management. It allows to detect early onset of health problems, verify diet accuracy and distribution, simplify reproductive management and monitor farm energy consumption. This can help improve production, the efficient use of resources and consequently the farm's environmental impact.
The aim of this study is to demonstrate that the digital technologies with which the animals can be monitored continuously have positive effects on the farm efficiency and the environment by improving the performances and the welfare of dairy cattle.
The effectiveness of PLF technologies in reducing the environmental impact was evaluated in three innovative dairy farms located the Lombardy region. Three LCA analyses of the farms were carried out before (year 2018), during (year 2019) and after (year 2020) the introduction of some PLF technologies. Primary data were collected by giving the farmers a questionnaire, while secondary data were obtained from databases and literature sources.
The functional unit was 1 kg of FPCM, the system boundaries were from cradle-to-farm gate and the environmental categories were: global warming, acidification, eutrophication, energy consumption. All the data were processed with CAP'2ER® (Niveau 2) developed at the French Institut de l'Elevage.
In 2018 the estimate carbon footprints (CFPs) of these farms were 0.78, 0.74 and 0.90 $kgCO_2$ eq/kg FPCM respectively; in 2019 CFP's were 0.80 for two farms and 0.93 $kgCO_2$ eq/kg FPCM, while in 2020 it was 0.83, 0.81 and 0.83 $kgCO_2$ eq/kg FPCM.
The results of this study showed that a continuous monitoring of animals may improve the early recognition of problems due to health, fertility and productivity, allowing immediate actions by the farmer. A proper utilization of production inputs can improve the farm efficiency and environmental performances, but the different situation at farm level required further studies to explain the different extent of the effect in each farm.

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O313

Does age affect learning capacity and grazing activities of Holstein cows managed with Virtual Fencing collars?

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Virtual Fencing (VF) can be a helpful technology in managing herds in pasture-based systems. VF system can replace physical fences with virtual ones defined in a GIS system: when an animal crosses the virtual border, the VF collar emits a sound of increasing pitch, followed by a weak electrical impulse (0.1 J). If the animal continues to walk forward, this deterrent stimuli sequence is repeated up to three times, until it returns to the defined paddock. It is well known that animals can learn the systems easily, but there is a lack of information, if learning capacity decreases depending on the animal age. Therefore, the study aimed to investigated whether animals of different ages differ in their ability to learn VF, and whether this has an impact on their behavior as well. The experiment took place in the summer 2022 in the Swiss lowlands on four strip-grazing paddocks, comparable in terms of forage biomass and botanical composition. Four groups of five lactating Holstein-Friesian cows each, equipped with VF collars (Nofence®), were allocated in separate paddocks after the daily milking. These groups differed in terms of age: two old groups (O1 = average lactation of 5.2; O2 = 4.8) and two young groups (Y3 and Y4 = first lactation). After a seven-day training period (T), each paddock was gradually increased by VF during five consecutive grazing periods, based on the forage biomass availability. Furthermore, to collect detailed information on animal movements, each cow was equipped with a leg pedometer (IceQubes, Peacock Technology Ltd) that recorded the daily step count (DS). To assess differences among groups, the total number of daily sounds (S) and electrical pulses (EP) emitted by the Nofence collars were elaborated. All data were analyzed using the GLIMMIX procedure of SAS Software. The results showed that age had no impact on animals' response to the VF. Thus, during the training, only O1 received significantly less EP than the other three groups. This difference was not observed after the training. Moreover, considering the entire trial duration, O2 and Y4 differ from O1 and Y3 in terms of S emitted by the collars, with Y3 and O1 that registered the highest and the lowest number of S respectively. Finally, there were no significant differences in DS among groups. In conclusion, results suggest that age does not affect animals' learning capacity to learn and interact with the VF, and their grazing activities as well.

