

# Sustainable practices in rice cultivation: minimizing impact for the environment with no penalty in yield.



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## INTRODUCTION

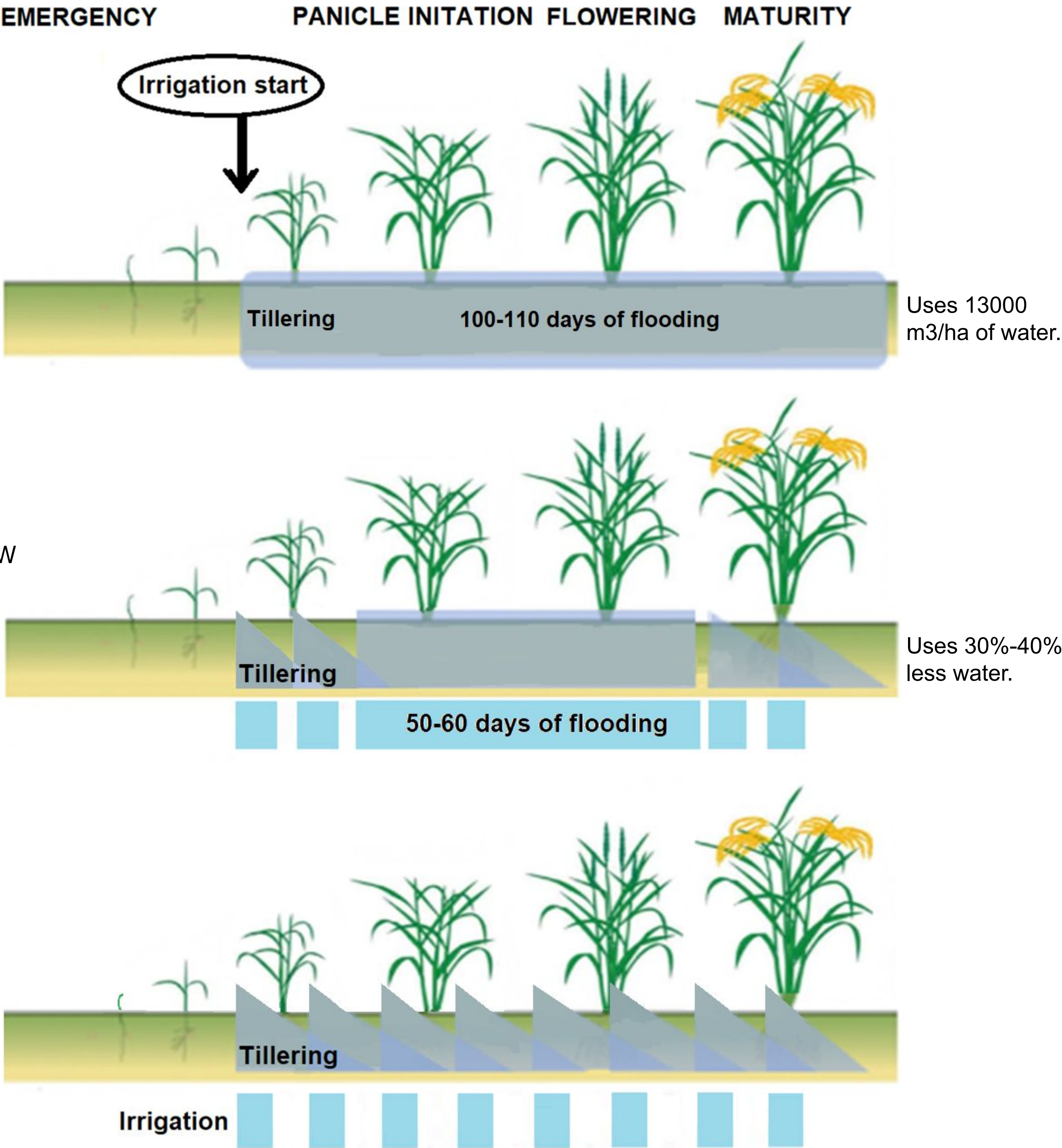
Rice production in Argentina is characterized by high consumption of irrigation water, which represents a significant cost for crop management. Continuous flooding of fields offers certain advantages for crop development and weed control, but results in inefficient use of water resources, agrochemical runoff, and high greenhouse gas emissions. However, there are alternative water and crop management practices that have the potential to improve the efficiency of these resources.

