

# CHAPTER I

## INTRODUCTION

### 1.1 *Nature and Importance of the Study*

One of the most effective factors in the destruction of the biosphere complexes is environmental pollution, especially by chemicals. Among all chemical contaminants, the trace elements (e.g. Pb) are chemical pollutants which are believed to have ecological, biological and health significance. These are probably caused by the rapid industrialization of the preceding decades that leads to population shifts from rural locations to urban centers. These industrialization and urbanization processes continued unabated worldwide. It is believed that the concentration of Pb in the ecosystems has increased to considerable amount especially in urban areas where man's activities are enormous. The man's impact to these ecosystems has led to irreversible changes which oftentimes these changes disturb the natural balance of each ecosystem and led to the degradation of the natural human environment.

Chiang Mai City is one of the urbanizing and industrializing cities of Northern Thailand. It is believed that because of the increasing pace of urbanization and industrialization, there is also a consequent increase in human activities, which as a consequence would exacerbate environmental degradation. Likewise, because of its

industrialization and urbanization process , there is a possibility of increasing demand for transport vehicles and as a consequence, a corresponding steady increase also in the amount of lead (Pb) in both arable and cultivated soil.

Soil is a very specific component of the biosphere. It is not only a geochemical sink of contaminants, but also acts as the natural buffer controlling the transport of chemical elements and substances to the atmosphere, hydrosphere and the biota. (Kabata-Pendias and Pedias, 1984 ) . The accumulation of lead in surface soil is of great ecological significance because this metal is known to greatly affect the biological activity of soil as reviewed by Tyler (1971), Anderson (1976a), Doelman & Haanstra (1979) and Hughes et. al. (1980). Thus , the fate of the anthropogenic Pb in soils has recently received much attention because this metal is considered hazardous to man and animals from two sources such as food chain and soil dust inhalation. Because of the hazards of lead to animals and man, scientists had been concerned with the understanding of the soil properties and processes (i.e. pH, organic matter content and clay mineral content ) which could influence the accumulation of this hazardous metal in soil.

Although the chemistry of soil contaminants presently has been subject to many studies, nevertheless, the knowledge of the risk assessment of lead has not yet been much emphasized. Thus, this study will be conducted that will focus on the

quantitative measurement of the degree of which this metal has accumulated in soil using the technique of atomic absorption spectrophotometry and risk was assessed using the lead immobility model and the Geographic Information System (GIS) by IDRISI Software.

One of the many environmental tasks in environmental monitoring and environmental resources management is environmental risk assessment. As defined by Nagel (1995), environmental risk assessment (ERA) is the analysis (identification and quantification) and evaluation of existing or potential (environmental) hazards to natural resources and to human health. This comprises the determination of the significance of effects on man, ecosystems or part of the ecosystems, including the assessment of the likelihood (or frequency) and severity of impacts and their consequences, especially with regard to stability and elasticity of ecosystems. Furthermore, Hunsaker et. al. (1993) stated that ecological risk assessment provides framework to enable a quantitative basis for balancing and comparing risk associated with environmental hazards and a systematic mean of improving the estimation and understanding those risks.

In the present technological advances, the Geographic Information System (GIS) is one of the useful information technologies in handling, analyzing and modeling geographic information for resource management (Goodchild, 1993). One of its main

to capture, manipulate, process and display spatial or geo-referenced data (Fedra, purposes is to process spatial information and its strongest and most successful areas of applications are addressed to problems in the environment. The GIS is also a tool 1993). Thus, the utilization of this technology may enhance the assessment of risk in the environment under study. Although there are many GIS Softwares present in the market today, the IDRISI Software was used in this study. The program is capable of mapping the risks through map overlays of many environmental factors. The mapping of risk is rather an abstract concept. However, it is easier to communicate with the use of GIS because it has the ability to integrate spatial variables into risk assessment models and maps. As central framework, this information technology also provides a variety of maps which is considered to be one as the powerful tools to communicate risk.

## ***1.2 Objectives of the Study***

### ***General Objective***

The general objective of this study is to assess the risk of the level of lead contamination in soil at different grids of Chiang Mai City using the lead immobility model and the Geographic Information System (GIS)

## ***Specific Objectives***

The specific objectives of this study are as follows:

1. To determine the level of lead in soil of Chiang Mai City using the atomic absorption spectroscopy (AAS)
2. To map and assess the risk of the present lead level in the soil of Chiang Mai City using the lead immobility model.
3. To map and assess the risk of lead contamination in the soil of Chiang Mai City using GIS -IDRISI Software.

## ***1.3 Statement of the Problem***

In an industrializing urban ecosystem like Chiang Mai City, is there a possibility of heavy metal (i.e. Pb) contamination in soil derived from several sources? If there is any, will the degree of contamination pose possible risks to human and animal health based on acceptable threshold limits?

