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ASSESSING THE EFFECT OF AN INNOVATIVE LOW TEMPERATURE VACUUM DRIER PRILLING TECHNOLOGY ON CIRCULARITY AND SUSTAINABILITY OF CROPPING SYSTEMS

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SPOKE, WP & TASK

Spoke 8 – Circular economy in agriculture through waste valorization and recycling,
WP 8.4 – Sustainability assessment of the technologies and their integration in agriculture,
Task 8.4.2 - Multidimensional sustainability assessment of circular technologies in agriculture.

INTRODUCTION AND OBJECTIVES

The transition towards circular economy has raised up the interest on the potential role of new technologies as a key loop for nutrients, carbon and water cycling in agriculture, because circularity within agricultural systems is potentially a key for achieving higher levels of sustainability.

It is often the case that at farm level, the nutrient management (especially nitrogen) has basically a linear structure, even when there are options for improving its degree of circularity. This applies particularly in the case of livestock farms, where animal slurry management often becomes an issue for the farm, even when it is potentially a resource (Fig. 1).

This study aims at assessing the effect of low temperature vacuum drier prilling technology on the sustainability of livestock farming systems that comprise anaerobic digestion with the purpose of verifying where circularity occurs along the production chain.

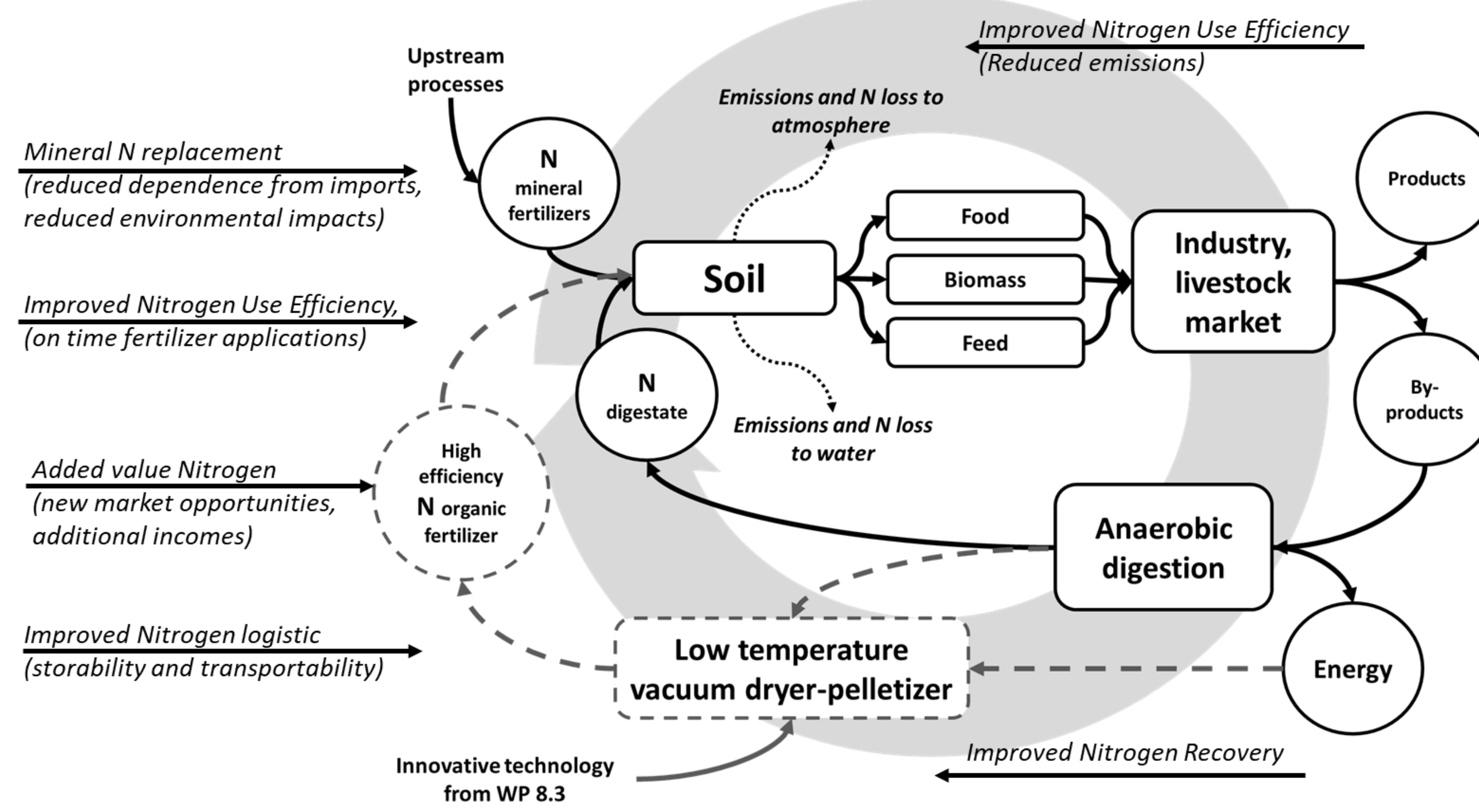

Figure 1: studied system and circularity indicators

