

Huai Ma Nai Catchment: The MSEC Benchmark Site in Thailand (Based on Country Report)



Introduction

In Thailand, soil erosion has been identified as a major problem in sustaining agriculture on steep lands. It causes severe on- and off-site environmental and socioeconomic impacts. To address these concerns, the Royal Forest Department (RFD) and the Land Development Department (LDD) entered into an agreement with the International Board for Soil Research and Management (IBSRAM) in Bangkok to implement the collaborative project entitled, 'Catchment approach to combating soil erosion in Thailand' in 1999 under the umbrella of the Management of Soil Erosion Consortium (MSEC).

MSEC employs a new research paradigm based on a participatory, interdisciplinary catchment approach in mid- to long-term experiments (5–15 years) to assess the significance of sustainability factors on steep lands. Catchment studies will also be useful in quantifying the processes occurring within and the interactions among the different compartments of the ecosystems. The three key elements of this approach are: the focus on on- and off-site impacts, the provision of scientifically sound information for decision-makers, and the involvement of the whole range of stakeholders from land users to policy-makers.

Benchmark Catchment

Seven watersheds were pre-selected by the national authorities for consideration by the MSEC Mission. Based on the recommendations of the MSEC Cebu meeting in 1996, the selected catchments were evaluated for their suitability. From the seven sites visited by the site selection mission, three watersheds, namely, Mae Chaem, Mae Yom, and Khun Sathan were identified as the most suitable for the project. Khun Sathan Watershed was recommended during the MSEC assembly in February 1997, but was changed later to Mae Yom ([Figure 1](#)) after the Hanoi assembly in June 1998. The advantages of the Mae Yom Watershed as the representative MSEC catchment are: a) most of the land is agricultural area with many kinds of land use or crop diversity, and b) the moderately steep topography represents the steep land being eroded in Thailand. Huai Ma Nai catchment was further delineated within the Mae Yom watershed for more detailed [study \(Figure 2\)](#).

The Mae Yom Watershed covers an area of 102.8 km² about 550 km north of Bangkok. Within the watershed, a smaller catchment, Huai Ma Nai, was selected as experimental site for the MSEC study. It lies within the Mae Thang subwatershed. Huay Yai is located in Pak Huay Ooi village, Ban Wiang subdistrict, Rong Kwang District, Phrae Province at 18° 14' north latitude and 100° 24' east longitude and covers a total area of approximately 71 ha ([Figure 2](#)). The topography of Mae Thang subwatershed is rolling to mountainous with slopes ranging from 12–50%. The elevation is about 400–480 m asl. It can be

reached by travelling from Phrae along Highway no. 101 which links Phrae and Rong Kwang District and then by turning right on the provincial road no. 1134. The other biophysical and socioeconomic characteristics of the site are shown below.

Biophysical characteristics

Climate

The climate is influenced by two main monsoons causing rainy and cold seasons. The rainy season normally occurs between May to October. March and April is a transition period when the weather is hot and dry but in some years, unexpected rain occurs due to tropical depressions from the South China Sea. The cold season is from November to February.

Data recorded at the Phrae Meteorology station from 1974 to 1999 showed an average annual rainfall of 1,077 mm ([Table 1](#)). About 90% of the rainfall occurs during May to October with a peak in August or September. The distribution is considered sufficient relative to the evaporation rate ([Figure 3](#)). The temperature varies from a minimum of 15.3°C in December and January to a maximum of 37.5°C in April. The mean annual temperature is 26.8°C and relative humidity ranges from 82–95%.

Soil

The soils of the Mae Thang subwatershed are derived from siltstone, sandstone with intercalated limestone, shale, and phyllite ([Figure 4](#)). They vary from medium to fine texture, low to medium fertility, high to medium organic matter content, shallow to moderately deep, moderately drained to well-drained. They have moderate permeability and available moisture content. Most of them are not very suitable for upland crops because of the topography and dominance of gravel ([Table 2](#)). About 41% of the area is very well suited for fruit trees, although a large portion (about 53%) of the land still has shallow soil depth.

Water resources

Mae Yom Watershed is composed of four main streams. They are a) Mae Thang, b) Mae Khum Pong, c) Mae Terk and d) Mae Lai. Mae Thang originates from the mountain range in the east and runs down to Huay Hom village. It then passes through Pak Huay Ooi village, and down to Mae

Thang reservoir. Mae Khum Pong stream, which originates from many tributaries in Khun Sathan subdistrict in Nan Province runs down and joins the Mae Thang stream at Wiang village, Ban Wiang subdistrict, Rong Kwang District.