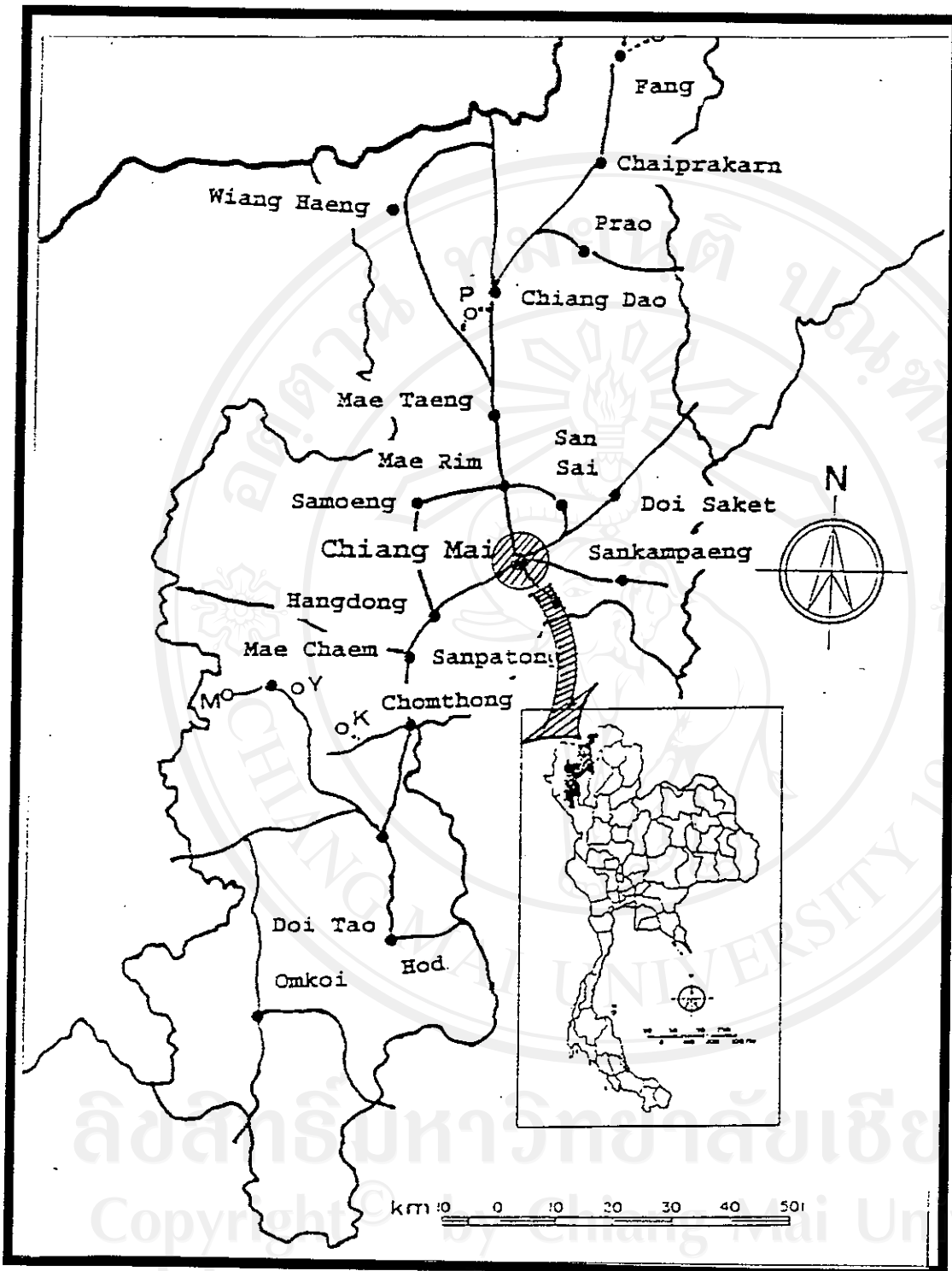
## ***1.4 Time and Place of the Study***

This study was conducted in Chiang Mai City from April 1996- September 1996.

### ***1.5 Location and Description of the Study Site***

Chiang Mai Province is located at the northern part of Thailand, the capital of which is Chiang Mai City that is the site of this study (Figure 1). It is situated at the Chiang Mai Basin which covers about 3,000 square kilometer that include both Chiang Mai and Lamphun Provinces. The basin lies between the latitudes 18° 00' and 19° 00' N and longitudes 98° 30' and 99° 15' E. and is the biggest intermontane basin in northern Thailand. The basin trends from north to south for approximately 140 km and is approximately 35 km wide. It is about 280-300 m above sea level and surrounded by mountain ranges between 800- 900 m high in the east and about 1,200-1,600 m high to the west. The highest mountain in the vicinity of Chiang Mai City is Doi Pui, which has an elevation of 1,685 m. The Ping River is the main river which runs through the City of Chiang Mai and flows southwestward to the reservoir of the Bhumibhol Dam.

The study area is centered on Chiang Mai City covering about 20 sq. Km (center) , comprising the old municipality of Chiang Mai and the urbanizing nearby areas (Figure2). The city lies in the alluvial plain of Chiang Mai Basin cutting across in the alluvial plain on both sides are the Mae Ping River and the Mae Kah Canal. The city is geographically located (center) between the latitudes 18° 49'10" N and longitudes 98° 59' 15" E. The old Chiang Mai City is surrounded by a moat which distinguishes the old city and the and expanded areas where continuous expansion and development are being undertaken. Generally, most of the areas in the city center are residential houses, temples and government offices.



**Figure. 1** The map of Northern Thailand showing the location of Chiang Mai City

