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Environmental Impact Assessment of Rice Cultivation in Da Nang, Vietnam – Options for Sustainable Production Systems

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Abstract

Rice is the main staple food in Vietnam. which occupies the biggest share of the agricultural areas. This also applies to the environs of the city of Da Nang, located in the central region of Vietnam. The overuse of inputs, in terms of fertilisers, pesticides, and water in the rice production systems resulted in environmental issues and also health problems for the population. In this study, the environmental impacts of the traditional rice-farming system in Da Nang was assessed following ISO 14040 and ISO 14044. Potential alternatives were modelled and evaluated based on the functional unit (FU) of 1 kg harvested rice. Accordingly, the traditional cultivation (baseline) was modified regarding the direct incorporation of harvesting residues, irrigation management and the on-field burning as well as the composting of rice straw. The environmental impacts of the scenarios were evaluated regarding the global warming potential (GWP), the primary energy demand (PED), the eutrophication potential (EP) and the water consumption (WC). The GWP ranged from 0.8 – 1.76 kg CO_2-eq FU^{-1} and showed advantages when applying alternate wetting and drying (AWD) techniques compared to the baseline (1.07 kg CO_2-eq FU^{-1}). The incorporation of residues resulted in a higher GWP in the pairwise comparison with the baseline and the AWD scenarios. Burning (1.12 kg CO_2-eq FU^{-1}) and composting (1.76 kg CO_2-eq FU^{-1}) of rice straw resulted in the highest GWP. The EP ranged from 1.97×10–4 – 2.36×10–4 kg P-eq FU^{-1} indicating that an incorporation of residues or application of composted straw have positive effects. This also applies for the PED, ranging from 7.63 – 9.23 MJ FU^{-1} and the WC varying from 11.64–14.28 kg FU^{-1}. Furthermore, results show complex interlinkages and tradeoffs in both, within and between the chosen impact categories. Applying alternative rice cultivation systems can result in a lower GWP, but causing a higher WC, PED or EP instead, highly dependent on the local conditions. Therefore, further studies should clarify best practice solutions based on site specific-data and should also take social aspects into consideration.

Keywords: Alternative rice cultivation, global warming potential, life cycle assessment, water consumption

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