

CHAPTER 1

INTRODUCTION

1.1 Rationale

Biomass open burning is outdoor biomass combustion without any supply control which is the cause of green house gases (GHG) emissions as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and non-methane volatile organic compounds (NMVOC), and air pollutant as carbon monoxide (CO), nitrogen dioxide (NO_x), and particular matter (PM). It also effects to human health and visibility problem [M.D. Hays]. Biomass open burning represents the one of the major air pollutant emission sources in Thailand [PCD, 2006]. The main cause of this burning is to clear area for next cultivation season.

Thailand is one of the largest agricultural countries in the world which the main economical crop is rice. In Thailand, the rice production has increased continuously from about 23,580 million kilogram in 1997 to 29,900 million kilogram in 2007 [OAE, 2006]. Rice field residues are the parts of paddy left in the field after the paddy have been harvested and thrashed. The amount of rice field residue between 2001 and 2006 was 10,691 -12,676 million kilogram [KDI, 2008].

Rice contributes the most to residue burning emissions, accounting for around 84% of emissions, followed by sugarcane (15%) and corn (1%) [Garivait, S. et al., 2005]. It demonstrates the main sources of agricultural emissions are paddy fields. About 20-24% of the total rice straw is left from utilization and there is commonly eliminated by burning [PCD, 2005] because of saving time and cost [Suramaythangkoor, T. and Gheewala, S.H., 2008; CAO, G., et al., 2008; Yang, S., et al., 2008]. The emission from agricultural burning is about 14% times of emission from heat and power plant. In 2005, the 43 Tg of CO₂, 2.61 Tg of CO and 77 Gg of NO_x was emitted into the atmosphere caused by burning 23.76 to 28.76 Tg of rice straw and stubble in paddy field [Garivait, S. et al., 2005].

The air pollution from open fire burning becomes an interesting problem in many countries. California has a long term plan to reduce open field burning, a part of this plan is to provide a fund for the demonstration of new rice straw technologies in a market place [Kadam, K. et al., 2000]. In Asian countries has an agreement to use zero burning policy in Asian countries [Pollution Control Department, 2005]. In case of Thailand incorporation is proposed Pollution control department to use instead of open burning. Although

incorporation enhances the nutrient into the soil, it also affects to the CH₄ emission in rice cultivation [2006 IPCC guideline].

To reduce agricultural open burning emissions, the main focus should start with paddy field burning. The decreasing of paddy field burning, it needs to know 2 factors; amount of biomass and possible management method. For amount of biomass, it can be estimated from the production of rice product and rice per residue ratio (RPR). The rice production value is provided by Office of Agricultural Economics (OAE) whereas the RPR value is still not clear. For possible management method, there are 2 main using purposes; used in agricultural purpose as incorporation, and used in energetic purpose as heat and power production.

Using rice residue for energy purpose is another method proposed for avoiding emissions from biomass open burning and also a mitigation option from energy production [Papong, S. et al.; Suramaythangkoo T. and Gheewala, SH., 2008]. Rice residue is a high potential biomass for energy production because of the suitable in term of amount and property its.

From the possible management method, up to now, no evidence proves burning, incorporation or using as fuel, which one is the most suitable management method for reduce emission from rice residue burning. Since, burning emits CO₂, CO, NO_x and particular matter (PM₁₀, PM_{2.5}) from combustion, incorporation in the field emits emission as CH₄ and CO₂ which occurred from decomposition process and rain flood and, using them as fuel in cement power plant, emitted emission as CO₂ and CO from transportation and fuel production. It demonstrates all of residue management methods are also the cause of air pollution.

This study aims to assess the optimum utilization of unused rice field residue to reduce agricultural open burning emission.

1.2 Objectives

1.2.1 To assess spatial and temporal distribution burning of rice field residues in Thailand.

1.2.2 To estimate air pollutants and greenhouse gases (GHG) emissions from burning of rice field residues in Thailand.

1.2.3 To optimize utilization of unused rice field residues constituted of fraction of residues burned in the fields.

1.3 Scope of the Research Work

This study attempts to estimate rice field residues, include rice straw and stubble which occurred in the paddy field in Thailand. This study compost of 3 main parts;

1.3.1 Assessment of spatial and temporal distribution of rice field residue in Thailand

The assessment of spatial and temporal of rice field residues includes the amount of rice field residue generated, the amount of rice field residue burned, and the size of paddy field area burned. The assessment will be monitored for each region (spatial) which divided by department of agricultural extension, Ministry of agricultural and cooperatives and development, in each month (temporal). The estimation will be done by ground survey which included questionnaire survey and site survey.

1.3.2 Estimation air emissions from rice field residue burning

The amount of emission from rice field residue burning included in this study are CO₂, CO, CH₄, and PM_{2.5}. The emission will be estimated from the product of rice field residue burned and emission factor. The amount of rice field residue burned will use from the result of part 1, whereas the emission factor will quote from IPCC Vol. 4, 2006.

1.3.3 Validation of the optimum utilization of unused rice field residues to reduce emission from agricultural open burning

Validation of the rice field residues utilization is used to validate the optimum management of unused rice field residue which otherwise be burned in the paddy field. Two management methods considered in this study are incorporation in the paddy field and used for heat and power production. The validation of the optimum utilization for unused rice field residues will considerate in term of carbon dioxide equivalent.