Precision Livestock Farming as mitigating technique for the environmental sustainability of dairy cattle farms

Daniela Lovarelli1, \*, Matteo Barbari2, Marco Bovo3, Lorenzo Leso2, Simona Porto4, Patrizia Tassinari3, Francesca Valenti4, Marcella Guarino1

1Dipartimento di Scienze e Politiche Ambientali, Università degli Studi di Milano, via G. Celoria 2, 20133, Milano. 2Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Università degli Studi di Firenze, Via San Bonaventura, 13, 50145 Firenze. 3Dipartimento di Scienze e Tecnologie Agro-alimentari, Università di Bologna, Viale G. Fanin, 48, 40127 Bologna. 4Dipartimento di Agricoltura, Alimentazione e Ambiente, Università degli Studi di Catania, Via S. Sofia, 100, 95123, Catania.

\*phone: +39 0250317992; email: daniela.lovarelli@unimi.it

**Keywords.** Life Cycle Assessment, dairy cows, monitoring tools, smart farming

**Abstract.** The livestock sector has both positive and negative impacts on the environment, similarly to other production sectors. The positive aspects include food production and preservation of the territory and biodiversity, while the negative ones are mostly related to emissions to the environment. The adoption of the Life Cycle Assessment (LCA) method is very important because it is a method globally used and standardized that permits to quantify the potential environmental impact of different products, such as milk. The main environmental hotspots of milk production are emissions from rumen activity, storage and field application of manure/slurry, and feed and energy production and use. In this context, the adoption of Precision Livestock Farming (PLF) techniques can be a valid way to monitor the health and welfare of farmed animals, finally supporting the farmer with the decision-making process. Enabling livestock to be more efficient, PLF can lead also to sustainability improvements related to environmental, economic, and social aspects. The aim of this study was to quantify the environmental impact through LCA of the milk production on farms that adopted PLF techniques within the Project “Smart Dairy Farming: Innovative Solutions to Improve Herd Productivity”. Data were collected from 2 dairy cattle farms before and after the introduction of PLF tools. In the first farm were adopted pedometers to improve the oestrus detection capabilities, while in the second were adopted cameras to monitor the daily access to pasture and recording systems for milk production. Both techniques allowed to achieve, directly or indirectly, some improvements on the environmental sustainability. In fact, even small enhancements that permit to use target inputs result in increased efficient production, improved animals’ health and welfare, and finally lead to improved environmental sustainability. The use of pedometers allowed to reduce the environmental impact of milk production in the category of Climate Change by 5.4%, simply by properly identifying the oestrus and inseminating cows when needed. Instead, making cows access to pasture allowed to achieve an increase of 4.1% in milk production and a reduction in health problems, which involves a direct reduction of the environmental impact on Climate Change.