# CHAPTER 1
# INTRODUCTION

Air pollution is a major global problem that has been recognized throughout the world. Thailand, being a developing country with very visible environmental side effects from a rapidly growing economy and high population densities, has a growing problem with air pollution. In 1992, the United Nation Environment Program (UNEP) reported that the Thai capital was one of the most air-polluted cities in the world due to the city's notorious traffic problems (Energy Information Administration, 2003). It is estimated that around 48,026 $\times 10^3$ tons of $CO_2$, 214 $\times 10^3$ tons of $NO_x$ and 21 $\times 10^3$ tons of $SO_2$ are emitted due to transportation (Ministry of Energy, 2002).

Besides transportation, power plants, factories, construction, forest fires, agricultural burning and open cooking all contribute to the emission of pollutants, like dust, $PM_{10}$, $PM_{2.5}$, $SO_2$, lead, CO, $NO_x$, hydrocarbon, ground level ozone, etc. While air pollution certainly has regional and global implications, its most severe impacts are felt by people living in cities, where concentrations are highest. The report from the Ministry of Public Health (1998-2002) indicated that Lampang city has increasing numbers of respiratory problems. Kawaii (2003) referred to the study in the municipal area of Lampang city between 1996-1997, in which a correlation was found between $PM_{10}$, $NO_x$ and $O_3$, and the health problems of people. Since a high incidence of pollution-related health problems has been observed, this should serve as an important wake up call for the growing air pollution problem in Lampang city.

Air pollution has many direct and indirect adverse effects on human beings, animals and vegetation. Among the many atmospheric pollutants, nitrogen dioxide ($NO_2$) and sulfur dioxide ($SO_2$) are two major environmental concerns and are often included in air quality monitoring programs. They are relatively toxic and their increased concentrations in the atmosphere are due to anthropogenic sources. Anthropogenic $NO_2$ is mainly produced by fossil fuel combustion in urban areas. It plays a major role in the formation of ozone, PM, and acid rain. Short-term exposure, even less than three hours, to low levels of $NO_2$ may lead to changes in lung function in individuals with pre-existing respiratory illnesses and can increase respiratory illnesses in children. Long-term exposure to $NO_2$ may increase susceptibility to respiratory infections and cause permanent alterations in the lung (The World Bank Group, 2002). Anthropogenic $SO_2$ is emitted by energy reduction plants, industrial combustion and industrial process, particularly from roasted sulfide ores and combustion of sulfur containing fuels. People with asthma, the elderly and people with heart or lung disease are particularly sensitive groups (Manahan, 1999).

Therefore, air pollution monitoring of the primary air pollutants is very important as it provides data for pollution prevention and management. Although instrumental monitoring can determine the level of pollutants in the air, the data obtained cannot always indicate when humankind, fauna and flora are at risk (Batič, 2002). Using living organisms to monitor air pollution is an excellent alternative method since they can measure all the abiotic and biotic factors that can affect life. Moreover, bioindicators can clearly show the effects that particular pollutants and their mixture are having on biota.

Lichens are one of the organisms that have been used to assess air quality, due to their sensitivity to atmospheric pollutants such as oxides of sulfur, nitrogen, fluoride, heavy metals, etc. The use of lichen as a bioindicator of air pollution monitoring can provide a rapid and low cost method to determine polluted areas. This technique is very useful, particularly in remote regions, where it is often the only technique possible.

Various techniques have been used in the determination of air quality using lichens as bioindicators. The mapping of lichen is widely used, as it is easy and provides an estimate of the biological impact of air pollution, and give an integrated picture of air quality by supplying information on the synergistic effect of all the pollutants present in the atmosphere. This technique provides a valid, quick and economic way for assessing and mapping the long-range effect of pollution in a given area (LeBlanc *et al.*, 1972). Furthermore, it provides information as a human health predictor, as claimed by Cislaghi and Nimis (1997), who found a high correlation between lichen biodiversity and lung cancer in young male residents ( $r = 0.95$, $p < 0.01$) in Veneto region, Northeastern Italy.

However, one of the main problems for the general acceptance of lichen use in monitoring air pollution is the difficulty in finding a quantitative relationship between lichen data and actual pollution levels (Nimis *et al.*, 1990). Therefore, if lichen data are to be used to monitor and formulate regulatory decisions regarding air pollution levels, we need to know what levels are damaging to lichens and which gaseous pollutants are primary or contribute to the observed damage or distribution change of lichens (Nimis and Purvis, 2002). Thus, in this study the passive sampling technique was used to obtain the level of atmospheric air pollutants for comparison with the lichen data, since it can provide a high density of sampling points. Moreover, this technique is very cheap and feasible; hence it is the best alternative substitute for sophisticated instruments, which are infeasible and expensive.

Consequently, the main objectives of this study are; (a) To investigate air quality and produce an air quality map of Amphoe Mueang Lampang by using lichen diversity on mango tree trunks (*Mangifera indica* L.) (b) To correlate lichen diversity with air quality using passive sampling technique to determine concentration of $SO_2$ and $NO_2$ in ambient air. This pioneer study demonstrates for the first time that lichen data will be evaluated against air quality in the tropics. The hypothesis is that the lichen diversity are inversely proportionate to air pollutant concentrations.