V. CONCLUSIONS AND SUGGESTIONS

Conclusions

Water management is a key factor in affecting methane flux from wetland rice. Aerating the rice soils during the growing period significantly reduced methane flux.

Methane flux from continuously flooded wetland rice was larger compared to that from intermittent irrigation and saturated soil conditions; and methane flux from intermittent irrigation was larger than from saturated soil conditions.

b. Intermittent irrigation can suppress total methane emission up to 53% and saturated soil conditions up to 67% with respect to continuous flooding without significantly (p = 0.05) reducing the rice yields. But there was a tendency that for saturated soil conditions to slightly reduce rice yield and this type of water management is susceptible to weed invasion and rat attack.

Two rice varieties were studied, they showed different emissions of methane when all other factors were controlled. IR-64 rice variety showed a tendency to emit methane larger than Cisadane rice variety, even though the growing period of IR-64 was longer than Cisadane rice variety. Larger methane emission from IR-64 rice variety was closely correlated with the tiller number, which for this rice variety, were more than for the Cisadane rice variety.

Results of this study revealed that diurnal methane flux variations were strongly affected by the type of water management, rice variety and soil temperature.

a. There was a general tendency that methane flux in the afternoon was larger than in the morning or at predawn.

b. In all type of water managements, Cisadane rice variety showed less diurnal methane flux variations compared to that of IR-64 rice variety.
The increase of average soil temperature at 5-cm depth between predawn and afternoon of about 5 °C caused seasonal daily average of methane flux in the afternoon 1.4 - 1.9 fold larger compared to methane flux at predawn.

Ambient methane concentrations above the rice fields (0.5 - 1.0 m above the soil surface) were closely correlated with the growth stage of the rice plants and thus methane emission rates. Average methane concentrations at predawn were higher than that in the morning, and than that in the afternoon.

Seasonal daily average of methane flux in plots planted with IR-64 and Cisadane rice varieties under all water management treatments fall in the range of 0.08 - 0.48 g/m²/d, and seasonal total methane flux fall in the range 9.0 - 40.7 g/m². The highest was measured from IR-64 rice variety under continuous flooding, while the lowest was measured from Cisadane rice variety under saturated soil conditions. Based on the data of seasonal daily average methane flux from both rice varieties under continuous flooding and intermittent irrigation water management, it is estimated that methane emission factor from Indonesian wetland rice is 0.31 g/m²/d.

b. Total methane emission from Indonesian wetland rice is estimated to be around 4 Tg/year or about 6% of the total global methane emission from rice fields.

This study revealed that rice production is misleading if used to estimate methane emission from rice fields. Increasing rice production does not necessarily cause increases in methane emissions. Methane emission per ton wetland rice production in 1950 of about 0.2 Tg/million-ton-rice became about 0.1 Tg/million-ton-rice in 1990 or have declined by 5% within four decades.
Suggestions

Considering the lack of irrigation water sources in the future, it is suggested to use intermittent irrigation water management in rice agriculture. This type of water management besides consumed less water, it can reduce methane flux from wetland rice without reducing the rice yield.

Aside lowland wetland rice there is highland wetland rice in Indonesia which is mostly using rural irrigation. This is a unique type of wetland rice in Indonesia and thus measurement of methane flux from this type of wetland rice are recommended.

With respect to water usage, there are four types of wetland rice in Indonesia i.e. irrigated, rainfed and tidal swamp and swamp. Results of this study are representative of lowland irrigated rice fields. The tidal swamp and swamp rice fields in Indonesia cover an area around 1.18 million ha (14% of the total wetland rice), this type of wetland rice is unique in terms of water management, rice variety grown and the soil type (mostly Organosol and Gleysol soils).

Methane flux behavior from this wetland rice is not known, therefore flux studies are needed to obtain better estimate of methane emissions for Indonesian rice fields.