

## CHAPTER III

### GENERAL MATERIALS AND METHODS

#### 3.1 Study site description

The study sites were located in Thongphaphum District, Kanchanaburi Province in western Thailand. Three areas were selected based on differences in land management. Vimandin (‘วิมานดิน’) farm represented on the organic farming system, and a Durian orchard was chosen to represent the chemically-intensive farming. Finally, a forest site was located in Thongphaphum National park. These 3 areas are neighboring to each other. General information regarding land management in the study sites was collected using questionnaires, interviews, and observations.

#### **Kanchanaburi Province**

Kanchanaburi (14° 1' 10" N, 99° 31' 52" E) has an area of 19,483.2 km<sup>2</sup>, making it the largest of the western provinces of Thailand. Neighboring provinces are Tak, Uthai Thani, Suphan Buri, Nakhon Pathom and Ratchaburi. In the west it borders Kayin State, Mon State and Tanintharyi Division of Myanmar. Kanchanaburi is subdivided into 13 districts, which are further subdivided into 98 subdistricts (tambon) and 887 villages (mooban). The population density of Kanchanaburi was 38 inhabitants/km<sup>2</sup> in November 2006 (National Statistical Office of Thailand, 2008).

#### **Thongphaphum District**

Thongphaphum (14° 44' 45" N, 98° 37' 30" E) is a district in the northern part of Kanchanaburi Province (Figure 3.1). The area of Thongphaphum is 3,655.171

km<sup>2</sup>. Population density was 17.2 inhabitants/km<sup>2</sup> in November 2006 (National Statistical Office of Thailand, 2008). Thongphaphum is surrounded by Tanintharyi Division of Myanmar, Umphang of Tak province, Ban Rai of Uthai Thani province, Sangkhla Buri, Si Sawat, and Sai Yok of Kanchanaburi province. The important water resource is the Khwae Noi River. Thongphaphum, Lam Khlong Ngu and Khao Laem National Parks are located in the district.

The district is subdivided into 7 subdistricts, which are further subdivided into 44 villages. Thongphaphum itself is a township covers parts of the Tambon Tha Khanun. There are further 7 Tambon Administrative Organizations (TAO), i.e. Tha Khanun, Pilok, Hin Dat, Linthin, Chalae, Huai Khayeng, and Sahakon Nikhom. The district area consists of forest area mixed with agricultural lands, which includes mostly of croplands (cassava, corn, for example), and fruit orchards.



**Figure 3.1** Map of Thailand showing the location of Thongphaphum District, Kanchanaburi Province. (Thailandmap.net, 2008).

### **Climatic condition**

The climate of Thongphaphum is classified as tropical climate which is influenced by southeastern monsoon in rainy season and northeastern monsoon in winter. Annual mean temperature is approximately 28.0°C and average annual relative air humidity is approximately 70% (Meteorological Department, 2006). Average annual rainfall is 1,661 mm with ranges from 1,100 to 2,300 mm (Royal Irrigation Department, 2006).

Normally, summer is from February to April and winter is from November to January. April is the hottest month with the average temperature of 36.7°C, while January is the coldest month with average temperature of 15.8°C. However, critical minimum and maximum temperature might range between 6-42°C. Rainy season starts from early May to late October with the average rainfall of 1,765 mm yr<sup>-1</sup>. Dry periods cover about 6 months, from early November to late April having only 187 mm of rainfall equivalent to 10.6% of the annual rainfall during such period.

### **Selected study sites**

Three selected study sites included the organic farming area, as represented by Vimandin farm, the chemically-intensive farm, as represented by a Durian orchard and the forest in Thongphaphum National park, which was designated as forest conservation area. These 3 areas are adjacent to each other.

### **Organic farm**

Vimandin organic farm was selected on the basis that the farm avoids application of chemical fertilizers and/or pesticides. The farm relies only on organic inputs. Total area is 80 rai (0.128 km<sup>2</sup>). The Vimandin farm emphasizes an

intercropping system design for diverse production and pest management. There are various plants such as Burmese grape, mango, mangosteen, rambutan, *Parkia speciosa* (sa tor), star fruit, banana, neem, pepper, and flowering plants such as *Heliconia* sp. Products can be harvested throughout the year. The farm was occasionally irrigated in dry season.



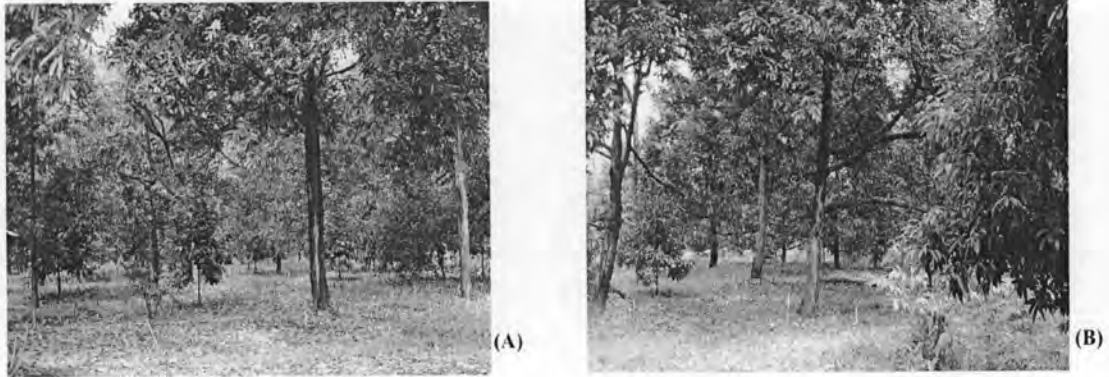
**Figure 3.2 (A and B)** The organic farm study site, Vimandin farm.

