

ห้องสมุดงานวิจัย สำนักงานคณะกรรมการวิจัยแห่งชาติ



E46249

**OPTIMIZING RICE FIELD RESIDUES UTILIZATION TO REDUCE AGRICULTURAL  
OPEN BURNING EMISSIONS IN THAILAND**

**MISS FENWADEE CHEEWAPHONGPHAN  
ID: 50920111**

**A THESIS SUBMITTED AS A PART OF THE REQUIREMENTS  
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY  
IN ENVIRONMENTAL TECHNOLOGY**

**THE JOINT GRADUATE SCHOOL OF ENERGY AND ENVIRONMENT  
AT KING MONGRUT'S UNIVERSITY OF TECHNOLOGY THONBURI**

**2<sup>ND</sup> SEMESTER 2010**

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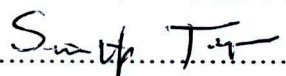
The Joint Graduate School of Energy and Environment  
at King Mongkut's University of Technology Thonburi

2<sup>nd</sup> Semester 2010

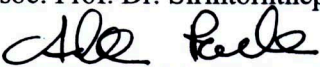
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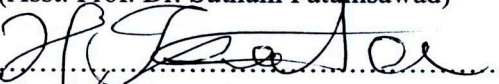
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**Topic:** Optimizing Rice Field Residues Utilization to Reduce Agricultural Open Burning Emissions in Thailand

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**ABSTRACT**

**46249**

Emissions from open burning of rice residues are becoming an environmental problem of concern due to its impacts, especially on air quality. The objective of this study is to investigate the optimum utilization of unused rice field residues to reduce agricultural open burning emissions using field survey and questionnaire survey in order to evaluate which emission reduction alternative would be the most beneficial to the environmental in terms of air quality and global warming.

The research methodology was composed of 3 parts:

- 1) Determination of the amount of unused rice field residues by using statistical and physical properties modeling tools.
- 2) Estimation of air pollutants and GHG emissions from open burning of unused rice field residues based on 2006 IPCC guidelines.
- 3) Estimation of the amount of rice field residues usable for possible emissions reduction options and their associated emissions of air pollutants and GHG based on 2006 IPCC guidelines.

This study found the amount of unused residue that subjected to open burn is about  $30.8 \pm 7.47$  Mt (26% $\pm$ 6.3% of generated rice residue) included  $16.8 \pm 4.07$  Mt of stubble and  $14.0 \pm 3.38$  Mt of straw. At the average combustion rate  $0.18 \pm 0.03$  for stubble and  $0.68 \pm 0.06$ , the amount of residue consumed by fire will be about  $11.3 \pm 2.19$  Mt (15% $\pm$ 2.9% of generated rice residue) comprised  $2.4 \pm 0.49$  Mt of stubble and  $8.9 \pm 1.70$  Mt of straw. Burning of  $11.3 \pm 2.19$  Mt contributes GHG as CO<sub>2</sub>  $13.35 \pm 2.595$  Mt, CH<sub>4</sub>  $0.003 \pm 0.0006$  Mt and N<sub>2</sub>O  $0.0008 \pm 0.0001$  Mt and pollutant as CO  $1.5 \pm 0.29$  Mt, NO<sub>x</sub>  $0.035 \pm 0.0007$  Mt, PM<sub>2.5</sub>  $0.31 \pm 0.060$  Mt, PM<sub>10</sub>  $0.15 \pm 0.028$  Mt, and black carbon  $0.008 \pm 0.0015$  Mt.

To reduce emissions from rice residue open burning, the 3 utilization of  $16.8 \pm 4.07$  Mt of unused-stubble and  $14.0 \pm 3.38$  Mt of unused-straw scenarios were purposed and compared emission with base line scenario for validation the optimized utilization. The base line scenario covered open burning unused residue, rice cultivation in the burned field with incorporation in the pre-cultivation season, and lignite power production. 3 scenarios for mitigation emission from burning of unused residue included, (1) zero open burning by agricultural purpose (all of unused straw incorporated into the soil), (2) zero open burning by energy purpose (all of unused straw used for power production), and (3) zero open

**Thesis Title:** Optimizing Rice Field Residues Utilization to Reduce Agricultural Open Burning Emissions in Thailand

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burning by energy and agricultural purpose (unused straw in the high of power and provincial capacity is used for energy purpose, the otherwise is used for agricultural purpose). Zero open burning by energy purpose (scenario 2) was the good option in term of non-CO<sub>2</sub> emissions reduction (0.76 MtCO<sub>2eq</sub> reductions), the largest of net emission reduction (44.7 MtCO<sub>2eq</sub>) and also the outcome as power 1,221-1,998 MW. Zero open burning by agricultural purpose (scenario 1) mitigated the open burning emission but enhanced emission especially in the group of non-CO<sub>2</sub> from the rice cultivation activity. Stop open burning by agricultural and energy purpose (scenario 3) was the good option in term of CO<sub>2</sub> emission reduction (37.1 MtCO<sub>2</sub> reductions) and implementation.

So, the emission mitigation option of rice residue open burning is to manage the unused rice residue. The optimum utilization of unused residue in terms of environmental friendliness and implementation for agricultural and energy purposes.

**Keywords:** Rice Field Residues, Open Burning, Incorporation, Energy Production, Emission Reduction

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