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N_2O Emission in an Agricultural Land with Corn, Peanut and Cassava Crops in Bogor, Indonesia

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Abstract:
The amounts of nitrous oxide (N_2O) fluxes were closely monitored in an agricultural field where corn (*Zea mays*), peanut (*Arachis hypogaea*) and cassava (*Manihot esculenta*) have been seasonally cultivated in Bogor Regency, West Java Province, Indonesia. The field measurements in November 2010 – February 2011 covered a cropping period (from planting to harvesting) which normally spans about 2-3 months for both corn and peanut, and an early growing time segment for cassava which requires around 7 to 9 months. Data analyses yielded the following estimates of total N_2O fluxes in the study sites: corn (77-d) - 2.103 kg $N\text{-}N_2O$ ha^{-1}, peanut (75-d) - 0.186 kg $N\text{-}N_2O$ ha^{-1}, and cassava (246-d) - 0.622 kg $N\text{-}N_2O$ ha^{-1} respectively.

Materials and methods

The field experiment was conducted in an agricultural field where corn (*Zea mays*), peanut (*Arachis hypogaea*) and cassava (*Manihot esculenta*) have been cultivated on rotation basis for several decades. The field is located in a village called Bantar Kambing, Bogor Regency, West Java Province, Indonesia ($6^0$32'12.36"S, $106^0$43'38.42" E). In this study, all crops were planted in November 2010. The growing period (from planting to harvesting) for corn and peanut is about 2-3 months, but cassava requires a much longer growing period, which is around 7 to 9 months. Hence, the site observations were done at three different ages for the cassava field: 0-3 months, 3-6 months, and 6-9 months; whereas for corn and peanut, the measurements were undertaken for each growing period.

Results and Discussion

The increasing levels of N_2O emission into the atmosphere have aroused particular global concern. This is because, although CO_2 is by far the most abundant GHG, N_2O possesses unique radiative properties and long residence time in the atmosphere that result into a high global warming potential (GWP), reaching the magnitude of around 296 times that of CO_2 (IPCC, 2001, 2007). N_2O emissions from the soil can vary by orders of magnitude in a location, both spatially and temporally. Therefore, serious efforts have to be systematically exerted in

order to reduce and mitigate N_2O emission. Toward this end, this study has yielded useful estimates of total N_2O fluxes in agricultural fields that are traditionally planted to seasonal crops, namely: corn (77-d) - 2.103 kg $N\text{-}N_2O$ ha^{-1}, peanut (75-d) - 0.186 kg $N\text{-}N_2O$ ha^{-1}, and cassava (246-d) - 0.622 kg $N\text{-}N_2O$ ha^{-1} respectively. N_2O flux is significantly increased by the use of N fertilizers, especially when followed by rain. This traditional farming practice, which is the rule rather than the exception in tropical agriculture, such as in Indonesia, raises soil moisture and forms water filled pore spaces (WFPS) which, within limits, encourages microorganism growth and activity while limiting the presence of O_2 in the micro pores thereby accelerating the production of N_2O in the soil. In this context, in order to reduce N_2O emissions, the use of fertilizers has to be efficiently used and effectively controlled. Besides its negative environmental impacts, such as emitting N_2O, excessive fertilization can also become counterproductive and yield (costly) disbenefits to farming itself, as well as pose a serious health hazard to people and animals due to water pollution.

Keywords: Agricultural land; closed chamber method; N_2O gas emission; tropical mineral soil