O274

Assessment and validation of individual water intake of dairy cows from reticular boluses

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The whole dairy cattle community, scientists and farmers in particular, are putting efforts to improve environmental

sustainability of the sector. Future generations of dairy cows must optimize natural resources use without impairing quantity and quality of their output. Water use in cattle, for example, can be more sustainable and efficient. Sensor data can often be good predictors of complex traits, like health status, fertility and stress. However, a large quantity of reference data is needed to develop robust predictive models and decision-support systems. In this study we explored the possibility to predict cow's water intake (WI) by mean of longitudinal temperature recorded by specific reticular boluses (smaXtec animal care GmbH, Austria) inserted into 8 cows undergoing a feeding trial at the experimental farm of the University of Bologna (October to December 2020). Cows, 4 primiparous and 4 pluriparous, were farmed in tie-stall with an individual drinker available. The WI was registered every day for 28 d, i.e. 7 consecutive d per each diet ($n = 4$); thus, data referred to adaptation phases were excluded. To quantify the number of times the reticular temperature dropped and duration of such drops, a daily 'drop area' was obtained for each cow by subtracting the area under the reticular temperature curve from the area under the body temperature curve. The 'drop area' was subsequently linked to the respective daily WI, body weight (BW), and milk yield (MY). Before boluses validation, the reference WI (140 ± 34 L/d) was adjusted for systematic effects (cow, parity, diet, and days in milk) using the GLM procedure of SAS v. 9.4. Then, the GLMSELECT procedure selected the most important predictors of WI among all imputed traits: mean, SD and minimum of both body and reticular temperature, MY and BW. Different models were tested by combining the predictors offered using a 5-fold cross-validation (75% training, 25% validation). Based on the mean square error in cross-validation, the best model was the one with all predictors available (R^2_{CV} = 0.90). When MY and BW were masked, the accuracy decreased (R^2_{CV} = 0.65). In both models, the 'drop area' was selected as one of the most important predictors and, when used alone, the R^2_{CV} was 0.61. Results are promising and suggest that there is potential to explore dairy cattle water efficiency: WI could be in fact estimated from sensor data in free stall barn/commercial contexts where recording individual intakes is not feasible.

O394

Modeling heat flows in heat-stressed dairy cows using System Dynamics techniques

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Heat stress (HS) condition is due to an excess of heat load (HL) in the cow's body, which can be expressed by increased body temperature. As a systems science methodology used in modeling complex environmental, ecological, and biological systems, System Dynamics (SD) can be used to understand the heat flows and HL accumulations in dairy cows. The aim of this work was (i) to analyze the differences in the HS response of dairy cows exposed to cooled and uncooled environments in terms of body temperature and milk production, (ii) to use these data to test a simple SD model built based on THI variation and on the HS response of dairy cows. Data on barn weather and milk yield of nine dairy cows were collected during August 2022 from a dairy cattle farm. Cows were selected based on their milk yield (MY) (49.1 ± 4.2 kg/d), days in milk (DIM) (97.6 ± 14.7 d), the number of lactations (NL) (3.4 ± 1.4) and average daily milking (ADM) (2.9 ± 0.5). The cows were divided into two groups housed in the same barn, but one in a cooled open environment (C, 5 cows) and the other in an uncooled open environment (UC, 4 cows), at the beginning of the HW period based on the weather forecast. The body temperature (BT) of each cow was recorded daily from August 8 to August 18 2022 with vaginal dataloggers. Animal and weather data from August were then used to feed the dynamic heat stress model and to calibrate it. Then, the milk yield predictions of the SD model were evaluated. As main results, during the HW period, the average MY was 50.1 ± 6.2 kg/d and 43.9 ± 5.3 kg/d, and BT was 39.5 ± 0.3 °C and 40.0 ± 0.3 °C, for C and UC groups, respectively ($p < 0.05$). Those results imply that both groups were affected by the HW, but C group adaptation was greater due to the cooled environment. The SD model can capture the HS response of the cows in the uncooled environment (with R^2 = 82%, CCC =0.89) more accurately than the cows in the cooled environment (with R^2 = 66%, CCC =0.80). Additionally, the model reproduced the dynamic pattern of the MY better for the uncooled environment according to the visual inspection of the results. These findings demonstrate the use of the SD model for predicting the MY of dairy cows under HS conditions and point out the potential improvements in the model structure, which includes considering additional variables related to animal response (e.g. body temperature variations, cooling conditions) to describe the HS variations over time more accurately.

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Milking parameters related to mammary gland health and milk characteristics in Italian Mediterranean buffalo

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