

PhD School on Agriculture, Environment and Bioenergy

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(XXXVIII cycle, 2022-25)

Project draft

1. Field of interest

AGR/19 Animal husbandry

2. Project title

Precision Livestock Farming for improving animal health and welfare and mitigating the environmental impact of milk production

3. Tutor Maddalena Zucali

4. Relevance of the topic and state of the art:

It is proved that a valid mitigation strategy to reduce GHG emissions in dairy farms is growth farm efficiency and optimize resource use (Gerber et al., 2013). Dairy production systems have rapidly intensified and concentrated over the past decades in many regions of the world (Clay et al., 2020). Larger farms tend to have fewer workers per animal and fewer opportunities for individual animal care; this creates the need of implementing automated systems for performing some routine operations (milking, feeding, etc.) and sensor systems for continuous monitoring of animal health and welfare conditions. Health and welfare affect mortality, morbidity and growth rates of young replacement animals, as well as fertility, productivity and longevity of adult cows, with a crucial influence on the production efficiency of the farm. These factors have an impact on the farm profitability but also on its environmental sustainability. The environmental impact of milk production, in terms of consumption of non-renewable resources and emissions per kg of product, tends to increase as a consequence of low production, lengthening of the unproductive periods, mortality and diseases (Tullo et al., 2019).

Precision livestock farming (PLF) relies on the application of sensors and information and computer technology (ICT) for the real-time monitoring of individual animals and the implementation of timely and optimized management actions (Norton & Berckmans, 2017). In dairy production, PLF systems can be important tools to support the farmer in managing herds and assessing animal health and welfare; they make individual care possible even in large herds and help to address the challenges associated with optimising operational efficiency (Andonovic et al., 2018).

Currently, the spreading of new technologies in livestock farming encounters some limitations: i) the large amount of data generated by existing sensor systems is only partially exploited by farmers as a decision support; ii) the integration between the information from the different sensors is still very limited; iii) there is a strong need to develop novel non-invasive animal-based sensors.

Thus the main objectives of the project are to:

- 1) study the possibility of using in a more effective and informative way the big datasets generated by the sensor systems currently available in the dairy farms or new developed sensors (e.g., accelerometers, sensors integrated in the milking systems, etc.);
- 2) integrate data flows from multiple sensors into a single comprehensive control system able to: i) predict and detect critical situations (diseases, distress); ii) alert the farmer; iii) provide decision support
- 3) study the effects of the implementation of the innovative solutions on the environmental sustainability of milk production, using the Life Cycle Assessment (LCA) methodology.

5. Layout of the project (draft)

6. Available funds

34876 RL_DG-AGR20MZUCA_01 CLEVERMILK - Uso intelligente della tecnologia per un latte a basso impatto ambientale 201,930 euro

22375 RL_DG-AGR17ASAND_01 META – Mungitura: efficienza, sostenibilità e qualità 12.288,00 euro

1. Literature:

- Andonovic, I., Michie, C., Cousin, P., Janati, A., Pham, C., & Diop, M. (2018, June). Precision livestock farming technologies. In 2018 Global Internet of Things Summit (GloTS) (pp. 1-6). IEEE.
- Clay N., Garnett T. & Lorimer J. (2020). Dairy intensification: Drivers, impacts and alternatives. *Ambio* 49, 35–48 . <https://doi.org/10.1007/s13280-019-01177-y>
- Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., ... & Tempio, G. (2013). Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO).
- Norton, T., & Berckmans, D. (2017). Developing precision livestock farming tools for precision dairy farming. *Animal Frontiers*, 7(1), 18-23.
- Tullo E., Finzi A., & Guarino M. (2019). Environmental impact of livestock farming and Precision Livestock Farming as a mitigation strategy. *Science of the total environment*, 650, 2751-2760