VENETO AGRICOLTURA
Azienda Regionale per i settori Agricolo, Forestale e Agro-Alimentare

CUEIM CONSORZIO UNIVERSITARIO DI ECONOMIA INDUSTRIALE E MANAGERIALE

REGIONE DEL VENETO

FINAL SUMMARY

BIOFITO Project

Treating livestock waste with integrated technological systems to reduce nutrient loads

OBJECTIVES

The three-year project, which began in 2013, involved studies and experiments to promote technological innovation and agronomy in agriculture with the aim of reducing the release of nutrients into the Venice Lagoon Drainage Basin.

The specific objectives of the BIOFITO project were to implement technologies to recover and divert nutrients contained in digestate from livestock effluents, thereby diminishing their impact on the Venice Lagoon Drainage Basin, and to verify, though tests in the field, the agricultural efficacy of utilizing the recovered nutrients.

Figure 1 – Ammonium sulphate in 1,000 l bins and dried digestate.

PROJECT DESCRIPTION

The guiding philosophy of the BIOFITO project was to reduce the pollution load of livestock waste by developing a technological production chain consisting of anaerobic digestion followed by digestate drying. This strategy aimed to employ nutrient recovery processes to reduce the pollution load (nitrogen, phosphorous, organic substances, etc.) by at least 50% in the treated waste.

The two guiding principles were therefore protecting the livestock waste's fertilizing properties and implementing innovative post-treatment technologies to use with anaerobic digestion in order to support the economic sustainability of the production chain.

The process was studied using a farm-based anaerobic co-digestion plant fed with livestock effluents, dedicated crops and agro-industrial waste.

The plant was equipped with a post-treatment digestate drying system that produced:

- a concentrated fraction composed of a solid residue – the dried digestate – and a liquid product – ammonium sulphate – which are used to fertilize fields (Figure 1);
- a liquid fraction that has had a portion of the pollution loads removed and that undergoes further treatment before being released into the environment.

Fertilization with dried digestate and ammonium sulphate was compared with an analogous traditional chemical fertilizer in field tests, analysing the distribution methods and the economic-environmental costs of the treatment and distribution chain. The development of this integrated treatment chain was used to build a model in which renewable energy production, through the anaerobic digestion process, combines with chemical-physical processes designed to recover nutrients present in digestate, which can be fully utilized for agricultural purposes (Figure 2).

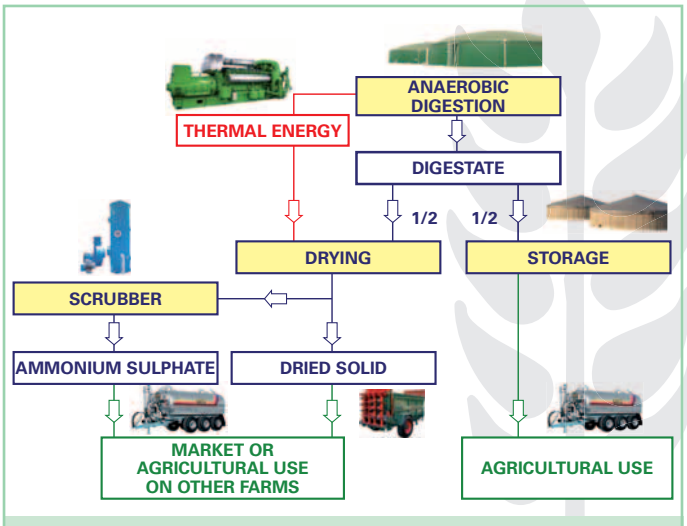

Figure 2 – Anaerobic digestion and digestate drying process chart.

PARTNERS

The project was developed with partners from the research world, represented by the Department of Biotechnology at the University of Verona and the University Consortium of Industrial and Managerial Economics, and the business world, represented by the Andretta e Bizzotto Farm in Marcon, with planning and general coordination by the Agricultural Research Department of Veneto Agricoltura.

PROJECT ACTIONS

The experiments involved monitoring the anaerobic digestion process (Figure 3), which was fed with livestock effluents, energy crops and by-products of various origins, and the additional process of thermally drying a portion of the digestate, with recovery of ammonium sulphate and dried digestate.

Figure 3 – Fermenters.

The monitoring results demonstrated that, of the approximately 250 kg of nitrogen that was fed into the anaerobic digester (as N), 200 kg was recovered through the drying process in the form of ammonium sulphate (approximately 150 kg) and dried digestate (approximately 50 kg) (Figure 4). Similar results were achieved for phosphorous: 37 kg of phosphorous entered the digester (as P) and more than half, 23 kg, was recovered in the dry fraction of digestate after drying.