## AIM

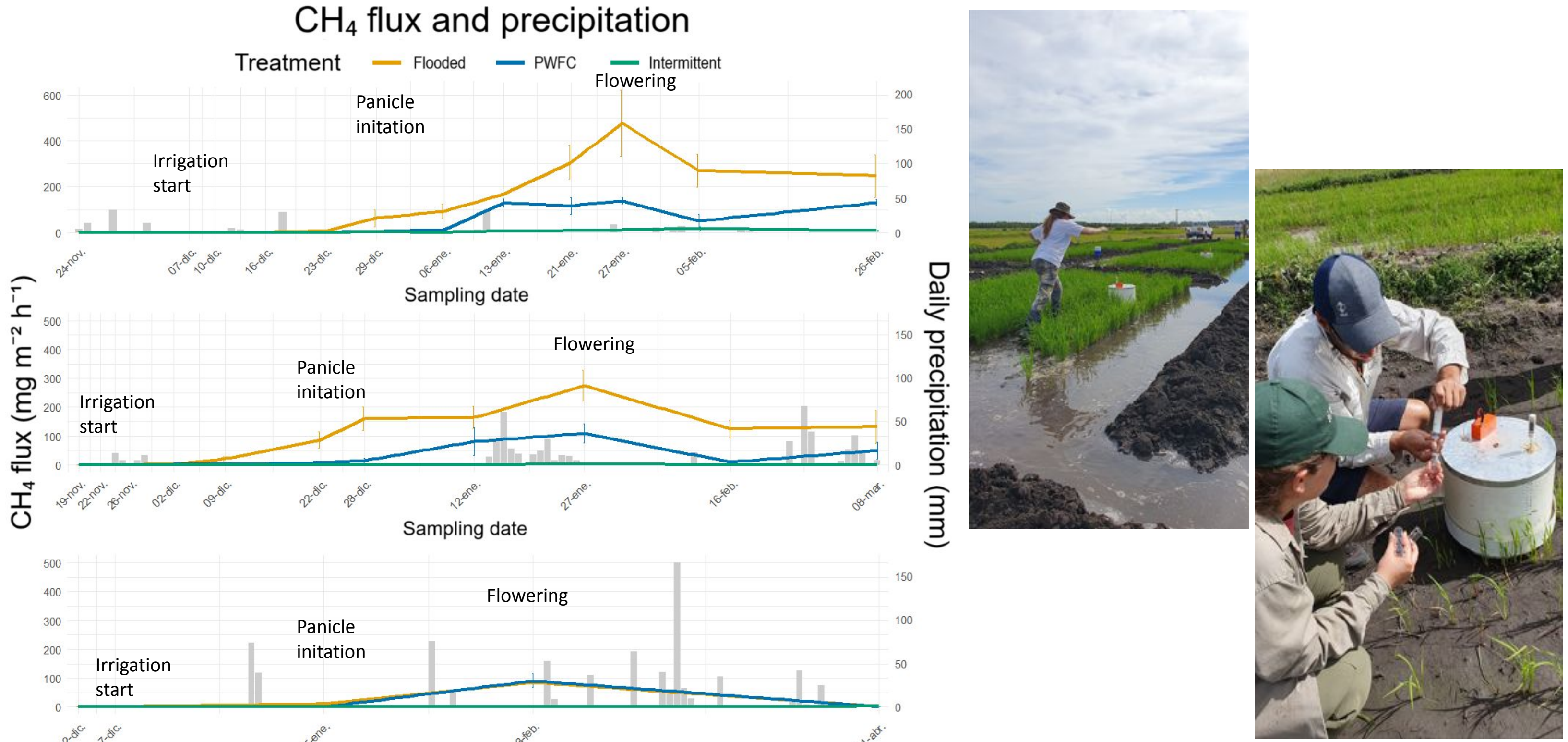
Evaluating the impact of alternative water management practices: Partial Water Flow Control - (PWFC) and Intermittent Irrigation (I.I.), on methane emissions, biomass accumulation and rice crop yield of the cultivar GURÍ INTA CL, in order to identify sustainable strategies that reduce water use and greenhouse gas emissions without affecting productivity

