



NUTRI • KNOW

# Transport

Technologies, tools and recommended practices from NUTRI-KNOW's EIP-AGRI Operational Groups

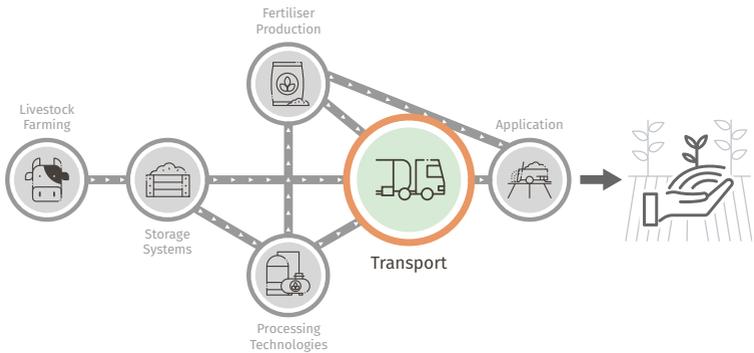




# Introduction

Nutrient Management stands as a paramount concern for farmers across Europe and efficient transport is a key link in the nutrient value chain. Efficient transport of nutrients not only reduces logistical burdens, but also plays an important role in minimising environmental impacts. From optimising routes to using innovative technologies, the transport step aims to streamline the flow of nutrients from source to application site.

This booklet explores strategies and technologies to improve nutrient transport efficiency, minimise emissions and maximise nutrient use efficiency, thereby promoting a more sustainable and economically viable agricultural landscape.





## Transport

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This booklet explores innovative strategies and technologies aimed at optimising nutrient transportation processes in alignment with sustainability and resource efficiency goals. The Operational Groups featured here concentrate on minimising slurry transport expenses, employing computer algorithms to optimise transport logistics, and producing pelletised biofertilisers. For more information see the links to the home pages of the Operational Groups presented below.



## Organic Farming and Nutrient Management

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Nutrient management on organic farms is based on working with ecological processes as well as the recycling of existing nutrients to build soil fertility, including soil organic matter and biological activity that promotes circular systems and helps to minimise dependence on external inputs. Alongside good soil management, efficient use of nutrients is critical, owing to their limited availability. Additional sources of organic materials outside the farm may be needed to secure sufficient nutrient levels, particularly on stockless farms, where links between arable and livestock enterprises may not be established. Under EU organic legislation, application of organic manures and other waste materials must be authorised for use in organic production.



# Slurry Concentrator to Reduce Transport Costs

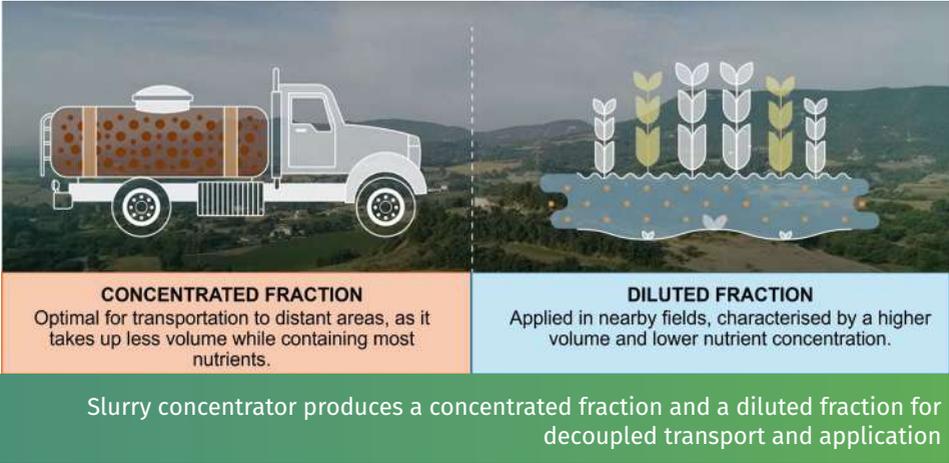
In regions with high livestock density, there is an imbalance between the volume of nutrients generated and the farmland available for their application. Manure and slurry management is a particular challenge for farmers, especially those with small and medium-sized farms. There is an urgent need for effective solutions that improve and simplify the application of these materials as fertilisers and, when necessary, facilitate their transport to nutrient-deficient areas.