Mae Terk stream originates from many tributaries in the southeast, passes through Mae Terk mountain and joins the Mae Thang stream at Ban Boon Roeng village, Wiang subdistrict, Rong Kwang District. The Mae Lai stream, which captures all the three streams at Ban Wiang subdistrict joins the Yom River at Ban Mae Lai subdistrict, Muang District.

The MSEC site in Huay Yai is within the Mae Thang subwatershed. Huay Yai tributary comprises five small tributaries with dendritic patterns. They are: a) Huay Mee, b) Huay Ma Nai, c) Huay Bong, d) Huay Tong and d) Huay Yai. Except for the Huay Yai, water is present only during the rainy season.

Vegetation and land use

Mae Thang subwatershed used to be covered by mixed deciduous forest, but is now a degraded area and more or less totally cultivated. Field crops such as soybean and mung bean are the important crops grown. Fruit trees such as sweet tamarind, mango, litchi, and longan are planted in patches. A transect of the area that shows the different land uses in the landscape is presented in [Figure 5](#).

Soybean followed by mung bean is the common cropping pattern in the area ([Table 3](#)). In some areas, fruit trees such as sweet tamarind, mango, litchi, and longan are grown with soybean and mung bean. At present, many farmers plough their land every other year to reduce soil erosion and use chemicals and labour to control the weeds.

In the lowlands, the cropping sequence is mung bean/paddy rice/soybean or corn. Farmers usually apply small amounts of chemical fertilizer. The rotation with soybean is to improve soil fertility. A crop calendar is shown in [Figure 6](#).

Animal and fauna

Rabbits, rats, chickens, snakes, and wild birds are commonly seen in the area. Earthworms are found in places where the soil is moist and high in organic matter and in flat areas, gullies or streams.

Insect pests and diseases

Insect pest and diseases cause problems to farmers. The main diseases found are fungal and bacterial diseases such as rust, stem rot disease. The main insects found in the catchment are leaf worms, stem borers, pod borers, lice. Farmers spray chemicals at least two times per cropping season to prevent damage caused by disease and insect invasion.

Population

The experimental site is currently farmed by 50 families, all of them living outside of the area. About 92% of them live in Pong village, approximately 25 km from the site. Earlier, there were about 203 households in the village with 1,375 persons. At present, there are 489 households with 3,655 persons. Household size is from 3-11 persons with an almost equal ratio of male and female. The population density is about five persons per ha.

Settlement and land use history

Originally, Pong village consisted of two hamlets called sub-villages no. 4 and no. 10. These two hamlets were founded very long time ago. When the population increased, the villagers separated and built other hamlets called sub-villages no. 8 and no. 12. However, they are located around the same area. At present, there is no more in-migration to the village because no more land is available.

Pong villagers have a very close relationship with the land use history of Mae Thang subwatershed which dates back before the 1970s. In the past, Mae Thang was a mixed deciduous forest primarily with teak. Then logging activities caused deforestation and changed land utilization. Villagers occupy sloping land for their cultivation. The significant events that occurred in the area are shown in [Table 4](#).

Composition of village population

About 90% of the Pong residents working in the site are 20–60 years old, compared to about 75% of the total population who are 16–65 years old. They are all farming households with minimal education reaching only the primary school level. Farmers cultivating the site have about 3–4 persons per household with 1–2 persons available for labour. About 70% of the farmers have upland farms of 0.96–3.2 ha. Almost all of the farmers have at least one piece of equipment such as small tractor and sprayer.

Farming is the main occupation and source of income of the people in the catchment. Others are engaged as hired labour, traders, weavers, or in bamboo handicrafts. Of the available labour, about 65% does not have not enough time to work off farm. The total annual family income of the 87% of the on-site farmers is less than US\$857 per annum.

Access to markets, agricultural information and credit

The farmers sell their agricultural products in the nearby town about 19 km from the village. They use public transport to the market. About 50% of on-site farmers own a vehicle (motorcycle or car) which they also use to transport their products.

Agricultural information and knowledge mainly come from local agricultural extension workers. Farmers complain of the lack of technical knowledge on growing alternative crops. Extension services are virtually non-existent.

The Bank of Agriculture and Cooperatives primarily provides the credit services in agricultural activities. The bank provides not only agricultural loans but also the special financing schemes under the various government programmes. Because of the low agricultural income of the farmers, the bank suffers from low repayment.

Local organizations

The RFD operates 18 watershed research stations in Thailand. One of them is the Mae Yom Watershed Research Station in Phrae Province. It was established in 1982 in Rong Kwang District, near the experimental site. The area of responsibility covers the Mae Thang subwatershed. Its main functions are to carry out research related to watershed management and to identify the impact of human settlement and land use on water quality and quantity in the watershed area (Saifuk, 1998).