## MATERIALS AND METHODS

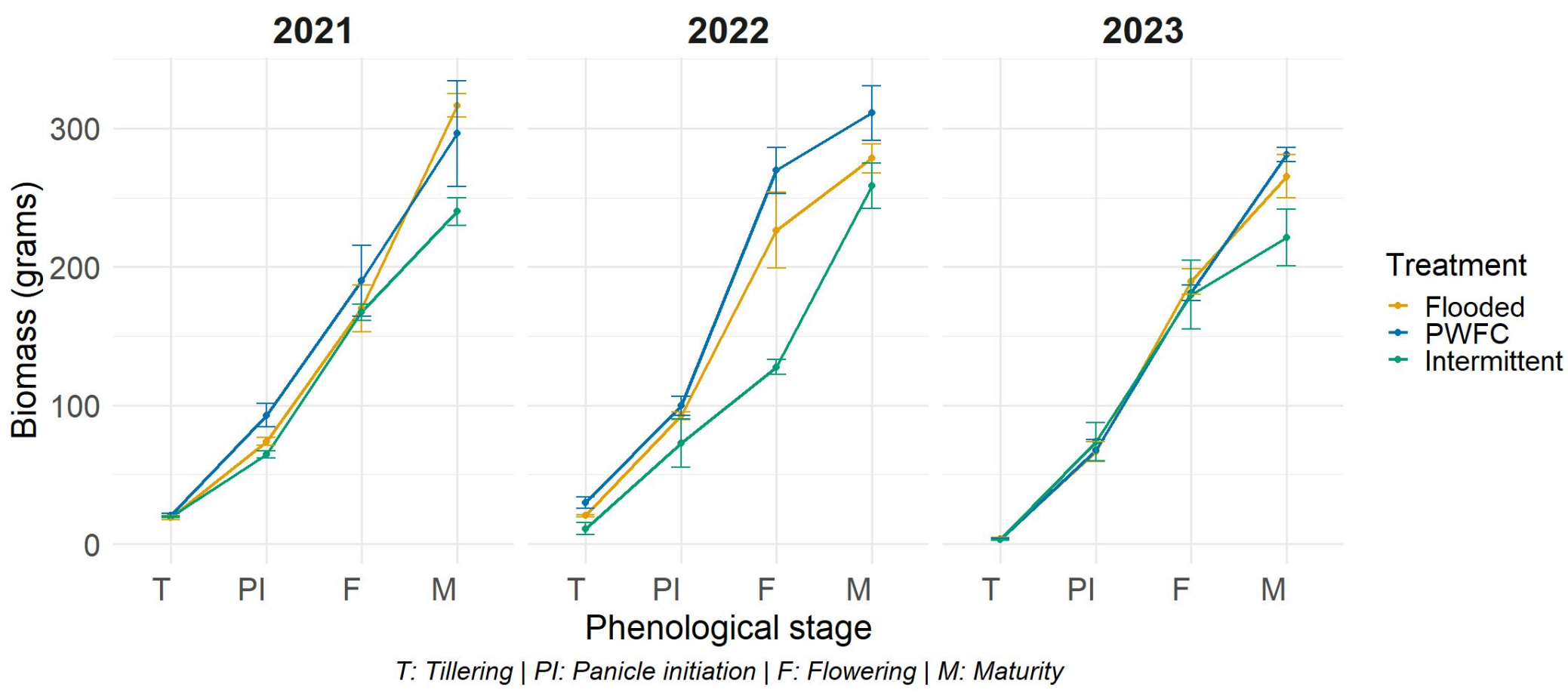
The study was carried out in three consecutive crop cycles using the GURÍ INTA CL cultivar. Three irrigation management strategies were evaluated as shown in the diagram. Flooded, continuous field flooding from tillering to maturity; Partial Water Flow Control - (PWFC), combines intermittent drenching from tillering, permanent flooding from panicle primordium differentiation and up to 15 days post-flowering and intermittent drenching until maturity (1, 2); and Intermittent Irrigation (II), is a non-flooded irrigation system that maintains soil moisture near field capacity and avoids a continuous water layer. We quantified methane emissions using the static closed chamber technique (3) and monitored biomass accumulation throughout the crop cycle.



