Irrigation Management and Greenhouse Gas Emissions in Uruguayan Rice Production Systems

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Abstract

Environmental impact and sustainability of agricultural systems and management practices leading to climate change mitigation are one of the most relevant issues to agricultural production nowadays. Mitigation is the process of reducing emissions or enhancing sinks of greenhouse gases (GHG), to limit global warming potential and restrict future climate change. The most relevant GHG are Carbon dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). The steady increase of its concentrations in the atmosphere over several decades has led to enhance global warming. CH_4 and N_2O are the most relevant GHG emitted mainly in the agricultural sector. It is well known that water management has great impact on GHG emissions from rice paddy fields. One of the most important tools for rice crop production and mitigation of CH_4 emission is the controlled irrigation. However, it could result in a N_2O emission increase and reduced rice yields. For these reasons, it is remarkably important to assess the tradeoff relationship between both GHG and the effect on rice productivity. A 3 year field experiment with two different irrigation systems was set at southeast of Uruguay. Conventional water management (continuous flooding after 30 days of emergence, CF30) and an alternative irrigation system (controlled deficit irrigation allowing wetting and drying, AWDI) were compared. The objective was to study the effect of water management on GHG emission, water productivity and rice yields in order to identify strategies for further progress in sustainable intensification of Uruguayan rice. Results showed that mean cumulative CH_4 emission values for AWDI were 55% lower than CF30 systems; on the other hand, there were no significant differences in N_2O emission among systems. Significant yield differences were not observed in two of the rice seasons, while AWDI recorded a significant yield reduction in one of them. Total irrigation water applied and irrigation water productivity did not showed differences in two of the rice seasons, while CF30 reported a higher amount of water applied and lower water productivity in one of the seasons. It can be concluded that AWDI could be an option to enhance water productivity and GHG emission mitigation. However, grain yield can be compromised in AWDI systems. The adoption of these technology is based on the indispensable assess of an overall tradeoff between the risk of possible yield losses, total water used and GHG emissions.

Keywords: greenhouse gas emissions, methane, nitrous, oxide, water productivity