Land tenure and conflicts

Most of the catchment area lies within the boundary of Mae Khum Pong National Forest Reserve. Conflict over the land between the government and farmers who encroach on the forest was common more than 10 years ago for farmers who had occupied and cultivated land within the national forest reserve for a long time. As a result, the RFD has allocated certain areas for cultivation and granted land titles through the Land Reform Department. The problem has been minimized but encroachment still continues on a small scale.

Relevant policies

In 1996, the Thai government under pressure from farmer's organizations and NGOs, launched a countrywide programme to allocate land to landless people who had been living in state forests. As a result, parts of the research area in Mae Thang sub-watershed are used for cultivation. Only pockets of forests with compact poor soils remain scattered over the Mae Thang subwatershed. Farmers were granted a maximum of 2.2 ha per family. However, some families have more area as they are able to buy the land allocated to others. Those who sold their land have start forest encroachment again with the speculation that the government will run a similar scheme some time in the future.

Table 1. Monthly rainfall and temperature from 1974–1999.

Month	Rainfall (mm)	Temperature °C		
		Maximum	minimum	Mean
January	7	30.9	15.3	23.1
February	12	33.5	16.9	25.2
March	23	36.3	20.9	28.6
April	83	37.5	24	30.8
May	167	35.3	24.5	29.9
June	121	33.6	24.5	29.1
July	148	32.4	23.8	28.1
August	209	32.1	24.4	28.3
September	186	32.3	23.8	28.1
October	90	31.9	22.6	27.3
November	23	31.1	19.4	25.3
December	8	30.5	15.3	22.9
Annual	1,077	30.8	22.9	26.8

Source: Phrae Meteorology Station.

Table 2. Soils and slopes of the selected microcatchments.

Soil series name	Slope (%)	Area (ha)				
		Mee	Manai	Bong	Tong	Yai
Li Clayey-skeletal, mixed, semiactive, isohyperthermic, shallow, Ultic Haplustalfs	12–20	-	-	-	-	2.3
	20–35	3.1	3.5	-	-	7.6
	35–50	-	0.5	2.9	3.4	15.7
Muak Lek Clayey-skeletal, mixed, semiactive, isohyperthermic, shallow, Ultic Haplustalfs	20–35	-	2.2	-	-	3.7
Wang Saphung Fine, mixed, active, isohyperthermic, Typic Haplustalfs	15–20	-	-	0.8	0.6	5.2
	20–35	7.3	-	-	2.5	9.8
Tha Yang Loamy-skeletal, siliceous, isohyperthermic, Kanhaplic Haplustults	20–35	-	2.4	-	-	26.8
Total		10.4	8.6	3.7	6.5	71.1

Table 3. The present land use in the selected microcatchments.

Land use	Area (ha)				
	Manai	Mee	Bong	Tong	Yai
Soybean	4.925	6.75	0.275	3.325	43.45
Tamarind	4.875	0.825	-	-	6.55
Shrub	-	1.1	-	0.95	11.35
Tamarind and shrub	-	-	3.475	0.2	6.6
Mango and tamarind	-	-	-	1.525	1.55
Soybean and tamarind	0.6	-	-	0.5	1.6
Total	10.4	8.675	3.75	6.5	71.1

Source: Watershed Hydrology Sub-division, LDD (Aug, 2000).

Table 4. Key events in the history of the Mae Thang subwatershed.

YEAR	KEY EVENT
<1970s	The catchment area had a mix-deciduous forest with teak as the major tree.
1970	Private timber company was permitted to cut trees; a few farmers started growing upland rice, cotton, and corn on the deforested land; due to low productivity they stopped growing 1–2 years later.
1971–1972	A few farmers grew soybean on the deforested land.
1977	A gravelly earthen road was constructed downstream and passed through the site uphill.
1979	Many farmers cultivated upland rice because of lack of paddy fields to produce sufficient rice; some farmers grew soybean.
1980	More farmers occupied more land.
1982	High-yielding varieties and chemical fertilizers were introduced by credit personnel and middlemen.
1970s–1982s	The slash-and-burn technique was generally practiced for land preparation.
1983	Many farmers changed corn to soybean and grew mung bean as a second crop; small tractors and herbicides were used.
1989	All of the area was occupied; farmers grew fruit tree such as sweet tamarind, mango, and litchi.
1991–1992	2 small dams were constructed (Mae Thang and Mae Kum Pong dam).
1992	Local government officers established soil conservation demonstration plots and distributed sweet tamarind seedlings to farmers for planting as part of the conservation measures.
1995	Farmers observed topsoil loss and crop yield reduction; farmers improved their traditional land use practices by 1) ploughing across slope; 2) ploughing crop residues into the soil; 3) use of soybean trash to cover the soil; 4) minimum tillage and using herbicides in alternate years; soybean/mung bean were generally grown on upland areas.
1999–2000	Private company contracts farmers to grow a corn variety in the lowland area as part of its seed multiplication programme; some farmers abandoned their land in the upland area due to very poor soil conditions; some farmers stopped growing field crops because the fruit tree canopy shaded the annual crops below.