Given the high concentration, these nutrient flows can easily and economically be diverted for agricultural use in another area.

In order to better understand the agricultural quality of the nutrient flows produced, the ammonium sulphate and dried digestate were utilized in tests conducted on experimental fields of maize and wheat at the Diana Pilot Farm in Mogliano Veneto. The results were compared to control fields fertilized with conventional NPK fertilizers. The performance of the post-treatment materials was almost identical to that of the chemical fertilizers (Figure 5).

RESULTS

In order to optimize management, the project involved a comparison of the cost to the economic and environmental benefits at the farm level, evaluating the possibility of integrating anaerobic digestion, digestate treatment and the sale or farm use of post-treatment products. This comparison was made through a cost-benefit analysis and demonstrated that the integrated technological production chain for managing anaerobic digestate and the nutrients it contains is sustainable from both economic and environmental perspective, with investment recovery times ranging from 4.3 years for financial aspects and 3.1 years for socio-environmental aspects.

Economically perspective, the production chain enables sustainable diversion of the effluents and digestate, reducing their volume and therefore transport and distribution costs, and recovery of the nutrients contained in the digestate with transformation into by-products like ammonium sulphate and dried digestate, which can be used instead of chemical fertilizers and have a market. Environmental sustainability is ensured by reducing the N and P pollution loads on land and in water bodies in the drainage basin, reducing atmospheric emissions and improving the soil's organic matter content and structure.

The project results provide a model system that can be replicated on other farms in the drainage basin. The net result would be the recovery of nutrients in a concentrated and easily transportable form and the reduction of the overall pollution load in the lagoon system.

Figure 5 – Experiments with wheat, comparison.

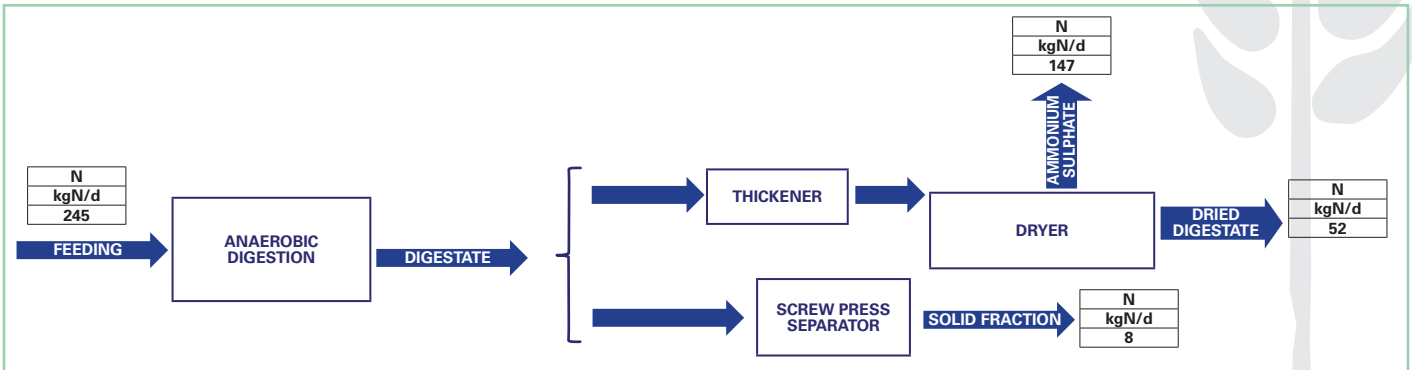

Figure 4 – Nitrogen balance.

Work group:

Lorenzo Furlan - *Veneto Agricoltura, Agricultural Research Department*

David Bolzonella - *University of Verona, Biotechnology Department*

Giulia Ruol Ruzzini - *consultant, University Consortium of Industrial and Managerial Economics (CUEIM)*

ISBN 978-88-6337-163-5

For information:
Veneto Agricoltura - Agricultural Research Department
viale dell'Università 14, Legnaro (Pd)
tel. 049.8293912 - e-mail: fata@venetoagricoltura.org

Printed July 2016

BIOFITO PROJECT – a project funded by Veneto Regional Council Decision No. 2580 of 6/8/2004, project profile C5.1.5
"Managing agricultural practices: promoting eco-friendly environmental innovation in agriculture in the Venice Lagoon Drainage Basin"