Animal Reproduction

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Effect of calving interval on productivity and carbon footprint in high-producing cows

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The demand for sustainable development has motivated the implementation of practices and technologies for agricultural production that aim to increase productivity while reducing global gas emissions. 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. 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 fertility of the herd, evaluated by the calving interval index (CI), influences the productivity and carbon footprint of the herd. The objective of this study was to show the influence of CI on the results of milk production and CO_{2eq}. emissions in an operational system with different modeling scenarios. 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}. from milk production. 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 200 milking Holstein cows (n = 795 animals in the herd), housed in a compost barn system, with CI average of 14 months and 34.5 liters of milk per day (considered as high producing in Brazil). The herd composition was adjusted for different CI, increasing lactation length while maintaining the number of milking cows. The carbon footprint was estimated for these scenarios and linear regressions were performed to estimate the effect of CI on production and CO_{2eq}/milk (corrected for fat and protein content) in the following groups: 1) CI-12 months (n = 818), 2) CI-13 months (n = 809), 3) CI-14 months (n = 795), 4) CI-15 months (n = 794), and 5) CI-16 months (n = 788). It was considered that longer CI determined longer lactation lengths and the feed efficiency was adjusted for methane emission of lower productive cows. Statistical analyses were performed using SAS©. The productivity (liters/cow/day) was directly affected by CI index [y = 52.74 – 1.30x, r^2 = 0.9991; CI-12 months (37.2 L), CI-13 months (35.8 L), CI-14 months (34.5 L), CI-15 months (33.2 L), and CI-16 months (32.0 L)]. The total of emissions for 1 kg of milk (CO_{2eq}/milk) was 0.8206 when the CI index was 14 months (average of studied farm). However, for the 12, 13, 15 or 16-month CI, the amount kg CO_{2eq}/milk produced was 0.7860 (reduction of 4.5%), 0.7908, 0.8437, and 0.8652 (y = 0.5254 + 0.0211x, r^2 = 0.9592; an increase of 5.5%) respectively. It is concluded that reproductive efficiency (lower CI index) is important to improve the productivity of high-producing dairy cows and to reduce the amount of CO_{2eq} per liter of milk produced.