

Use of Precision Livestock Farming technologies on dairy cows in a mountain environment

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The preservation of alpine pastures is important for maintaining biodiversity and landscape quality and supporting local economies and traditions, reducing the risk of mountain abandonment. Proper management of grazing cows is crucial to ensure grass quality and availability, as well as animal welfare and productivity. Sustainable grazing practices, supported by Precision Livestock Farming (PLF) technologies, offer a potential solution for optimizing herd and pasture management in mountain regions. Sensors can monitor pasture quality and quantity, assessing how dietary changes affect milk yield (MY) and quality, animals' body condition and welfare, enabling improvements in herd management through targeted actions. The study aimed to assess the impact of alpine grazing on productive efficiency, milk quality and animal welfare in an alpine environment through PLF technologies. The study was conducted during summer 2024 on 20 Brown Swiss cows grazing an alpine pasture in Valchiavenna (>1,700 m asl). Milk samples were collected every 2 weeks and analyzed for chemical composition and somatic cell count (SCC). Pasture biomass was measured using a plate meter and grass composition was assessed by identifying plant species and analyzing samples using near-infrared spectroscopy. Cows wore collars, equipped with accelerometers and GPS, and pedometers to record activity, while 10 of them were additionally fitted with RumiWatch halters for monitoring feeding behavior. Body Condition Score (BCS), Locomotion Score (LS), Hygiene Score (HS) and Respiratory Rate (RR) were evaluated. Data analysis was conducted using RStudio for the Principal Component Analysis (PCA), and SAS for the General Linear Model (GLM) procedure. Pasture cover varied across different grazing areas, ranging from 533 to 3,044 kg/ha of biomass, due to the presence of trees, shrubs and rocks. Individual MY decreased over the season ($p < 0.0001$) from 9.9 to 5.8 kg/milking, with average fat and protein content of 4.64% and 3.77% (SD 0.73 and 0.44 respectively). Differences ($p < 0.0001$) in MY, milk fat and protein, as well as HS and RR, were found across different pasture areas. Higher MY levels were associated with areas with higher pasture cover and biodiversity, as identified by PCA.

Continuous monitoring and targeted actions are necessary for mitigating the effects of alpine grazing on MY and animal welfare during summer season. PLF technologies may help the management of grazing cows in mountain areas, especially regarding different pasture zones in the alpine systems.

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