Animal Reproduction

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Contrast of low and high reproductive performance on herd composition, productivity, and carbon footprint in dairy production system

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The Life Cycle Assessment (LCA), used to calculate the carbon footprint, has been used to map environmental impacts and support the development of technologies and the use of mitigation solutions for agricultural production. LCA studies of milk production in the tropics have shown that herd diet, genetics and fertility are factors that influence estimates of CO_2 equivalent emissions (CO_{2eq}). The objective of this study was to demonstrate the contrast of low and high reproductive performances, evaluated by the age at first calving (AFC) and calving interval (CI) index, on the herd composition, productivity, and CO_{2eq}. emissions of a dairy production system. The carbon footprint of milk production was estimated based on the LCA. The study followed ISO 14040 and ISO 14044 requirements. Open LCA 3.11.1 software was used for data modeling and estimation of CO_{2eq}. The frontier considered was cradle- to-farm-gate, comprising the stages of animal management, use of natural resources, energy, inputs and waste management, direct and indirect emissions. Data were collected on a farm located in the state of Minas Gerais, with 421 milking Holstein cows (n = 1037 animals in the herd), housed in a compost barn system. The AFC, CI, and the milk production averages were 24 and 14 months, and 32.0 liters of milk per day, respectively. The herd composition was classified as milking and dry cows, heifers (33-36, 29-32, 24-28, and 12-24 months), calves (0-12 months), and bulls. Twenty scenarios were modeled combining different CI (12, 13, 14, 15 or 16 months) and AFC (24, 28, 32 or 35 months), adjusting the herd structure and milk production. The adjusted for different CI of the herd had increasing lactation length while maintaining the number of milking cows. Also, it was considered that longer CI determined longer lactation lengths and the feed efficiency was adjusted for methane emission of lower productive cows. The carbon footprint was estimated for these scenarios and linear regression was performed to estimate the effect of AFC and CI on production, and CO_{2eq}/milk (corrected for fat and protein content). Statistical analyses were performed using the REG procedure of SAS© 9.4. It was observed that as AFC decreases, the quantity of calves and heifers required is also reduced, especially between the 24-28 months [AFC36 (n = 57), AFC32 (n = 56), AFC28 (n = 55), AFC24 (n = 0)]. Furthermore, the total of emissions for 1 kg of milk (CO_{2eq}/milk) was affected by CI and AFC (y = 0.0840 + 0.0216*CI + 0.0182*AFC, r^2 = 0.9971), being higher in the low-performance group (AFC36- CI16 = 1.07) than in the high-performance group (AFC24-CI12), in which the amount kg CO_{2eq}/milk produced was 0.786. In conclusion, the high efficiency and fertility (low AFC and CI) are relevant to improving productivity (14.0%) per liter of milk produced, being an opportunity for dairy production systems to be a part of ecosystem management and contributing to reducing the intensity of CO2eq. emissions (27%).