The Slurry Concentrator has tried to provide an innovative solution to this challenge that consists of separating manure into two phases: a semi-liquid phase (concentrating the majority of the organic matter and nutrients) to be transported and applied to distant fields where nutrients are not available; and a liquid phase (with a low nutrient concentration) to be applied in nearby fields. The differentiated management of the two phases is designed to minimise transport costs and optimise the application of nutrients to the soil from the agronomic and environmental perspectives.



Top view of the concentrator and the two ponds

## Slurry Concentrator to Reduce Transport Costs



### Benefits

- The Slurry Concentrator improves manure management and farm sustainability. It is a mobile unit, allowing shared use, reducing investment costs, and making management more efficient compared to fixed systems.
- Transporting treated slurry instead of untreated over 135 km can lead to significant annual savings. Breeding farms see benefits at 350 m<sup>3</sup> of treated slurry, while fattening farms benefit at almost 500 m<sup>3</sup>.
- The system requires two ponds for storing liquid fractions, but it is versatile, climate-independent, and suitable for any farm producing livestock slurry.
- Initial investment is quickly recovered through savings and efficiencies. It has low maintenance, minimal energy consumption, no building work needed, and very low installation costs.



### Current Status

Operation at a pilot-scale demonstrated the technological and economic viability of the technology for farms and the cooperative to manage manure more efficiently.



More information can be accessed at the home page of the Operational Group **Slurry Concentrator**

# Development of Tools to Optimise Manure Transport Logistics

Appropriate and efficient manure management involves optimising transport to reduce distances, working time, fuel consumption and overall costs, thus minimising the environmental impact and economic burden on farmers.



Conductivity meter installed in the transport tank

In Catalonia, livestock manure transport vehicles (such as tanks, trailers, and tractors) are required to have an electronic global positioning system (GPS) and a unit for receiving, recording, and transmitting data about the origin, destination, and characteristics of the manure. This data must be sent in real-time to the platform managed by the department responsible for agriculture and livestock farming in Catalonia. The Operational Group Manure Management Tools has improved management logistics by using computer tools to optimise transport routes, register applications and ensure the traceability of fertiliser applications on the plot. The aim was to optimise transport routes and accurately locate and record both loading points and fertiliser application sites.

### Benefits

- To make long-distance manure transport more economical, it is advantageous to transport manure with a high nutrient content, either from the source or after treatments. This was achieved by determining the nutrient content of manure through the use of conductivity meters installed in the transport tanks, which measure electrical conductivity and the levels of various nutrients.
- The online monitoring devices installed in transport tanks record information including the location and routes of the application vehicle, timetables, number of operations per loading and unloading point, the total kilometers traveled, etc. This makes it possible to generate the livestock manure management book as well as the fertilisation plans more quickly and accurately.



Field Use of a Manual Conductivity Meter to Determine Slurry Application Rates Based on Nutrient Content



### Current Status

Several transversal actions have been carried out in coordination between the participating Catalan cooperatives, and the management tools are near-to-practice.



More information can be accessed at the home page of the Operational Group **Manure Management Tools**



# Tailor-Made Pelletised Biofertiliser to Cut Transport Costs

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The main objective of the Operational Group Bioferti+ is the conversion of a bovine manure composting plant into a plant producing high-quality tailor-made fertilisers in the form of pellets to be used to fertilise woody crops (e.g., vineyards and apple orchards).

