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Conversion from rice to vegetable production increases N_2O emission via increased soil organic matter mineralization

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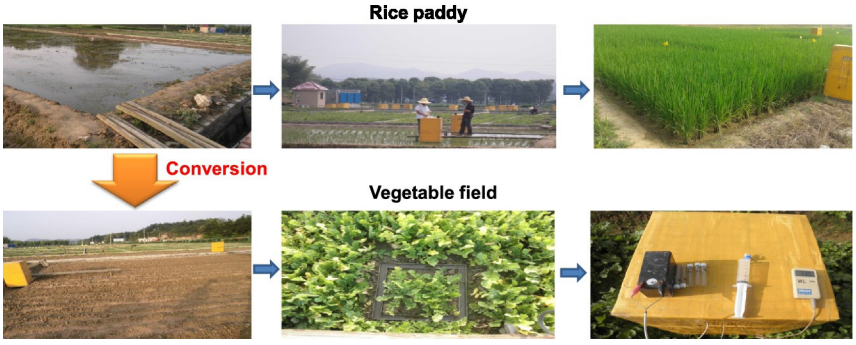
HIGHLIGHTS

- The impact of rice conversion to vegetable production on N_2O emission was studied.
- Rice paddy conversion to vegetable production dramatically increased N_2O emissions.
- N_2O emissions from converted vegetable field were highest in the first year.
- For converted vegetable fields, N_2O fluxes were positively related to CO_2 fluxes.
- SOM mineralization contributed to N_2O emission from converted vegetable field.

GRAPHICAL ABSTRACT



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ABSTRACT

The conversion from rice to vegetable production widely occurs in China. However, the effects of this conversion on N_2O emission and the underlying mechanisms are not well understood. In the present study, 12 rice paddies (R) were selected and half of them converted to vegetable fields (V) with the following treatments: rice paddies without N-fertilizer (R-CK), rice paddies with conventional N-fertilizer (R-CN), converted vegetable fields without N-fertilizer (V-CK), and converted vegetable fields with conventional N-fertilizer (V-CN) in a randomized block design with 3 replicates. N_2O emissions were measured with static chambers from December 2012 to December 2015. Within each V-CN plot, a root exclusion subplot was established to measure soil heterotrophic respiration (CO_2 effluxes), a proxy for soil organic matter mineralization. Conversion of rice paddies to vegetable production dramatically increased N_2O emissions. The three-year cumulative N_2O emissions were 0.59, 1.90, 55.50 and 160.14 kg N ha^{-1} for R-CK, R-CN, V-CK and V-CN, respectively. The annual N_2O emissions from vegetable fields ranged between 5.99 and 113.45 kg N ha^{-1} yr^{-1}, with substantially higher emissions in the first year. N_2O fluxes from V-CN were significantly and positively related to CO_2 fluxes and inorganic N concentrations. The linear relationship between natural logarithms of N_2O and CO_2 fluxes was stronger and the regression coefficient higher in the first year, showing the dependence of N_2O on soil organic matter mineralization. These results suggest that soil organic matter and N mineralization contributes significantly to N_2O emission following conversion of rice paddies to vegetable production.

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