APPROACH

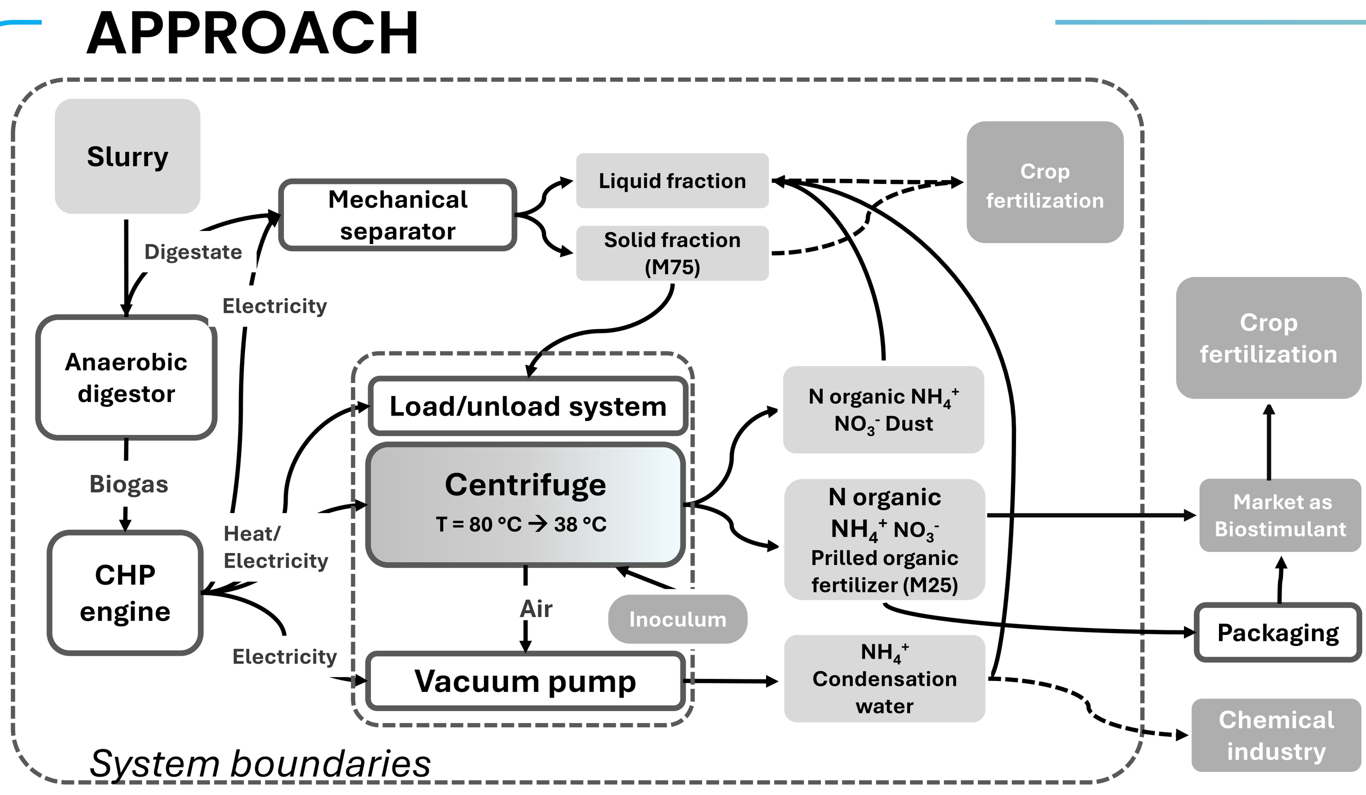

Figure 2: processes and system boundaries

The approach for assessing the environmental performance of the studied system is the attributional life cycle assessment (LCA), while for measuring circularity the focus is on the potential Nitrogen recovery. This is measured in terms of: *i*) the effective N recovery that the IT allows; *ii*) the potential replacement of mineral N; *iii*) the Nitrogen Use Efficiency (NUE) of the crop. To evaluate quantities of N applied as fertilizer and the N absorbed by the fertilized crop, the analysis must regard all phases; not only the organic fertilizer production and all linked processes but also the crop productions that utilize the fertilizer, therefore the system boundaries are set accordingly (Fig. 2). The technology, developed by a start-up company (WROTE Srl), consists in a reactor equipped with a vacuum pump and a rotary drum.

The former is designed for using the residual heat provided by the cogeneration unit (Combined Heat and Power) fuelled by a biogas plant (or other sources) and it allows the water evaporation from the inlet raw material (moisture content about 75%). The rotary drum, by a slow rotation, allows the granulate formation. The outputs are a granular fertilizer with a moisture level of about 25%, residual dust and distilled water with a content of $NH4^+$, NO_3 and NO_2. The distilled water and the dust can be recovered by incorporating them in the liquid fraction of digestate or slurry for agronomic purposes.