### **Chemically-intensive farm**

The chemically-intensive durian orchard was selected in an area adjacent to the Vimandin organic farm. It has the total farm area of approximately 130 rai (0.208 km<sup>2</sup>). In this durian orchard, intensive inputs of chemicals such as synthetic fertilizers, pesticides, and herbicides have been applied year-round. In dry season, during November to April, the orchard was irrigated every other day using sprinklers which transport the nearby brook, Huai Pak Khok.

Durian trees were planted in systematic rows. Rambutan and mangosteen trees were also planted in interspersed space. Durians were harvested in May to June, followed by branch cutting in July. After that, durian trees were nourished by applications of fertilizers. Manure and several formulas of chemical fertilizers were used as fertilizers. Pesticides used in this area included Glyphosate 48% as an

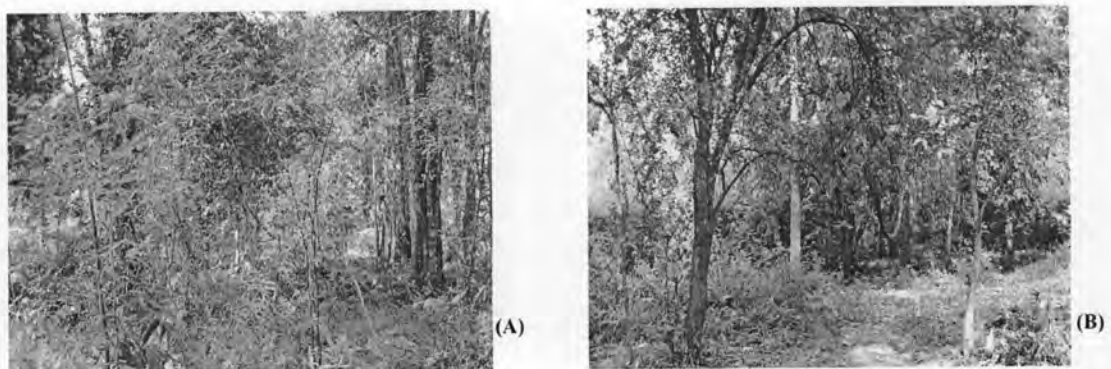
herbicide, Fenpyroximate as an acaricide, Omethoate as an insecticide, Chlorpyrifos and Metalaxyl as fungicides.



**Figure 3.3 (A and B)** Chemically-intensive farm, Durian orchard

### Forest

The forest site was located in Thongphaphum National Park, which was established in 1991 and covers a total area of approximately 700,000 rai (1,120 km<sup>2</sup>). Neighboring areas are Thungyai Naresuan Wildlife Sanctuary, Sai Yok National Park, Khao Laem National Park and Myanmar border. The selected site for this study is approximately 150 rai (0.24 km<sup>2</sup>) in size, and located in Huai Khayeng Subdistrict. The site is a complex limestone mountain supporting moist evergreen forest, and mixed deciduous forest. The park is the major habitat of large animals such as elephant, gaur, sambar deer, and tiger.



**Figure 3.4 (A and B)** The forest, Thongphaphum National park study site.

### 3.2 Soil sampling and collection

Soil samples were collected from study sites in two different seasons, namely dry season (February 2007) and wet season (August 2007), based on average monthly rainfall at Thongphaphum district, Kanchanaburi province during 1997-2005 (Royal Irrigation Department, 2006).

At each site, six 1x1 m<sup>2</sup> plots were randomly selected. In each plot, one random soil sample upto 15x15x15 cm<sup>3</sup> was collected with a spade and surface litter was discarded. All equipments were sterile, either autoclaved or cleaned with 95% ethanol. Each collected soil sample was divided into 4 subsamples for different analyses.

The first subsample of approximately 1 kg of fresh-moist soil was packed in a plastic bag and labeled, then air-dried, ground and 2 mm-sieved for texture, pH and nutrients analyses. For the second subsample from each plot, 200 g of fresh-moist soil was packed separately in a plastic bag and sealed for measurements of soil moisture and water holding capacity. The third subsample of approximately 100 g of fresh-moist soil was packed in a sterile 50 ml plastic tube (Corning<sup>®</sup>, USA). As soon as possible, these soil samples were stored at 4°C for culture-dependent methods of bacterial diversity analysis.

The last subsamples of remaining soil from the 6 plots of each site were pooled and mixed thoroughly. 100 g of the composite soil sample was taken from the composite mixture, and packed in a sterile 50 ml plastic tube (Corning<sup>®</sup>, USA). The mixed samples were kept at -20°C for molecular analysis of bacterial diversity. Air temperature, soil temperature at 15-cm depth, and relative air humidity in each plot at the sampling sites were also recorded.