CHAPTER I

INTRODUCTION

1.1 History of the problem

The research undertaken over the last 4 years by the International Water Management Institute (IWMI) and Department of Agriculture at Phatat Pha Daeng sub-district, Mae Sot district, Tak province of Thailand has found that there are significantly high concentrations of cadmium (Cd) in soils, and in rice grain and other agriculture areas. The result of this research by IWMI has shown that of over 500 samples collected in the area soil cadmium concentrations range from 0.05 – 284 mg/kg. Figures 1 and 2 illustrate Cd concentrations in soil and rice grain in their study area. Associated with these soil cadmium concentrations, concentrations within rice grains collected in this area are ranged from 0.05 – 7.7 mg/kg. These results show that over 90% of analyzed rice samples contain Cd concentrations that exceed the Codex Commission on Food Additives and Contaminants (CCFAC) Maximum Permissible (MP) Level of 0.2 mg/kg. Further more, all soybean samples collected from 76 contaminated fields had cadmium concentrations exceed CCFAC Maximum Permissible (MP) Level (Simmons et. al., 2003).

These levels of cadmium concentrations indicate a significant risk to the residents in the area who consume rice grain and other crops grown in contaminated fields. Results from several researches undertaken over 40 years show that the long-term consumption of cadmium contaminated rice is related to human cadmium disease as manifested predominantly by proximal tubular renal dysfunction (Osawa et al., 2001). This is further confirmed by the study undertaken on deictically exposed populations from non-rice growing areas, which did not show elevated levels of renal dysfunction in the exposed populations (Baker et al., 1997; Ewers et al., 1985; McKenzie-Parnell and Eynon, 1987; Strehlow and Barlthrop, 1988; Sarasua et al., 1995). Cd-induced renal dysfunction in individuals exposed to increased dietary-Cd is irreversible and progressive despite decreases in exposure (Nogawa and Kido, 1993). Moreover,

several studies have confirmed that Cd-induced renal dysfunction interferes with Vitamin D metabolism, which results in a decrease of calcium absorption and the occurrence of osteopenia and osteoporosis particularly, in multiparous women (Kido et al., 1990; Tsuritani et al., 1992).

Actually, the survey of blood and urine samples of 250 villagers in the affected area showed that 8 % of sample population showed indication of potential renal dysfunction (Ministry of Natural Resource and Environment, 2004). This ratio of renal dysfunction is significantly higher than the national average.

From the information described above, Cd contamination becomes a major concern both for health and farming practice for villagers nearly the area. Therefore, several measures have been proposed by related agencies. Consequently,a short term measure by government agencies is the prohibition for rice planting in order to avoid the problem of Cd uptake to plants and then transfer to the food chain. Therefore, this study aimed to investigate the farming practices that could reduce cadmium uptake to rice plant. This research proposed an investigation on the relation between cadmium, iron, manganese, and zinc concentrations in soil and soil solution, redox potential, and pH with rice plant cadmium uptake in order to clarify the parameters that show the highest effects on rice plant Cd uptake. In addition, this study determined different practices of rice plantation to investigate that are able to prevent Cd uptake in rice plant effectively.

