CHAPTER 1
INTRODUCTION

1.1 Statement and significance of the problem

Chiang Mai basin is the biggest Cenozoic intermontane and structural basin in northern Thailand. Two big cities of Chiang Mai and Lamphun are located inside the large plain areas. Population of Chiang Mai and Lamphun is 1,488,892 and 385,313, respectively (Office of Central Civil-registration, Local Administration Department, 2001). During the past decade, the increase in population is about 0.06%, while industrial establishment in Chiang Mai rises about 1.39 times. Due to the population in the areas have increased rapidly and the cities are expanded very quickly, especially in Chiang Mai, groundwater resource have to be more exploited. However, the total amount of groundwater abstracted in Chiang Mai basin is not accurately known. Margane et al. (1998) reported the rate of annual depletion is about 0.2-0.5 meters per year. The highest rate occurs around Amphoe San Pa Tong and east and north of Changwat Lamphun. The groundwater level depletion is a damage sign to the groundwater resource of the basin. Effective groundwater resource management is required to protection and correction of the groundwater damage. Assessment of groundwater recharge is an important consideration of groundwater management. The accurate estimation is important for proper and effective management of groundwater systems.

There is a few study on groundwater recharge in Chiang Mai basin (Suvagondha, 1979; Suvagondha and Jitapunkul, 1982; Intrasuta, 1983; Wongpornchai, 1990 and Tatong, 2000). To reassess the recharge estimation of Chiang Mai basin, the present study reviews state of the art for estimating groundwater recharge. Many different existing methods for estimating groundwater recharge, such as water budgeting, direct measurement, tracer techniques, isotope dating, chloride mass balance (CMB), hydrograph analysis, Darcian approach, water table fluctuation (WTF), numerical modeling, etc. Each method has its own advantages and limited accuracy. It depends on field constraints and availability of field data. Choosing an appropriate method for a particular site is rather difficult. However, the WTF method is among the most widely applied. It requires knowledge of specific yield and changes in water level over time. In the present study, the WTF method has been adopted for estimating groundwater recharge because of its simplicity, quick estimation and the data used is already available.

1.2 Location of the study area

Chiang Mai basin is located in the northern part of Thailand, approximately 800 kilometers north of Bangkok, at latitude 18°30′N to 19°00′N and longitude 98°45′E to 99°15′E. The study area covers about 2,771 square kilometers. The two big cities situated in the basin are Chiang Mai and Lamphun cities. Location of the study area is shown in Figure 1.1.

