UNIVERSITY OF HOHENHEIM

in collaboration with IRRI International Rice Research Institute

Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg Institute)

GHG emissions from rice production depend on season, water management, and variety

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Introduction

- Lowland rice production is a source of greenhouse gases (GHG) methane (CH_4) and nitrous oxide (N_2O).
- Adapted management of water, nutrients, and straw mitigates GHG emissions.
- The effect of variety on GHG is still poorly understood.
- We report here on CH_4 emissions of 20 lowland rice varieties grown under different water management

GHG field sampling using the closed chamber method in the Vietnam Mekong Delta

Conclusions

- Alternate wetting and drying (AWD) strongly reduces CH_4 emissions.
- Varietal emission under continuous flooding (CF) varied strongly.
- Scaling factors (AWD/CF) do not capture varietal differences in annual emissions.
- Varietal selection should be based on low annual emissions and a low scaling factor.

Results and Discussion

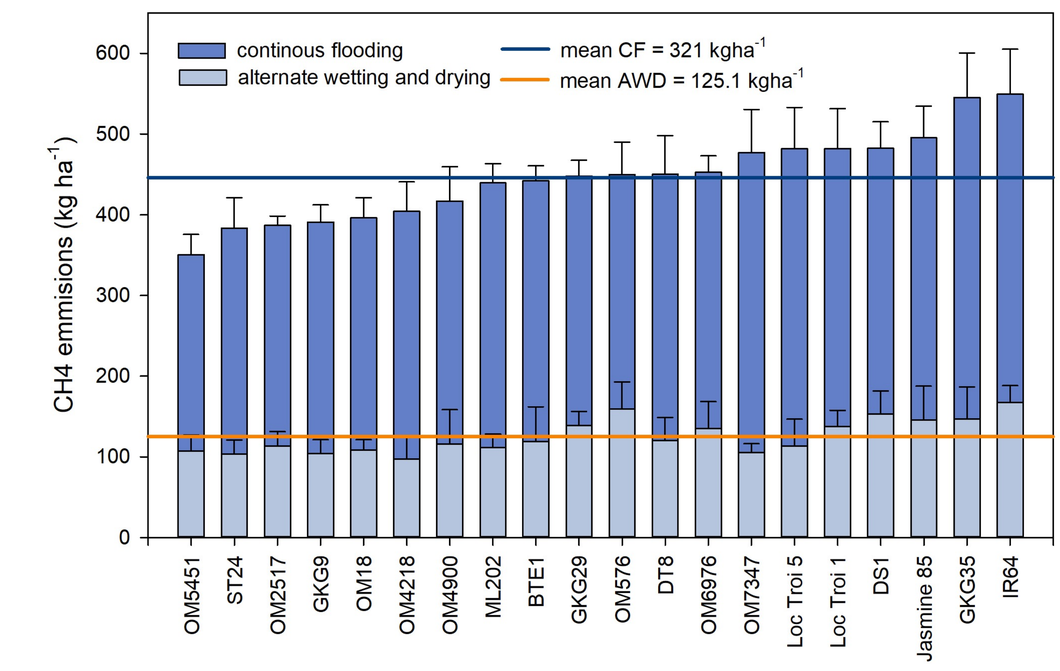
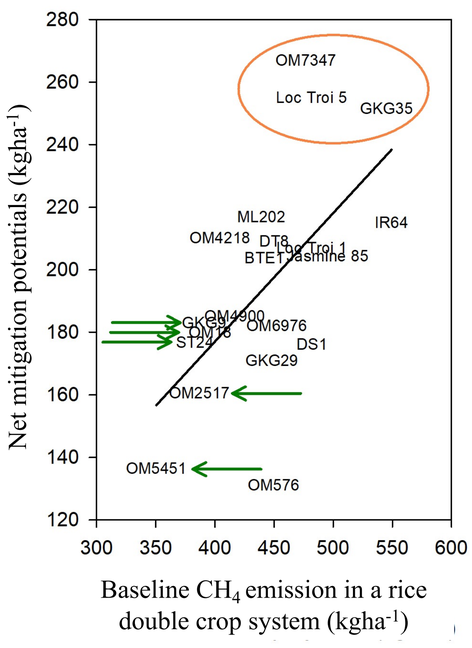


Figure 1. CH_4 emission rates of 20 rice varieties under continuous flooding and alternate wetting and drying irrigation management. Results are means over two dry seasons. Error bars = standard error of means; n= 6.

- CH_4 emissions under CF irrigation (considered as wet season) differed among the varieties by 155 kgha^{-1}.
- AWD (only applied in dry season) reduced CH_4 emissions on average by 61%.
- Varietal differences under AWD were small.



- Reductions through AWD in the dry season ranged between 135 and 270 kgha^{-1}
- Largest reductions through AWD in varieties high in annual emissions.
- In generally low emitting varieties AWD had a smaller effects.
- Varieties should be selected according to season.

