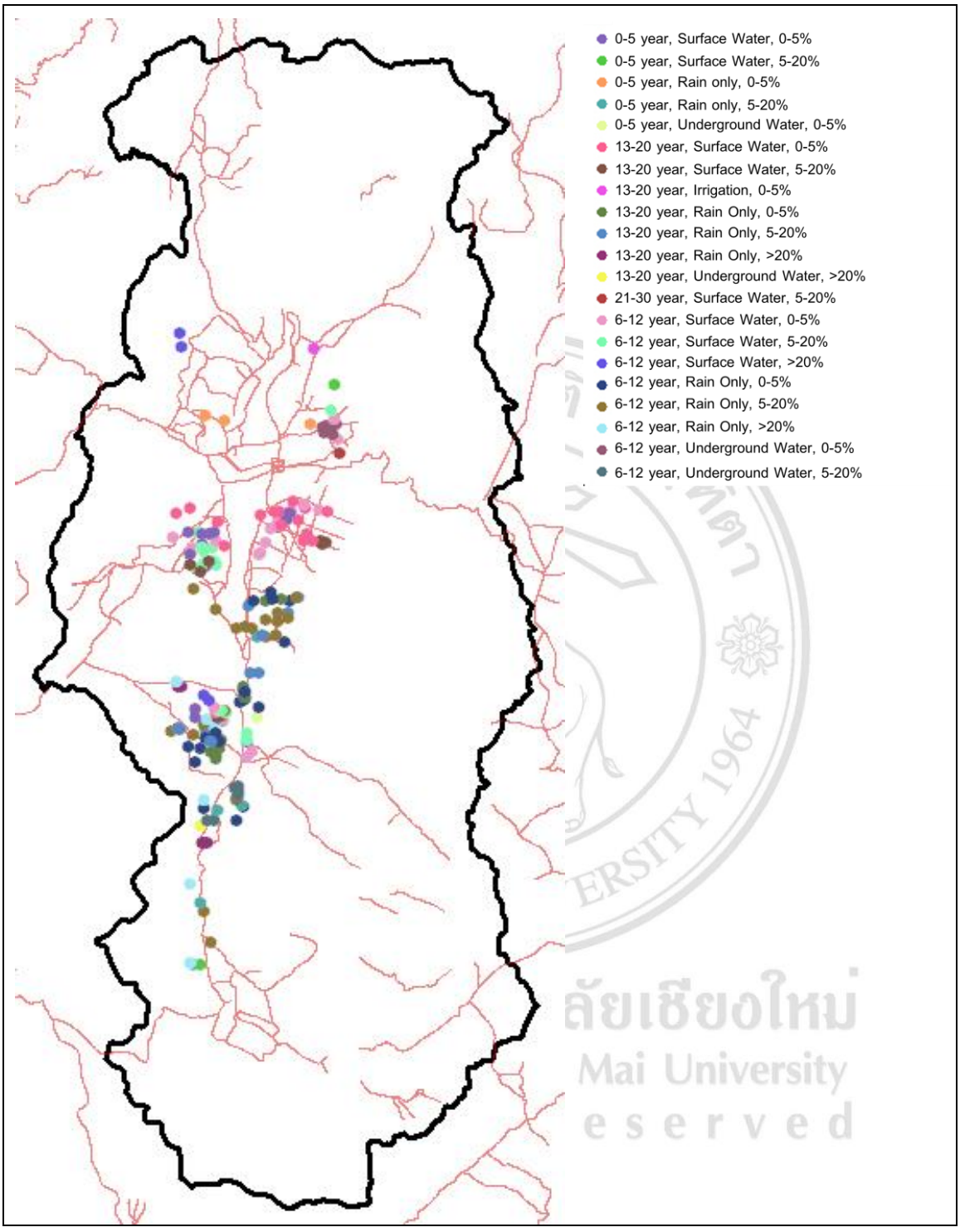

Figure 24 Orchard locations of longan farmers randomly selected for interviews.

4.4.2 Locations for Photographing Longan Trees

Thirty samplied orchards were selected out of the total already entered in the LMU map. Each of the 18 map units must have at least one farm selected from it for photographing but no more than 4 (Table 7).

