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Evaluation of energy use in a cascade agricultural system in the intermediate zone of Sri Lanka

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Different forms of energy are used in the process of agricultural production. Determining the energy invested for each step of a production process is important for efficient management of resources, improved agricultural production and productivity. Also, it is desirable to identify the agricultural tasks that are considered critical and strenuous for workers, so that those tasks can be prioritized for mechanical assistance. Energy analysis on paddy production is not performed in Sri Lanka. Therefore, a study was done under a cascade tank system in the Katupotha area of the Kurunegalla District with the aims of estimating the amount of direct and indirect energy consumptions and to compare the present and the past energy consumptions.

Farmers in this area were divided into Hinduwa tank, Umangawa tank and Karangamuwa tank farming communities. Quantities of different inputs, model of machines, duration of field operations, area cultivated and yield were collected from the sample communities. Conversion factors of machines and inputs were collected from suppliers and literature. Energy, both direct and indirect, for the present and the past scenario and the output energy was calculated for both cropping seasons using standard equations. Input-output energy ratio, specific energy and energy productivity were estimated and compared.

Energy analysis carried out revealed that the highest average human energy consumption was for harvesting under both the past (462.4 MJ ha⁻¹ – 621.6 MJ ha⁻¹) and present agricultural systems (291.0 MJ ha⁻¹ – 352.6 MJ ha⁻¹). Application of agro-chemicals did not show any significant contributions to the operational energy consumption under the past agricultural system. Usage of tractors for land preparation was more energy intensive (1497.6 MJ ha⁻¹ – 1497.6 MJ ha⁻¹) than using bullocks (807.6 MJ ha⁻¹ – 2467.8 MJ ha⁻¹). Combine harvesters (CH) and combine threshers (CT) have a very low energy intensity (1573.3 MJ ha⁻¹ and 718.8 MJ ha⁻¹) compared to man, animal and tractors (7638.1 MJ ha⁻¹ and 1548.7 MJ ha⁻¹). Farmers were able to reduce half of their energy by using CH and CT. The input-output ratio is reduced at present compared to the past as the input energy has increased considerably than the yield increment. Direct energy has reduced with the development of technology, while the indirect energy has increased. Increase of indirect energy is mainly due to the unnecessary application of agrochemicals. Therefore, specific energy has increased while the energy productivity is reduced. This indicates, that farmers in the Katupotha area are now less energy efficient and they should manage energy inputs more effectively, to gain yield in an energy saving manner.

Keywords: Energy, cascade system, direct energy, indirect energy, energy efficiency