## Benefits

- The pelleting process offers an economically competitive benefit in terms of transport. Also, it represents an advantage from a practical point of view for farmers, since it allows them to use the machinery they already use for chemical fertilisation.
- The formulation is adapted to the specific needs of each crop, considering factors such as production type, soil characteristics, and local climate conditions.
- Pellets provide a sustained release of nutrients, gradually decomposing to nourish soil and crops over extended periods. Long-lasting pellets reduce the need for frequent applications, contributing to more sustainable farming practices.

## Tailor-Made Pelletised Biofertiliser to Cut Transport Costs



The pelleting process provides a cost-effective advantage for transportation



### Current Status

Significant improvements have been made to the cow manure composting process, resulting in the production of a tailor-made fertiliser specifically formulated for vineyards and apple orchards. The pellets derived from this process are currently undergoing evaluation to assess their agronomic efficacy.



# Manure Transport Models and Smart Logistics

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The regions of Flanders, Gelderland, Catalunya and Oberpfalz, although geographically distant, share common challenges associated with livestock farming, manure production, and environmental sustainability and associated limitations on manure application.

The FERTIMANURE project sheds light on critical aspects of manure management, including spatial patterns of surplus manure, economic implications for logistics, and the potential for innovative technologies to reduce transport distances and mineral fertiliser input. It has developed a tool to determine the potential for the implementation of such innovative technologies.

## Benefits

- Implementation of pilot technologies focused on nutrient recovery can significantly reduce the costs associated with manure and fertilisation management.
- By using innovative technology to recover nutrients from animal manure, substantial amounts of valuable nutrients can be recovered as an alternative to mineral fertilisers. This not only reduces the external demand for nutrients, but also minimises the costs associated with manure transport.
- Cost reductions achieved outweigh the increased processing costs in several municipalities with excess nutrients in three regions (Flanders, Gelderland and Oberpfalz) except for Catalunya, where the technology is considered too costly. As a result, the newly produced bio-based fertilisers have gained acceptance in the market, capturing a market share ranging from 20% to 40%.



### Current Status

The primary objective of this tool is to address regional policy decisions concerning manure management, serving as a comprehensive database for the regions under study. The tool has been expanded to include additional regions such as Bretagne, Lombardy, all provinces of the Netherlands, and some regions of North-West Germany. While it can potentially be adapted for new regions, its use requires specific paid-for software (General Algebraic Modelling System), which limits accessibility, particularly for non-academic users.



## Summary

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### Products to Provide a **Cost-Effective Advantage** for **Transportation**

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- High-quality, tailor-made pelletised fertilisers offer economic transport benefits and practical advantages for farmers using existing chemical fertilisation machinery.

### Tools to **Optimise Manure Transport Logistics**

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- The use of specialised software can significantly streamline fertiliser transport logistics by optimising routes, accurately registering applications and ensuring traceability of fertiliser applications on the plot.



## Technologies to **Optimise Nutrient Transport** From an Economic and Environmental Perspective

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- The innovative slurry concentrator produces two liquid fractions with fertiliser potential: a concentrated fraction to be transported and applied to distant fields where nutrients are not available; and a diluted fraction to be applied in nearby fields. The differentiated management of the two phases is designed to minimise transport costs and optimise the application of nutrients to the soil from the agronomic and environmental perspectives.
- Understanding the spatial patterns of surplus manure in specific regions and their economic implications for logistics is crucial for identifying opportunities to reduce transport distances.

## Future Benefits

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- Pelleted biofertilisers concentrate nutrients, reducing transport costs, while slow-release properties minimise leaching and increase plant uptake efficiency.
- Specialised software optimises routes, reducing fuel consumption, and ensures precise nutrient application, enhancing efficiency and reducing environmental impact.
- The Slurry Concentrator minimises the total number of journeys required to transport manure, resulting in significant reductions in fuel consumption and greenhouse gas emissions.
- This makes it possible to generate the fertilisation plans more quickly and accurately.

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