CHAPTER 5

CONCLUSION

This Chapter consisted of four parts. The first two parts summarized the seasonal variation of methane emission from various land use types of Mae Chaem watershed. The third part suggested lesson learned from system modeling and simulation technique. And the last one suggested future research.

1. Seasonal Variation of Methane Emission

In term of the seasonal variation of methane emission, eleven land uses could be grouped into two categories, (1) partial source and sink of methane and (2) the methane sinks. Land uses, which being both source and sink were paddy fields, while non-flooded land uses were mainly methane sinks.

1.1 Methane Partial Source and Sink

Tremendous seasonal variations of methane emission were found in both rice fields. On the annual basis there were both methane production and consumption land uses. Methane consumption of rice fields occurred during the dry season between January to mid May and in December. The soils during this period were non-flooded with good aeration suitable for methane oxidation activities. Methane uptake rates ranged from 0.019 to 0.319 mg CH_4 m^{-2} d^{-1} with an average of 0.144 mg CH_4 m^{-2} d^{-1}. Methane production occurred during rice growing season from mid May to November. The seasonal pattern was that high emission rate occurred at the beginning of growing season due to high decomposition rate of biomass after first plough then declining and again gradually increased together with rice growing rates. Methane emission rate varied from 0.212 to 254.035 mg CH_4 m^{-2} d^{-1}, with an average of 68.930 mg CH_4 m^{-2} d^{-1}.

1.2 Methane Sinks

Six land use types were methane consumption land uses throughout the year. These land uses located at higher altitude with steep slope and good drainage as compared to rice fields, therefore no flooding occurred even during the wet season. The variation of methane consumption rates throughout the year ranged from 0.009 to 0.935 mg CH_4 m^{-2} d^{-1}. The rank of the average consumption rates in land uses were 0.517, 0.240, 0.236, 0.234, 0.209, and 0.161 mg CH_4 m^{-2} d^{-1} of fallow field, field crop area, deciduous forest, orchard field, evergreen forest, and pine forest, respectively. The study found that there was a highly negative correlation between methane consumption and soil bulk density.

2. Methane Emission from Mae Chaem Watershed

Mae Chaem watershed comprised of seven land use types, which could be both sources and sinks of methane. Methane sources were rice fields during growing season with and average emission rate of 68.930 mg CH_4 m^{-2} d^{-1}. Total methane emission from rice field in Mae Chaem watershed was 729.4 t y^{-1}. Non-wetland soils were methane consumers. Even though the consumption rates were very low compared to production rates, but the non-wetland soils have occupied most area of Mae Chaem watershed. The consumption areas consumed methane at amount of 293.5 t y^{-1}, so that the net methane emission from Mae Cham watershed was 435.9 t y^{-1}, in 1999.

3. Methane Production and Consumption Simulation Model

Methane production could be estimated by constructing a dynamic model using functions of leaf area development of rice, amount of Photosynthesis Active Radiation absorption, proportion of rice root exudate, soil organic matter and decomposition fraction, and functions of controlling factors, which were soil pH, soil Eh, water-depth, and air temperature. Some of the produced methane was oxidized at rice rhizosphere before emitting into the atmosphere. It was also simulated by the fraction of methane oxidation rate with the amount of methane production at a certain day of rice growth. The model could be used to estimate methane emission on a daily basis throughout the season. The simulation found that emission rates during rice growing season from mid May to November ranged from 0.432 to 246.798 mg CH_4 m^{-2} d^{-1} with and average of 59.702 ± 54.705 mg CH_4 $m^{-2}d^{-1}$. While the consumption rates ranged from 0.0006 to 0.802 mg CH_4 m^{-2} d^{-1}, with an average of 0.178 ± 0.220 mg CH_4 m^{-2} d^{-1}.

Methane consumption rates in DF1, F1, F4, F7, OF, and PF, were simulated by using the function of soil pH, soil moisture, air temperature, and soil organic matter under atmospheric concentration of CH_4 and O_2. The consumption rates from the simulations were 0.295, 0.566, 0.621, 0.595, 0.240, and 0.194 mg CH_4 m^{-2} d^{-1} of DF1, F1, F4, F7, OF, and PF, respectively. Therefore, model simulation can be developed to estimate methane emission, providing weather, soil, and crop management data sets.

4. Future Research

Although methane production and consumption rates can be estimated by the simulation model, but most of the functions used in the model were developed by research conducted on high yielding rice varieties. There should be research conducted on Thai rice varieties so that each function may be developed and compared. The methane production and consumption controlling factors, e.g., soil moisture contents, and soil organic matter should also be readjusted for more precise simulation results.

Water management and using low methane emission rice variety are possible and efficiently strategies to cut the net methane emission rate. Timing of water management (both water supply and drainage) without reducing rice yields need to be experimented. Reducing of aerenchyma and intercellular space in rice plant is another title for consideration before selecting or improving rice variety.