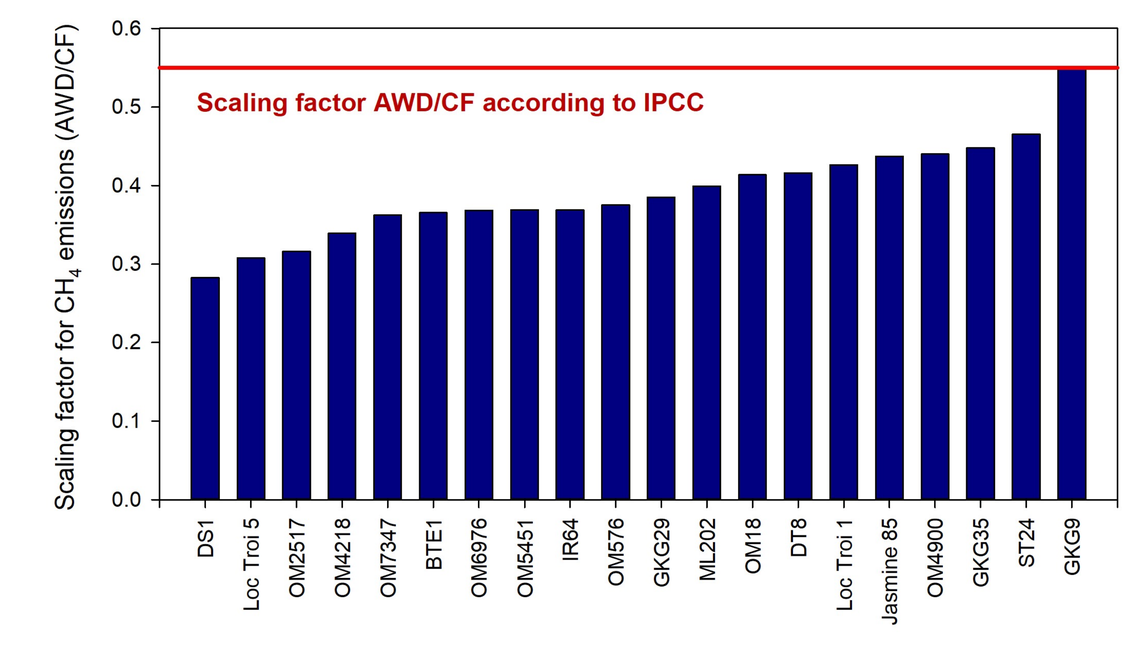
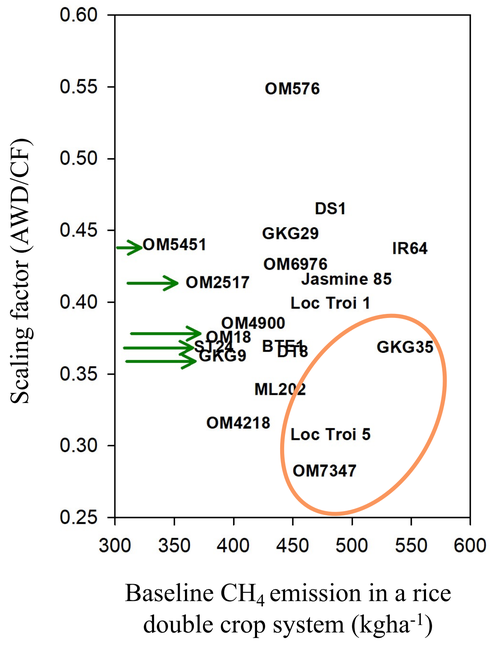


Figure 2. Scaling Factor (AWD/CF) for 20 rice varieties compared to the IPCC global default value

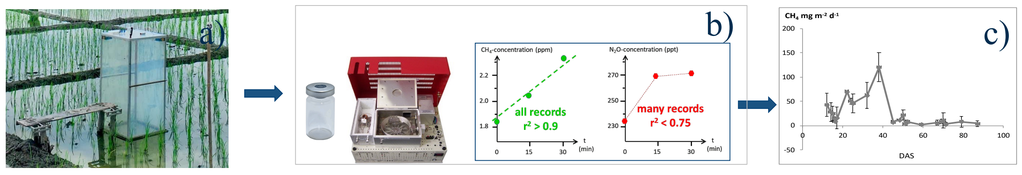
- AWD effects in varieties grown in this study resulted generally in lower scaling factors than the IPCC default value.



- Scaling factors varied between 0.29 and 0.55.
- Small AWD effects in low emitting varieties resulted in high scaling factors .
- Scaling factors alone cannot describe the varietal effect.
- Varieties should be annually low emitting with a small scaling factor.

Figure 3a) Baseline emission (annual emission of CF+AWD) vs. varietal AWD effect (left side); and b) varietal scaling factor (right side) for 20 rice varieties. Green arrows indicate the 5 lowest emitter from Fig.1. Orange circle includes high emitters with strong AWD reduction potential

Notes on Materials and Methods



Schematic presentation of individual steps of closed chamber approach:

a) Chambers for field sampling: three replicates were sampled in weekly intervals

b) Laboratory analysis: SRI 8610C gas chromatograph located at the laboratory at IRRI, Philippines.

c) Data evaluation: Flux rates calculated using the equation given by Minamikawa et al. (2015).

A 2-year field experiment conducted in the Mekong Delta, Vietnam, in 2020 and 2021 using the closed chamber method to 1) quantify the baseline emissions of 20 selected rice varieties under typical growing conditions; 2) assess interactive impacts of varieties and 2 water management practices: Continuous Flooding (CF) and Alternate Wetting and Drying (AWD); and 3) to compare these field emissions against the GHG estimates in the National Communications (IPCC Tier 2). AWD is practically only possible in the dry season whereas rainfall during the wet season does not permit AWD as an irrigation management.

Tropentag 2022, Prague