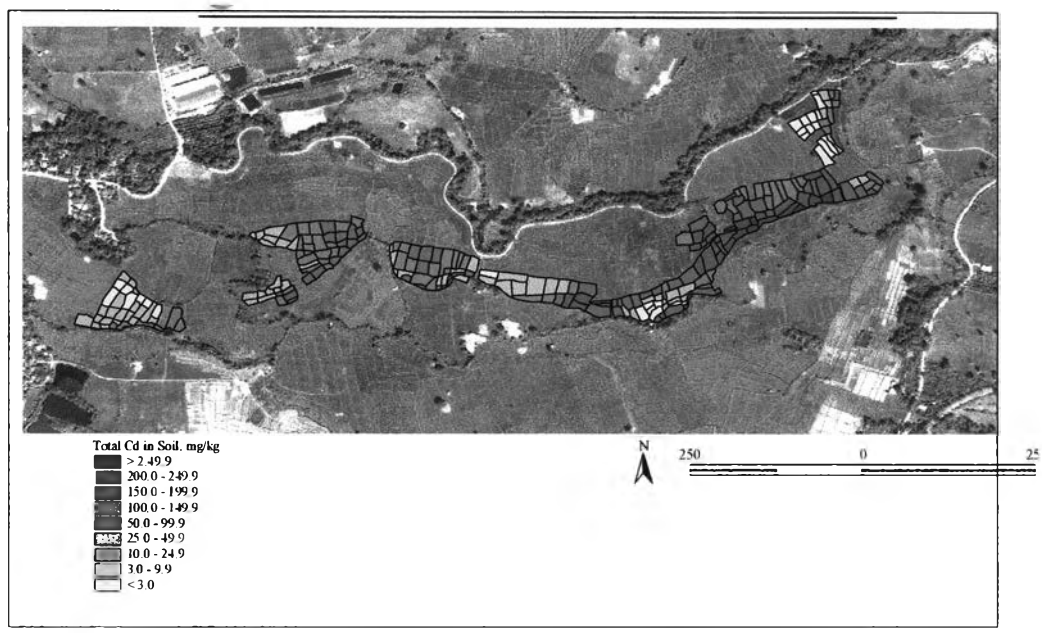

Figure 1.1 **Distribution cadmium concentrations in paddy soil at Mae Tao river basin, Phatat sub-district, Mae Sot district, Tak province, northern Thailand**

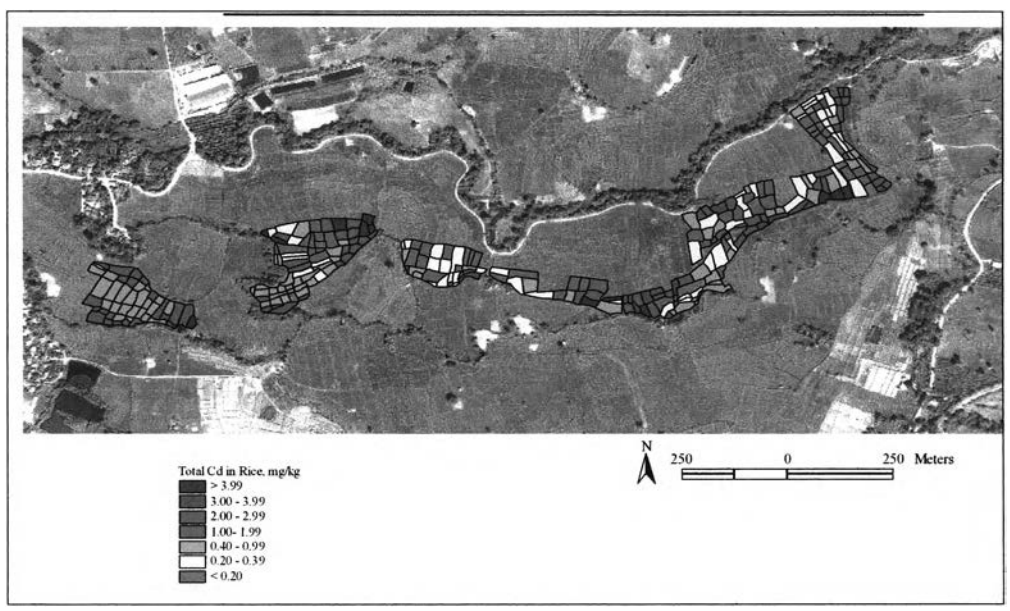

Figure 1.2 **Distribution of cadmium concentrations in rice grain grown in paddy field at Mae Tao river basin, Phatat sub-district, Mae Sot district, Tak province, northern Thailand**

1.2 Objectives of the study

The purposes of the study were to investigate the relation between pH and redox potential with cadmium uptake in rice plants in a cadmium contaminated area at Phatat Pha Daeng sub-district, Mae Sot district, Tak province, northern Thailand and to investigate the best practice for farming to minimize cadmium uptake in rice plants.

1.3 Scope of the study

The contaminated soils were transported from a contaminated area at Phatat Pha Daeng sub-district, Mae Sot district, Tak province, northern Thailand to the greenhouse at the Department of Agriculture, Kasetsart University. The rice plants were planted in the greenhouse only and greenhouse tap water was used for watering all rice plant in each pot as well as to maintain level of water in each pot. The soil redox potential and pH of soil solutions were measured within the greenhouse with a redox meter and a pH meter respectively. Soil samples and soil solution samples were transported and stocked in the refrigerator until analyzed and were analyzed at the National Research Center of Environmental and Hazardous Waste Management (NRC-EHWM laboratory). Plant samples were collected by Land Development Department (LDD), and sub-samples from LDD were transported to the NRC-EHWM laboratory and were analyzed at the NRC-EHWM laboratory.

1.4 Expected results

The best technique for rice planting which limits Cd uptake is expected to be obtained from the study result. Consequently, it can be further studied in the real paddy field to ensure the result as well as to consider other factors such as yield and applicable practice, etc for the farmers in the study area. It is also expected that the best practice can minimize the potential risk of the metals uptake to human health.