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Product Water Footprint on Rice Cultivation in Intermediate Zone, Sri Lanka: A Case Study in Kurunegala District, Sri Lanka

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Abstract

Water consumption by crops for ensuring food security for a growing population has become a threat to the limited natural resource of freshwater. In order to consume water in a sustainable manner for food productions, the concept of Water Footprint came into practice. Since the rice is the most water consuming crop compared to other food crops, a study was conducted to quantify the total water footprint: the volume of freshwater (m^3) that needs to grow a tonne of rice including freshwater volume needed to assimilate polluted water of rice fields due to the application of chemical fertilizers. An experiment was carried out under two conditions: controlled run-off and continual run-off at selected two locations in Kurunegala District in the Low Country Intermediate Zone, Sri Lanka from 2015 to 2016 for four consecutive cropping seasons with three replicates. Greywater footprints (WF_{grey}) for both sites were estimated based on the estimated leaching runoff fraction related to nitrogen (N) and phosphorus (P) fertilizers based on the site-specific data. The WF_{grey} for rice cultivated under the controlled run-off condition for N and P were $192 \pm 34 m^3/t$ and $39 \pm 07 m^3/t$ respectively. Under the continual runoff situation, WF_{grey} was varied showing $198 \pm 42 m^3/t$ for N and $58 \pm 03 m^3/t$ for P. This study revealed that the critical element for water pollution is nitrogen associated with rice cultivation and a considerable amount of nitrogen leaching and runoff could occur through paddy cultivation. The green and blue water footprints for both sites were estimated with the CROPWAT model by crop water requirement option according to the Water Footprint Assessment Manual. This study discovered that under the complimentary irrigation, the total water footprint for paddy production for run-off controlled condition was $1,370 \pm 294 m^3/t$ ($WF_{green}:705$, $WF_{blue}:473$, $WF_{grey}:192 m^3/t$) for the yield of 4.2 t/ha and for the continual run-off situation was $1,393 \pm 456 m^3/t$ ($WF_{green}:604$, $WF_{blue}:591$, $WF_{grey}:198 m^3/t$) for the yield of 4.5 t/ha. It expressed the volume of water required for the production of one tonne of paddy in Kurunegala District, Intermediate Zone, Sri Lanka for the period from 2015-2016. The experimental values are somewhat less with respect to the global average of $1,519 m^3/t$ for the rice under irrigated agriculture system for the yield of 4.67 t/ha. It was revealed that site differences, variation of agronomical practices were not significantly affected on the estimated total water footprint of the production of rice for the experimental period in the given settings.

Keywords: Water footprint, Paddy, Nitrate, Phosphate

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