CHAPTER 1
INTRODUCTION

1.1 Rationale

Rice cultivation is the most important agricultural practice in Thailand. Thais consume rice as a traditional food plant. Moreover, the largest three rice exporting countries are Thailand, Vietnam and the United States. The paddy fields account for 10.66 million hectares or 50 % of agricultural area in Thailand. The rice production is 32 million tons in 2007 and the productivity is 3 ton/ha or 481 kg/rai (Agricaltural Statistics, 2007). Rice is normally grown as an annual plant. Produced together with rice grain is rice straw. Normally, rice straw is burned on field after harvest because of lower cost in doing so than any other practices. The open field burning releases several air pollutants such as smoke, particulate matter, ash and greenhouse gases (CO_2 and CH_4). The suitable rice straw management is necessary for avoiding the effects of rice straw burning on environments. Recently, due to concerns over the negative air quality effects of the traditional practice of rice straw burning the government has issued the legislation with National master plan for open burning control. They encourage the incorporation of rice straw into field for improving soil fertility as attractive choice of rice straw management. However, rice straw incorporation increases methane emission from paddy field (Neue et al., 1996; Bossio et al., 1999; Ma et al., 2009). Another significant effect of rice straw incorporated before transplanting has been associated with decreases in rice yield (Sass et al., 1991) because the production of organic acids which reduce seedling root growth.

Currently, more serious global warming problems result from the huge increase in greenhouse gases, such as carbon dioxide, methane, nitrous oxide and other gases. Greenhouse effect is a matter of concerns worldwide. The increased amounts of methane (CH_4) and other greenhouse gases (GHGs) have been induced by human activities. The agricultural sector is considered as the main anthropogenic sources of CH_4 and N_2O. Rice paddy, a unique anthropogenic wetland ecosystem, is commonly believed to play a crucial role in the global CH_4 budget. The total annual global emission of CH_4 rice field in a calculated from the OECD/IPCC default values is 33-49 Tg yr^{-1} (Sass, 2002). Major causes for variations of CH4 fluxes in irrigated rice fields are differences in residue-organic amendments, aeration periods, soils, fertilisation and rice cultivars.

The study of rice straw management to support sustainable agriculture in aspect of greenhouse gases emission and carbon budget should be undertaken. The rate and pattern of organic carbon application and decomposition affect to the rate and pattern of methane formation. Generally, addition of rice straw enhances methane production (Neue, 1996; Chidthaisong and Watanabe, 1997) therefore, the methane mitigation option with water management trialed in this study. Moreover, the rice straw management may effects to soil carbon. Thus, the demonstration of carbon budget calculated the carbon input and carbon output in rice field system. The flow of carbon throughout the biosphere, lithosphere, hydrosphere and atmosphere is one of the most complex and important of the global cycles. The carbon budget is currently the topic of great interest because of its importance in the global climate system and also because human activities are altering the carbon pool in soil. The hypothesis of this study are the suitable rice straw management with unburned could avoid the air pollution problem and trend to remain the carbon budget in rice field system.

1.2 Objectives

The main objectives of this project study include:

1.2.1 To find suitable cultivation practices for methane mitigation and rice production in a rice straw management system.

1.2.2 To evaluate the carbon balance in paddy soils using different rice straw management methods.

1.3 Scope of Research Work

The methodological framework of this study was based on optimization of rice straw management and water management for mitigation of methane emission and storage carbon in paddy soil. Therefore, this study divided into two parts.

The first part consists of two field experiments: (1) Study of soil temperature and soil water content changing in rice field when rice straw was burning in real time and (2) Optimization of rice straw management field under drainage system in term of greenhouse gases reduction and yield maintaining. In the field experiment, close chamber method was used to determine CH_4 and N_2O fluxes in two rice cultivation. Soil, rice plant and rice straw samples was taken to analyze the amount of total carbon, total nitrogen, chemical and physical property in the laboratory. Rice plant and rice straw were measured for the

biomass, height, amount of shoot and rice yield in order to use as environment data support.

In the second part, the carbon budget assessment calculated the balance of carbon input and carbon output in rice field with difference rice straw management techniques. The rice straw managements consist of stubble incorporated (S), rice straw burning (B), and rice straw and stubble incorporated (I). Total carbon and total nitrogen in soil were analyzed throughout rice cultivation.

The statistical analysis was performed using SPSS software for Windows. Least significant difference (LSD) tests were used to comparison of means between treatments. Standard deviation of the means was calculated using Microsoft Excel software for Windows.