Table 7 The number of orchards for photo taking

ID	LMU	Number of orchard
1	0 - 5 years, surface water and water bodies,0 - 5%	2
2	0 - 5 years, surface water and water bodies,5 - 20%	1
3	0 - 5 years, rainfall only,0 - 5%	1
4	0 - 5 years, rainfall only,5 - 20%	1
5	6 - 12 years, surface water and water bodies,0 - 5%	2
6	6 - 12 years, surface water and water bodies,5 - 20%	4
7	6 - 12 years, surface water and water bodies, more than 20%	1
8	6 - 12 years, groundwater,0 - 5%	1
9	6 - 12 years, groundwater,5 - 20%	1
10	6 - 12 years, rainfall only,0 - 5%	4
11	6 - 12 years, rainfall only,5 - 20%	1
12	6 - 12 years, rain only, more than 20%	1
13	13 - 20 years, surface water and water bodies,0 - 5%	4
14	13 - 20 years, surface water and water bodies,5 - 20%	2
15	13 - 20 years, irrigation,5 - 20%	1
16	13 - 20 years, groundwater, more than 20%	1
17	13 - 20 years, rain only,0 - 5%	1
18	13 - 20 years, rain only,5 - 20%	1
	Total	30

The selected locations are mostly concentrated in the middle of the research field, but a distribution range as wide as possible was attempted in order to get a well-rounded representation. The locations of each selected site can be seen in Figure 25.

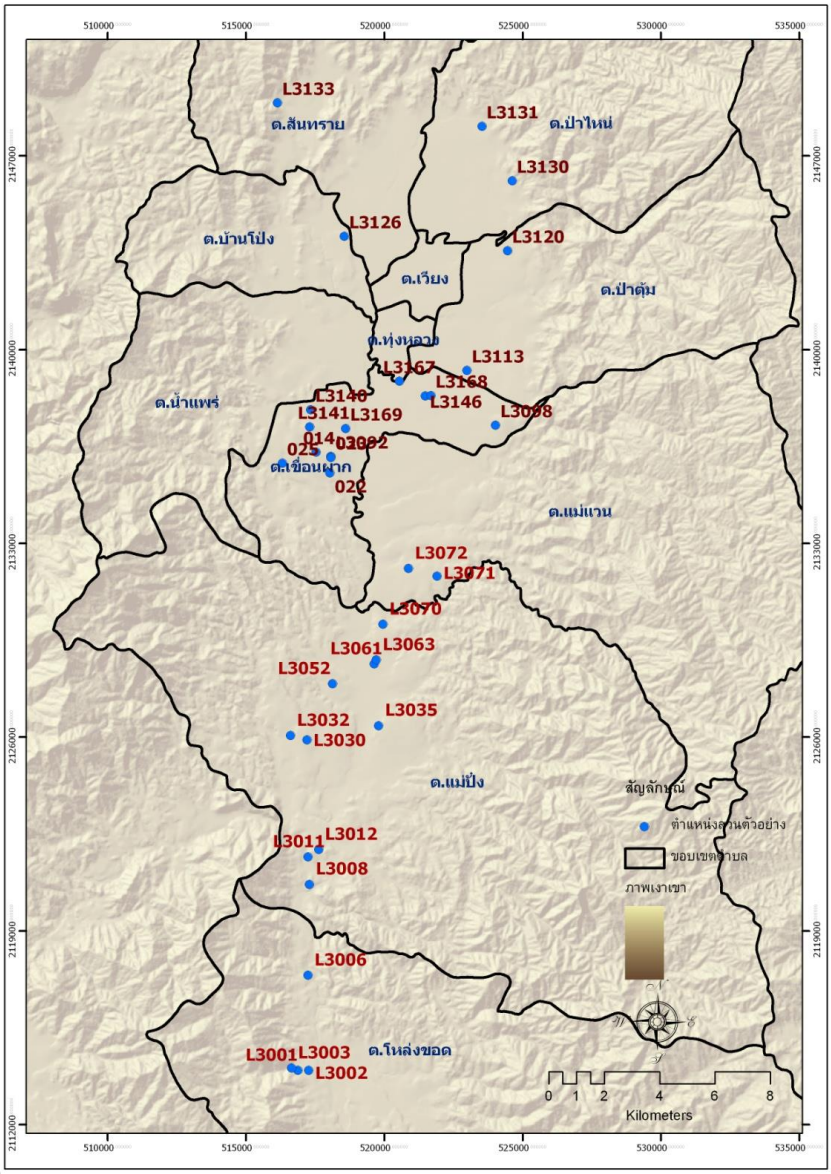

Figure 25 The farm sites selected for photographic documentation.