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Differences in Carbon Footprint of Dairy Production Systems in the Rural-Urban Interface of Bengaluru, India

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Abstract

The global environmental impact of dairy production systems (DPS), as measured by their greenhouse gas emission, varies according to productivity level and feeding strategy. In the (sub-)Tropics, the feeding strategy of dairy producers is affected by shifts in resource availability due to an urbanizing environment. India, where milk is a major source of animal protein, hosts the largest dairy herd worldwide and is rapidly urbanizing. Therefore, the aim of this study was to quantify emission intensity of four DPS (ubiquitous extensive DPS-1, rural (semi-)intensive DPS-2, DPS-3 and DPS-4; intensification level based on feeding (use of pasture, forages self-cultivation) and breeding strategy (cattle flows, specialised dairy genotypes) coexisting within the rural-urban interface of the Indian megacity of Bengaluru. Feedstuff offer and offtake of energy corrected milk (ECM) were quantified on 24 dairy production units (DPU), six per DPS, at 6 week intervals for one year (8 rounds). Following the 2006 IPCC Guidelines (<https://www.ipcc-nggip.iges.or.jp/public/-2006gl/>) the calculated carbon footprint (CF) included methane and nitrous oxide emissions due to enteric fermentation and manure management system. It was expressed in carbon dioxide equivalents (CO₂-eq) per DPU and round. Results show that the CF of Bengaluru's DPS differs with quality of diet offered and feeding intensity: emissions were low in DPS with low feeding intensity and good (DPS-1) or average (DPS-2) diet quality. By opposition, emissions were high in DPS with high feeding intensity and an average quality diet (DPS-3 and DPS-4). Overall, methane contributed to 92% of the emissions and nitrous oxide 8%. Milk offtake (kg ECM DPU⁻¹ round⁻¹) was low in DPS-2 (714), intermediate in DPS-1 (794) and high in DPS-3 (1260) and DPS-4 (1175). The CF (kg CO₂-eq per kg ECM), was lowest for DPS-1 (0.91) whereas significantly higher values ($P < 0.05$) were obtained for DPS-2 (1.21), DPS-3 (1.95) and DPS-4 (1.52). The results show that differences in local feeding strategies as shaped by the urbanisation level of a farming system's immediate neighbourhood impact emission intensities. Although they co-exist within the same geographical space of Greater Bengaluru, the individual dairy production practices of local DPU have distinctly different global environmental impacts.

Keywords: Dairy production, emission intensity, environmental impact, India, urbanisation

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