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Carbon footprint of fully and partially indoor dairy goat farming systems in Sardinia: a comparison between IPCC 2006 and IPCC 2019 prediction methods

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The aim of this work was to compare the carbon footprint (CF) of dairy goat farms estimated by the Tier 2 method of the 2006 Intergovernmental Panel on Climate Change (IPCC) with that estimated by using the Tier 2 IPCC 2019 refined method. A sample of 6 Sardinian (Italy) dairy goat farms was selected from 2 farming systems, identified as i) fully indoor (FI) with cosmopolitan specialized dairy breeds kept indoor and ii) partially indoor (PI), with mix breeds partially kept indoor and with access to pasture. Farms were surveyed, in a complete annual life cycle inventory (LCI) of cradle-to-gate farm production processes, from 1 October 2016 to 30 September 2017. The LCI included information on flock, animal diets, feed purchases, crops, farm stocks, and energy use audits. Data were analyzed by using the equation of Tier 2 of the IPCC (2006) and compared with those provided by the Tier 2 IPCC (2019). Reported values of CF were allocated 100% to milk yield. Total emissions were related to one kg of fat and protein corrected milk (FPCM). The FI and PI farming systems were, on average, 50 and 19 ha in size, with flocks of 265 and 192 female heads, respectively. Average milk production levels of the flocks were 761 and 576 kg FPCM head-1 year-1, for FI and PI farming systems, respectively. Total emissions were higher in the FI (185226 and 187676 kg CO_2eq) than in the PI (176394 and 179649 kg CO_2eq) farming systems, with an estimation based on IPCC 2006 and 2019, respectively. In contrast, CF was lower in the FI (1.12 kg CO_2eq kg FPCM-1) than in the PI (1.86 kg CO_2eq kg FPCM-1) farming systems, with no difference evidenced between 2006 and 2019 IPCC methods. The contributions of each emission component on total CF were 47 and 53% from enteric methane, 13 and 7% from manure management, 13 and 13% from energy use, 23 and 22% from purchased feeds, 5 and 5% from on-farm feeds, in the estimation based on IPCC 2006 and 2019, respectively. In conclusion, the FI farming system exhibited lower values of emission intensity irrespective of the IPCC method used. However, compared to the IPCC 2006, the IPCC 2019 guidelines incorporate additional studies and proposed new coefficients for goat species which in the previous method were not included suggesting that the new inventory method could improve the estimation.

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An innovative tool for assessing welfare of camels

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Whilst there are many tools for the assessment of welfare in livestock, there is none for camels. This study aimed therefore to pilot a method for assessing the welfare status of camels using animal-, resource- and management-based indicators at a camel market in Qatar. Adapting the AWIN protocol, data related to housing, feeding, health, and behaviour were collected at three levels: caretaker, herd, and animal. The Caretaker level was an interview exploring the caretaker's background, experience, and routine management practices. The Herd level was a check of the herd and of the place (i.e. box/pen) where camels were kept. At the Animal level, BCS, health, and behavioral parameters were recorded from 2 animals/pens, randomly selected. The number of animals/pens varied (average: 7, range: 1–37 animals) with a total population of 528 animals. The size of the pen was variable (26–256 m^2), and consequently the space allowance varied from 2.5 to 34 m^2/animal. The environmental temperature was high (average: 42 °C, range: 37–50 °C) and when in the paddock there was a shelter (86%) the camels moved into the shade (313/528 animals). In all paddock, there was a water point, but the water was often not available (22%), dirty (41%), or warm (max: 42.9 °C); the majority of the camels therefore drunk when clean and fresh water was offered (bucket test latency time: median =8 sec, IQR =3–40 sec). BCS varied and was rarely optimal (median =2, IQR =2–3). Most of the animals (89%, $p < .001$) were free of movements (1% tied, 10% hobbled). However, many animals were not free from disease (38%), injuries (5%), scars (7%), and cauterization (38%). Skin diseases were the most common health problems (28%; $p < .001$), followed by respiratory diseases (4%). The majority of the animals showed a good human-animal relationship (friendly, 48%, or neutral, 30%, approach; $p < .001$), and no stereotypes were noted. However, some animals were aggressive (6%), when they were old, in pain (2%), or distressed (8%). The caretaker came mainly from Sudan (91%; $p < .001$), with experience in camel handling often learned by father-son tradition (82%; $p < .001$) and for many of them, animal welfare was 'treat the animals gently, feeding and watering them'. This was a preliminary study to pilot a tool to assess welfare in camels; further studies are needed to validate this tool in other camel farms worldwide.