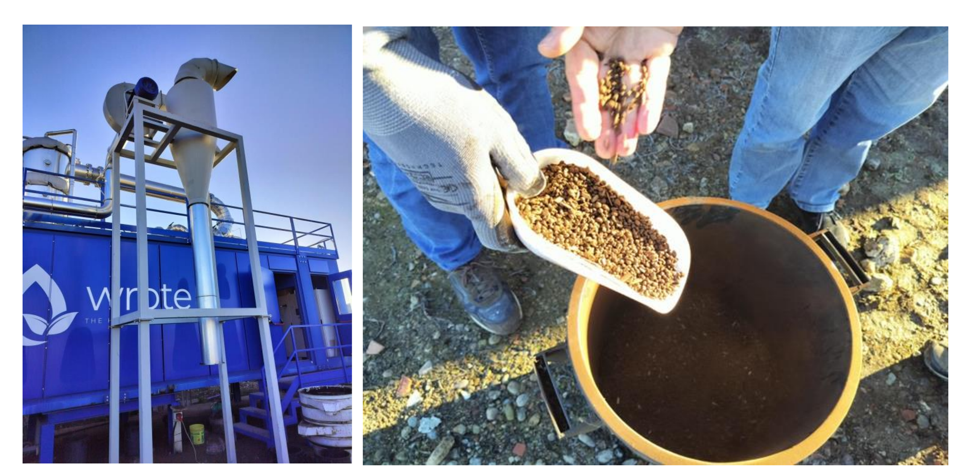

Figure 3: reactor developed by WROTE srl and granular fertilizer

The plant is modular, a single module is installed inside a transportable container and it does not require fixed concrete installation (Fig. 3). The system works in batch; a single batch has a load capacity of about 3,000 kg for a yield ranging from around 750 to 1,800 kg granulated fertilizer and a duration of 6-7 hours, depending on the initial moisture level. The final product can be upgraded to a biostimulant by incorporating inoculum of *Trichoderma spp*.

PRELIMINARY RESULTS

The selected technology has a high level of nutrients recovery (Fig. 4) associated with a potentially low environmental impact. Evaluations at cropping system level are yet to be carried out. Nevertheless, the fertilizer obtained may substantially improve the management of nutrients from slurry and/or digestate at farm level. Indeed, the fertilizer is suited to be packaged, stored (for longer periods compared to those currently adopted by farmers) and transported for longer distances than those reasonably affordable for the original raw materials. Storability and transportability may allow to: *i*) improve the logistic of digestate and slurry management; *ii*) reduce the intensity of N application at farm level, thus reducing the risk of leaching and volatilization; *iii*) improve the Nitrogen Use Efficiency through on time application according with sowing time and crop development; *iv*) reduce the dependency from mineral nitrogen; *v*) create market opportunities.

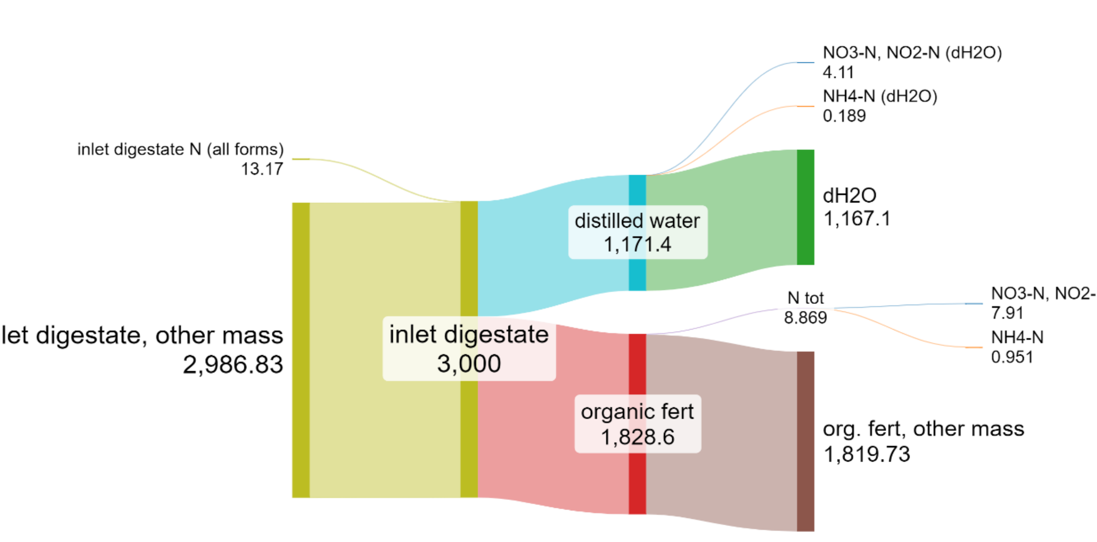

Figure 4: mass balance of the dryer prilling unit (figures in kg). Total N output is 8.87 kg per batch (in a total mass of fertilizer of 1,828.6 kg)

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