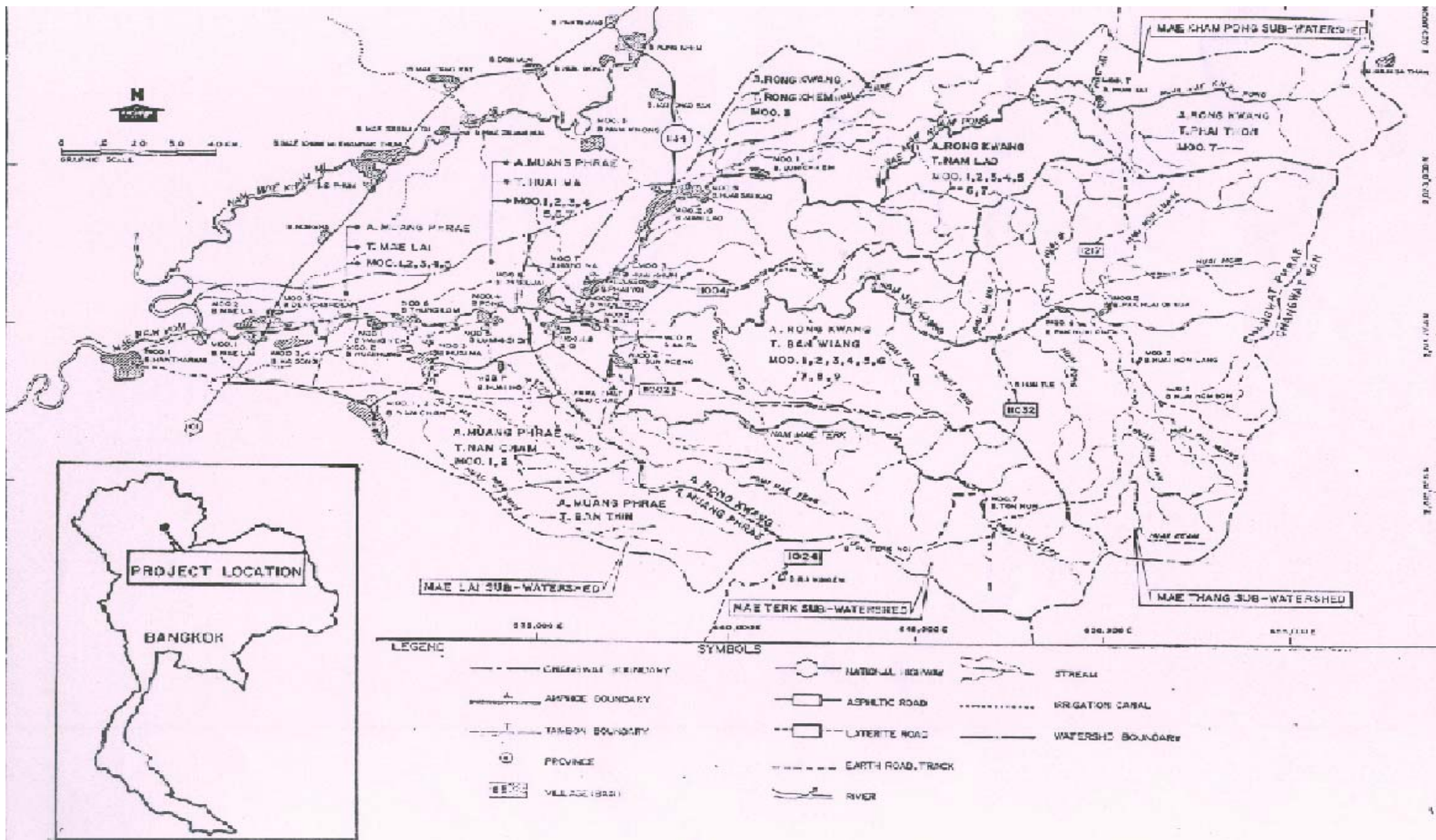


Figure 1 Mae Yom Catchment

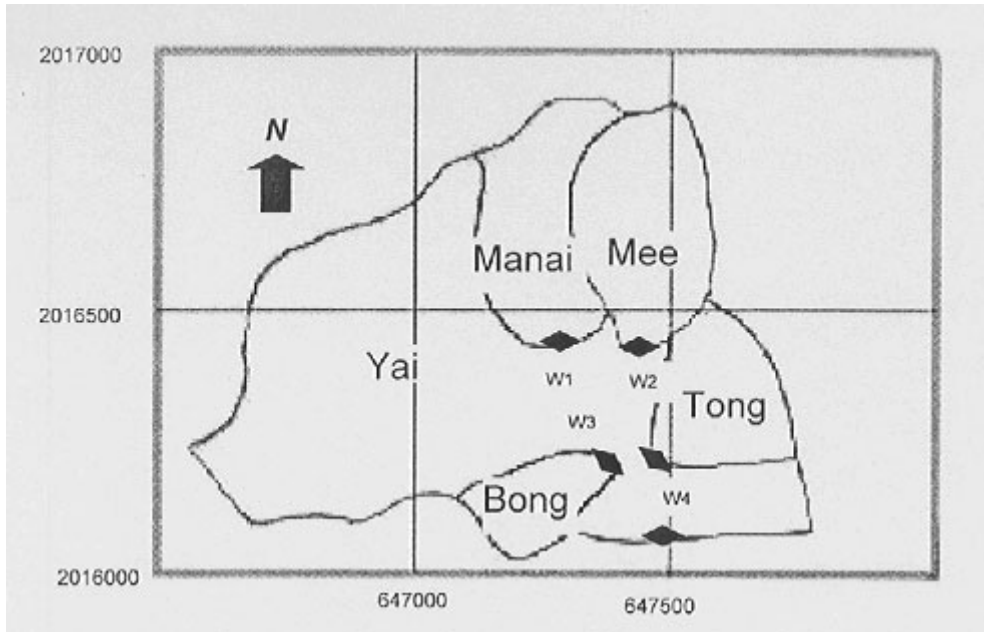


Figure 2 Huay Yai catchment and selected microcatchment (showing hydrological construction sites)