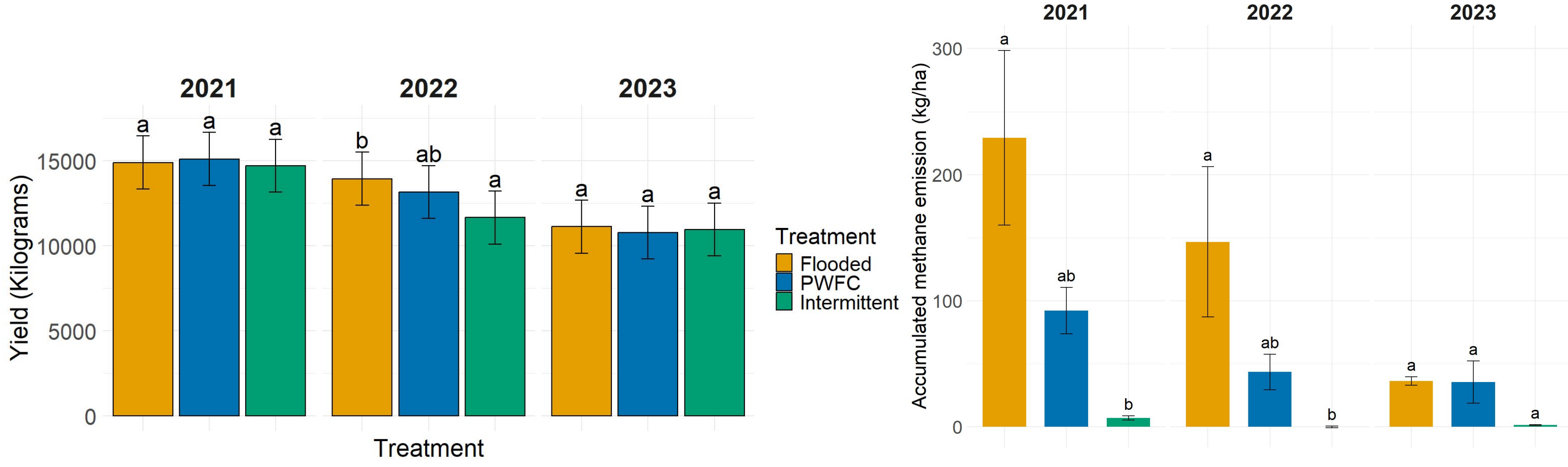
## RESULTS



**Figure 1:** Evolution of CH<sub>4</sub> flux (left y-axis) and rainfall (right y-axis) in the three rice crop seasons for the different irrigation treatments. CH<sub>4</sub> emission increased gradually over time after flooding and reached a peak in the flowering stage for flooded and PWFC treatment in all seasons. The difference between treatments was significant ( $p < 0.05$ ; Kruskal-Wallis test) from panicle initiation to post-flowering in 2021 and 2022. Points are average fluxes and error bars represent the standard error of 3 replicates. The photographs show the irrigation experiment and the static cameras.



**Figure 2:** Effects of the irrigation treatments on rice crop growth dynamics across its phenological stages: A mixed model was fitted, the analysis indicated an interaction between Year  $\times$  Treatment  $\times$  Stage ( $p = 0.0017$ ). This suggests that the effect of the treatments on biomass varies according to the phenological stage and the year. Multiple comparisons using Tukey revealed that in the initial stages of the cycle, no significant differences were observed between treatments in any year. At Maturity, the Intermittent treatment showed significantly lower biomass than Flooded and PWFC ( $p < 0.05$ ). Flooded and PWFC did not differ significantly between them in most of the stages and years evaluated.



**Figure 3:** Comparison of yield (left) and accumulated methane emission flux (right) between different irrigation treatments across years. Left: Yield showed significant differences between years ( $p < 0.001$ ), but not between treatments ( $p = 0.207$ ), nor interaction between year and treatment ( $p = 0.354$ ). Right: The Kruskal-Wallis test was applied separately for each year, and the Dunn test was used for multiple comparisons between treatments. Significant differences in accumulated methane emissions were found between treatments, especially between Flooded and Intermittent in 2021 and 2022, indicating that irrigation treatment affects CH<sub>4</sub> emissions. A similar trend was observed in 2023, although with less statistical evidence. Error bars represent the standard error of 3 replicates.

## CONCLUSION



- Rice yield varied significantly between years, but no statistical differences were observed between irrigation treatments, suggesting that alternative practices do not compromise productivity.
- The Intermittent Irrigation (II) treatment significantly reduced biomass at the flowering and maturity stages, particularly in 2021 and 2022, while Partial Water Flow Control (PWFC) and Flooded irrigation showed higher and similar values
- Intermittent Irrigation (II) was the most effective in reducing methane emissions, with reductions greater than 95% and lower water requirements, without negatively affecting yields

## REFERENCES

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## ACKNOWLEDGMENTS

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