Analyzing milk recordings to support better decision-making through AI: a case study in Italian Mediterranean Buffalo

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Nowadays, the modernization of breeding techniques is essential to enhance productivity and management efficiency. Precision Livestock Farming (PLF) represents a key approach for collecting and analysing herd data through Machine Learning (ML) and Artificial Intelligence (AI). While PLF systems are widely implemented in dairy cattle, their application in other species, such as buffalo, remains limited. One of the main barriers to the adoption of advanced PLF technologies is farmers' difficulty in understanding AI driven processes and properly interpreting model outputs. To address this challenge, a case study in the buffalo sector was developed by Logogramma using AI.CODIUM®, a proprietary platform designed to enable effective human–machine interaction.

The system has been already tested on a single buffalo herd within The BufalaCare project, developed under the framework of RESTART and through collaboration with the 5G Academy at the University of Naples Federico II. In this context, the overall system demonstrated suitability for: (i) Collecting human observations and integrating them with data from external sources such as farm sensors, cameras, scales, and tags. This enables the tracking of each buffalo's wellness history, group affiliation, insemination records, or human diagnosis; (ii) Processing natural language requests via a voice assistant, generating context-based responses derived from the knowledge graph; (iii) The platform integrates heterogeneous data into a unified system, giving farmers a reliable decisionsupport tool with a comprehensive overview of production, reproduction, and herd health. Users can query the knowledge graph in natural language and instantly access relevant information in text or visual formats. Starting from this experience, the aim of the study is expanding the system using information on milk yield, milk quality and reproductive information of 329 herds with 130,531 Italian Mediterranean buffaloes and 1,957,430 milk records collected over ten years (2013–2023). All data are structured within a unified knowledge graph powered by AI.CODIUM®, enabling advanced analytics and predictive modelling based on AI and Deep Learning techniques. The system streamlines the consultation and aggregation of data, fostering best practices, reducing observation time for farmers while delivering valuable support to breeder associations and regional stakeholders.