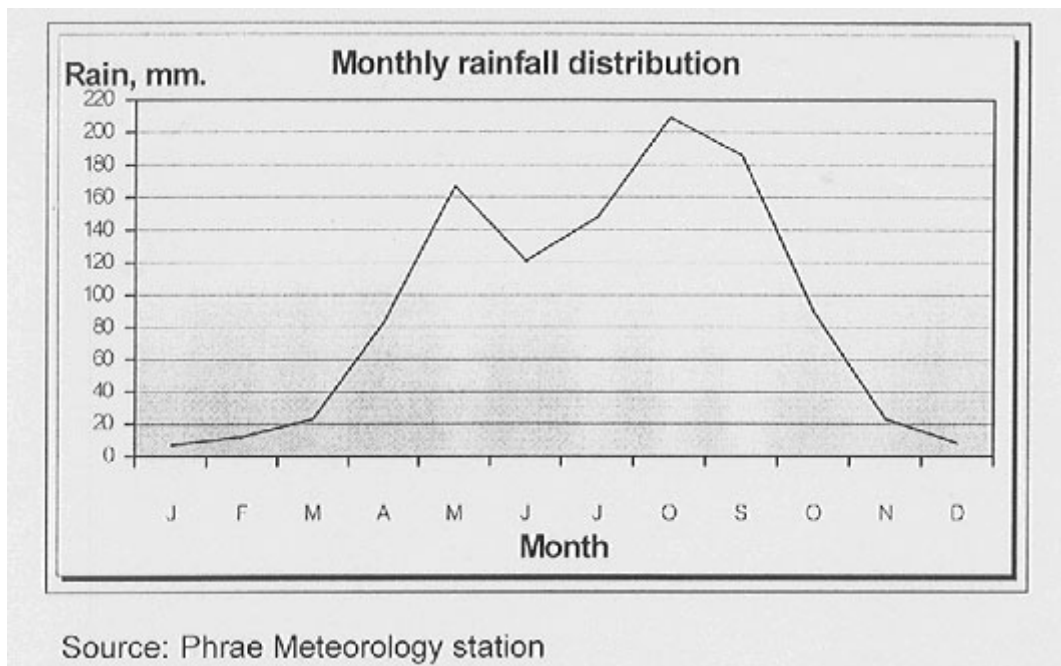


Figure 3 Average monthly rainfall from 1974 – 1999

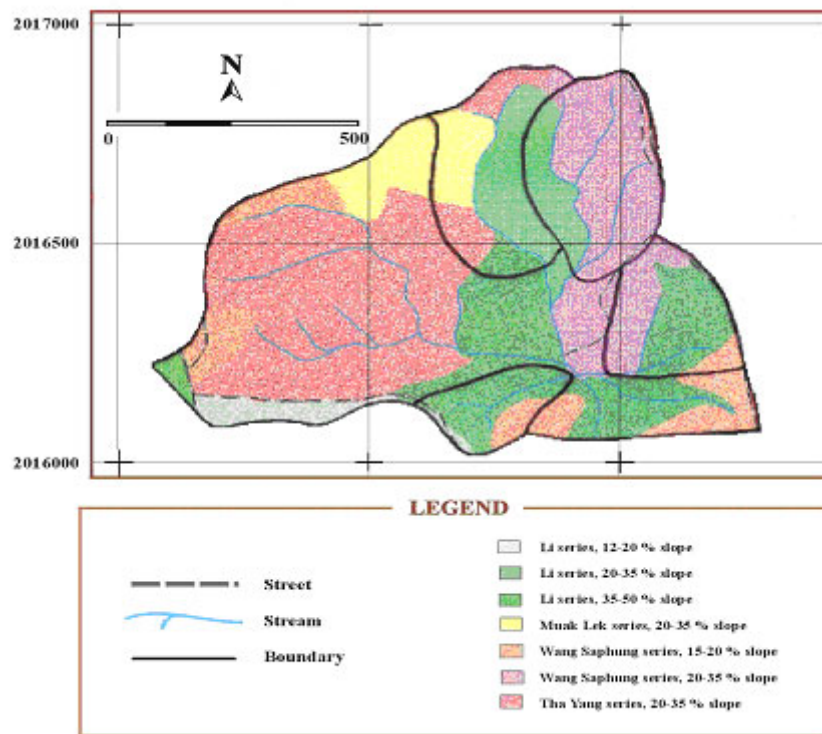


Figure 4 Soil map of Huay Yai Catchment

Insect pests and diseases

Insect pest and diseases cause problems to farmers. The main diseases found are fungal and bacterial diseases such as rust, stem rot disease.

