LIFE MIX_FERTILIZER - Valorization of the digestate from pig manure as new fertilizers with an organic / mineral base and gradual release

LIFE12 ENV/ES/000689

Project description  Environmental issues  Beneficiaries  Administrative data  Read more

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Project description:

Background

While the benefits of modern fertilisers are well known, their manufacture has a huge impact on the environment. The fertiliser industry alone accounts for 1.2% of the world’s total energy consumption. Ammonium is the basic component for the production of nitrogen fertilisers, but this process is very energy intensive (36.6 GJ/t NH3) as well as producing high emissions of CO2 (1 966.8 kg CO2 eq/kg) and nitrogen oxides. Organic fertilisers obtained from animal waste, however, can partially substitute inorganic fertilisers, but there are some difficulties linked to their variable composition, dosage and application, which limit their applicability and give rise to soil, air and water pollution. This problem is enhanced by the intensification in the world production of livestock that has led to the increase in the amount of manure produced in the EU, to 1 500 million tonnes/year.

Objectives

The objective of the LIFE MIX_FERTILIZER project was to demonstrate an innovative system for the agronomic valorisation of waste from the anaerobic digestion (decomposition without oxygen consumption) of pig manure (digestate) and to improve the associated environmental impacts. The project aims to obtain a new type of fertiliser with a mixed organic/mineral base, and with a gradual nutrient release due to the addition of the nitrification inhibitor 3-4 dimethylpyrazole phosphate (DPPP), along with an aqueous effluent fraction for use in fertigation. Specific objectives included the coordinated management of the demonstration plant and optimal integration of the individual steps for treating 120 m3 of digestate per day; recovery of the inorganic nitrogen from the
liquid phase for further use in new fertilisers to replace the synthetic mineral content; validation of the advantages of the new fertilisers in field trials; use of the water obtained as a by-product for the fertigation of sunflower; and a reduction of the carbon footprint associated with agricultural activities.

Results

The LIFE MIX_FERTILIZER project demonstrated the technical, economic and environmental feasibility of a novel pig manure treatment. This involved the construction of prototypes to recover inorganic nitrogen from the liquid phase by stripping (physical separation of components from a liquid stream), the formulation of new organic fertilisers containing an inhibitor to ensure the gradual release of nitrogen, and the application of the fertilisers and liquid fraction in field trials. The project achieved good results with direct environmental benefits. The new fertilisers are highly suitable for commercial purposes. The beneficiaries designed prototypes for the new fertiliser production, and adapted the facilities of Pural and Servimed to house the prototypes. During the project, the equipment to produce the pellets of organic fertiliser was re-designed, with the traditional worm screw system substituted by conveyor belts to transport the more fragile organic pellets. The installed stripping prototypes recovered 80% of the nitrogen from the liquid fraction of the digestate (pig manure). The project team characterised substrates for composting; formulated three mixtures for composting; produced three tonnes of compost; and produced and characterised three tonnes of new fertilisers (one tonne of each type). The new fertilisers were produced by composting the solid fraction of the pig manure in a specific mixture with poultry manure and straw. This methodology has a good replication and transfer potential. Three field trial plots (1 ha total) were sown with short-cycle barley. These trials demonstrated that the new organic fertilisers improved average production by up to 10% compared to traditional mineral fertilisers. Soil samples (78% of total samples) also showed an improvement in the percentage of organic matter compared to control plots with traditional mineral fertilisation. Two plots (0.7 ha total) sown with sunflower and fertigated with the liquid fraction phase (after the stripping process), however, had similar yields to those with traditional mineral fertilisation. The project tackled the problem of pig manure management. In 2015, the pig population in Europe was 148.5 million, located mainly in Spain and Germany, with the pig sector producing 178 million cubic meters of manure. A life cycle assessment showed that the carbon footprint of the new fertilisers was 62.5% lower and soil acidification 62.1% lower than for commonly-used mineral fertilisers. However, freshwater eutrophication increased in comparison with mineral fertilisers. Overall, the valorisation of pig manure reduced odours and environmental pollution. The project team therefore achieved an innovative solution for an existing environmental problem (management of organic digestate), by producing a new environmentally-friendly fertiliser that improves soil quality thanks to the slow release of nitrogen. As regards environmental awareness, the project aimed at informing the regional farmers about the benefits of organic fertilisers, and according to the feedback received, the level of interest in the project was very high. The proposed treatment process offers an economically-viable alternative for the management of pig manure, which will reduce the operation costs of pig rearing and increase its profit margin, thereby improving competitiveness. Fertiliser manufacturers will be able to include a new
product in their portfolio, which opens up new business opportunities. Farmers will have another fertilising product, at a similar price to mineral fertilisers currently used, that only requires one application due to its slow-release properties, so reducing farming costs. Regarding employment, the beneficiaries estimated that seven new jobs will be created. Proper management of pig manure will reduce odour from pig farms, which can have positive impacts for local inhabitants and for local tourism. The project’s solution, of using pig manure as raw material to produce an organic fertiliser with nitrate-release inhibitor, provides an alternative to directly applying it in fields, which generates environmental problems (odours, soil and underground water pollution). Thus, the project is directly relevant to the implementation of the EU Nitrates Directive (91/676/EEC) and the Waste Framework Directive (2008/98/CE). Further information on the project can be found in the project's layman report and After-LIFE Communication Plan (see "Read more" section).

Environmental issues addressed:

Themes

Waste - Agricultural waste

Keywords

fertiliser, waste use, waste recycling, manure, agricultural waste

Target EU Legislation

- Waste
- Water
- Directive 91/676 - Protection of waters against pollution caused by nitrates from agricultural so ...

Natura 2000 sites

Not applicable

Top
Beneficiaries:

Coordinator: Fundación CARTIF
Type of organisation: Research institution
Description: CARTIF is a horizontal centre which covers a wide range of scientific disciplines including automation and process control, mechanical engineering, robotics and computer vision, energy, environment, food and chemicals, ICTs and biomedical engineering. The centre is supported by laboratories that have emerged from different research areas. CARTIF’s primary focus is to contribute to social and economic development by promoting technological innovation via the development and publication of research.

Partners: Centro Provincial de Jóvenes Agricultores (ASAJA-SORIA), Spain; Purines Almazán S.L., Spain; SERVIMED, Spain

Top

Administrative data:

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Duration: 01-SEP-2013 to 31-AUG-2016
Total budget: 1,258,717.00 €
EU contribution: 617,232.00 €
Project location: Castilla-León (España)

Top

Read more:

Project web site: Project's website
Project web site - 2: Project's Twitter page
Publication: After-LIFE Communication Plan:
Title: After-LIFE Communication Plan (Spanish version, with abstract in EN) Year: 2016 Editor: CARTIF Centro Tecnológico No of pages: 8
Publication: Layman report:
Title: Layman report Year: 2016 Editor: CARTIF Centro Tecnológico No of pages: 16
Publication: Technical report:
Title: Project's final technical report (Spanish version) Editor: CARTIF Centro Tecnológico No of pages: 62