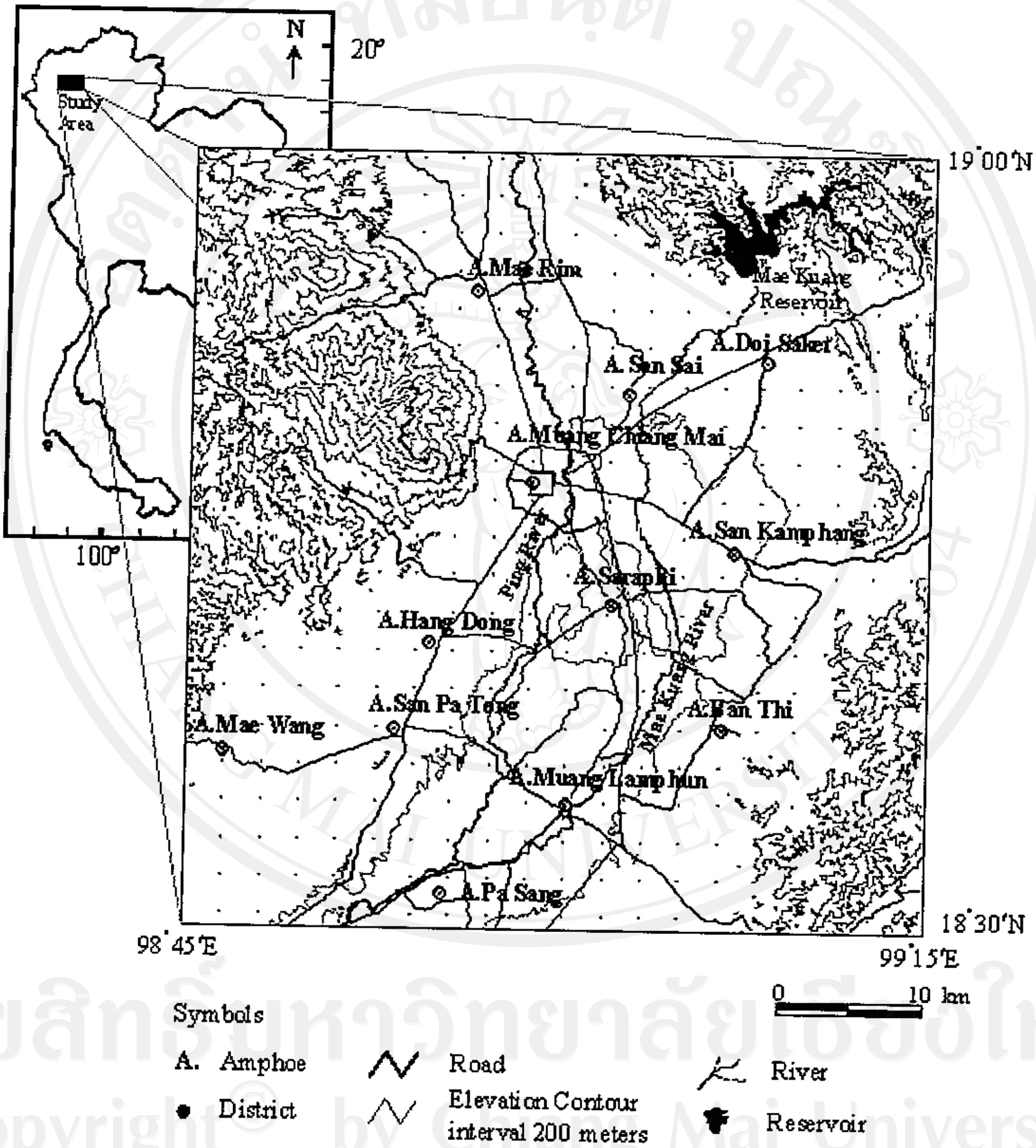

Figure 1.1 Location map of Chiang Mai basin.

1.3 Purpose and scope

1.3.1 To obtain a better understanding of various methods used for groundwater recharge estimation.

1.3.2 To reassess groundwater recharge of the Chiang Mai basin using the Water-Table Fluctuation (WTF) method.

1.4 Method of study

1.4.1 Review literature on hydrogeology of Chiang Mai Basin.

1.4.2 Review and familiarize techniques on estimating groundwater recharge.

1.4.3 Data compilation in monthly basis, including rainfall, temperature, relative humidity, cloudiness and wind speed, streamflow, groundwater level, and pumping test data. These available data are between 1967-2001 (Table 1.1).

1.4.4 Compilation and preparation of hydrogeological base map.

1.4.5 Derive the aquifer specific yield using two different approaches as follow:

(a) Water budget approach: using MATLAB code to estimate the potential evapotranspiration (*PET*) by means of Penman's equation. Changes in groundwater level (ΔH) over the inventory months can be measured by the recession curve method and the horizontal line method.

(b) Pumping test approach: using the computer program Infinite Extent Trial Versions to estimate the aquifer specific yield from pumping test data. Walton type curve for leaky aquifer is used in the estimation.

1.4.6 Analysis of groundwater table fluctuation. Data of groundwater table fluctuation are plotted as a function of time. The rise of water table (Δh) is set equal to the difference between the peak of the rise and low point of the trace lines at the time of the peak. The trace lines are horizontal line and recession curve. The groundwater table rises can be measured directly from the well hydrograph.

1.4.7 Calculation and analysis the groundwater recharge using water table fluctuation method.

1.4.8 Conclusion, discussion and recommendations of the study.

Table 1.1 Types and source of data used in the present study.

Types of data	Source of data
Climatological data including monthly rainfall, monthly mean temperature, relative humidity, cloudiness and wind speed.	Northern Meteorological Center, Thai Meteorological Department, Ministry of Information and Communications Technology.
Average monthly streamflow of Mae Nam Ping at Nawarath Bridge.	Hydrological and Water Management Center for Upper Northern Region, Royal Irrigation Department, Ministry of Agriculture and Cooperatives.

Table 1.1 Types and source of data used in the present study (continued).

Types of data	Source of data
Groundwater level from 19 monitoring wells (monthly basis), 11 wells with 10 years records and 8 wells with less than 10 years records.	Department of Groundwater Resources, Ministry of Natural Resources and Environment (Formerly Groundwater Division, Department of Mineral Resources).
Pumping test data from 41 wells which are constant rate pumping and single well test data.	Department of Groundwater Resources, Ministry of Natural Resources and Environment (Formerly Groundwater Division, Department of Mineral Resources).