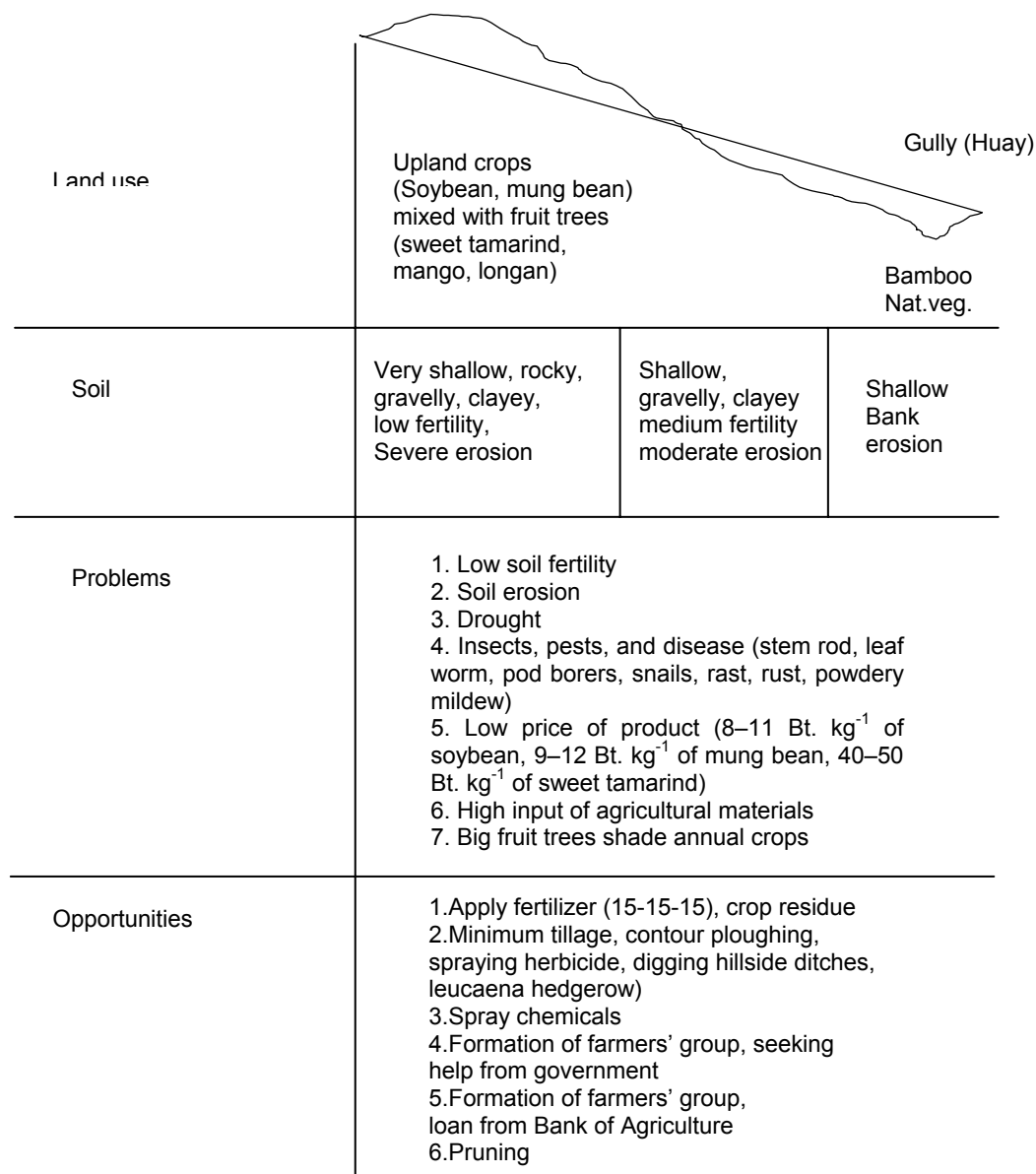


Figure5 Transect diagram

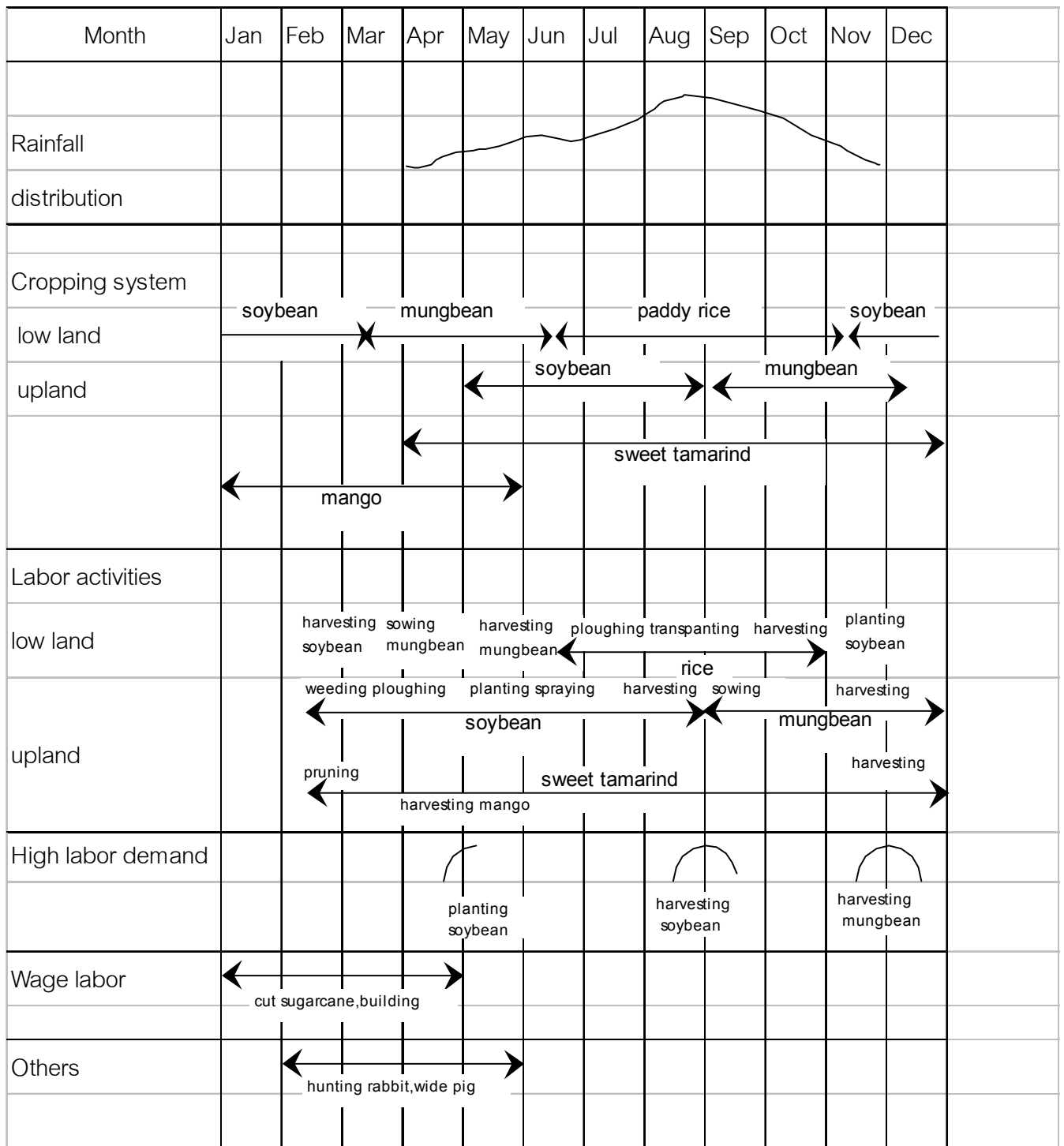
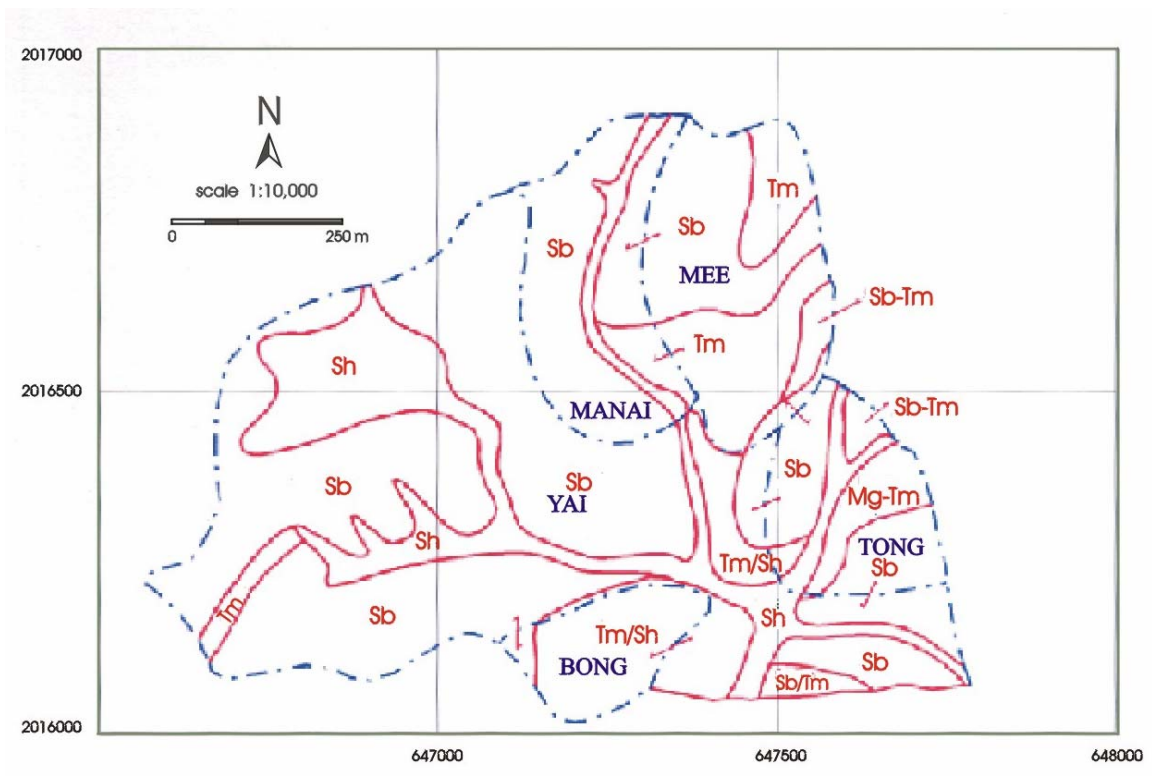


Figure 6. Crop calendar in Mae Thang subcatchment



Mapping unit	Description	Area		
		ha	%	
Sb	Soybean	43.45	61.1	<p>LEGEND</p> <p>--- watershed</p> <p>— landuse</p>
Tm	Tamarind	6.55	9.2	
Sh	Shrub	11.35	15.9	
Tm/Sh*	Tamarind/Shrub	6.60	9.3	
Mg/Tm*	Mango/Tamarind	1.55	2.2	
Sb/Tm*	Soybean/Tamarind	1.60	2.3	
* combination 70:30		Total	71.10	

Figure 7. Land use map of Huay Yai Catchment