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Storage Systems

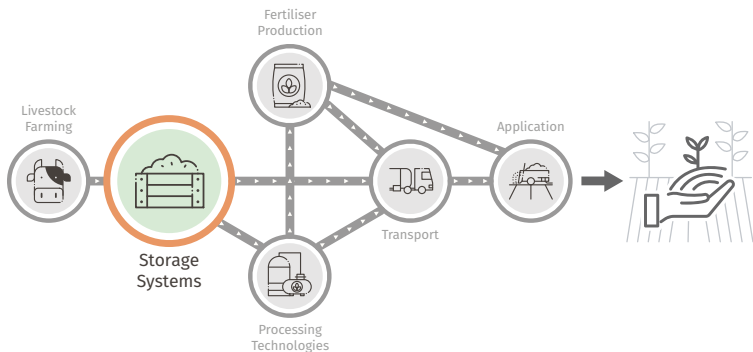
Technologies, tools and recommended practices from
NUTRI-KNOW's EIP-AGRI Operational Groups



Introduction

It is essential to have sufficient capacity for storing manure in order to facilitate its application on land at optimal times. Manure should be applied when crops require nutrients, such that the risk of loss to the environment is minimised. Storing manure is also an integral component of processing and treating animal slurry, enhancing the efficient utilisation of plant nutrients contained within the manure.

This booklet provides an overview of decision support tools, technologies, and recommended practices that are the outcomes of key Operational Groups dedicated to improving manure storage and management. These groups and associated projects have concentrated on refining manure storage processes and providing knowledge to farmers regarding management and treatments that mitigate environmental pollution, particularly ammonia and greenhouse gas emissions. They also contribute to the efficient and predictable use of nutrients in manure.



Manure Storage

This booklet focuses on tools, recommendations, and Best Available Technologies (BAT) for manure storage. These tools aim at promoting the most environmentally friendly management of manure as a fertiliser to ensure sustainable and secure food production. The innovations encompass processes, technologies, or facilities designed for the storage of animal manure from livestock farming. This allows for its use at a later stage in the manure management chain, either untreated or following valorisation through biogas or fertiliser production. For more information see the links to the home pages of the Operational Groups presented below.



Organic Farming and Recycled Manures

Strategies to optimise recycled organic manure use through improvements in handling and processing can play an important role in supporting soil fertility on organic farms. As well as helping to maintain a sustainable nutrient status, manure recycling seeks to build soil organic matter and biological activity. Materials and processing technologies used in handling and processing must be in line with organic principles and standards. Materials, for example, derived from animal waste obtained from permanently housed operations are not permitted in organic farming owing to potential contamination risk. Under EU organic legislation application of organic manures and other waste materials must be authorized for use in organic production.

Slurry Storage – Decision Making Tools

The Operational Group 'Manure Management Tools' has developed decision support systems that provide farmers with key knowledge to install the best storage systems for manure management. The systems include the use of tools (such as conductivity meters or computer applications) that provide information to the decision making of best livestock manure management. The recommendations are based on the fact that storage is an integrated part of the management of manure. Safe storage of animal manure is necessary in order to make it possible to spread the manure in optimal time, when the crops can take up the required nutrients at a reduced risk of environmental impacts.

The National Emission Ceiling Directive 2016/2284/EU sets national limits for the emissions of ammonia from countries in the European Union. Therefore, technologies that reduce emissions during slurry storage can be an important consideration in supporting farmers' decision-making. One such method is acidification which can potentially reduce emissions of ammonia and greenhouse gases, while another involves the addition of straw to create a surface barrier that reduces ammonia emission. Both methods are considered relatively inexpensive ways to mitigate emissions. Additionally, storing liquid manure in large flexible closed bags is a technology to produce biogas and reduce emissions.

Benefits

- The use of conductivity meters during application for the in-situ determination of the NPK content allows the fertilisation to be optimised.
- A computer application has been tested to generate the livestock management book as well as fertilisation plans more quickly and accurately by using devices installed in transport tanks. The



Biogas production – stored slurry covered and methane collected

computer application also generates real-time monitoring, control of the vehicle's location, routes, timetables, number of operations per loading and unloading point, total kilometres travelled, etc.

- Application of emission reduction strategies during slurry storage, such as acidification and the addition of plant material (straw), is relatively economical
- These methods, as well as the use of flexible bags, allow for the reduction of ammonia and greenhouse gas emissions,
- Improvements to be implemented in the management of livestock manure, mainly slurry, have been identified. This includes the use of hose equipment to apply liquid manure; the use of conductivity meters to estimate the nutrient content of slurry; the application of liquid manure in crop cover; and the adequacy of the dose of nutrients to be applied to crops.



Current Status

The development project is finalised, and the decision support system is being used by involved farmers for consultancy purposes.



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

Biogas Production - Flexible Ponds

The Manure Management Tools Operational Group has developed a decision support tool that assesses the potential for biogas production when storing slurry in flexible ponds. This tool assesses the transformation of organic matter in the slurry, the production of methane, the production of heat and power, that substitutes energy production from fossil fuels and reduces greenhouse gas emissions. The novelty of this tool lies in its inclusion of the effects of organic nitrogen being transformed into ammonium and the potential increase in ammonia emissions due to the rise in pH in the anaerobically digested slurry (digestate). Furthermore, biogas plants are constructed on the farm, so the farmer avoids manure transport, which reduces costs. Methane emissions from stored digestate will be lower due to a reduced organic matter content if the digestate is cooled down to ambient temperatures with heat exchangers. The project provides recommendations about the efficiencies of technologies that reduce emissions. This includes a calculation of total emissions from the fractions produced when separating the slurry into a liquid fraction with little dry matter and a solid high dry matter fraction.



Training of farmers about analysed BATs

The project helps to assess ammonia emissions from solid manure being composted. It includes the effect of addition of a range of substrates to improve composting and provides a calculation of the final quality of compost after having added substrates.

Benefits

- Valorisation of slurry based on its fertilising capacity, making it a competitive and attractive product for agricultural use.
- Savings in mineral fertilisers due to the calculations of the nitrogen needs, the treatment systems, and the tasks of advice and optimisation of the contributions in cases of double harvest.
- Rationalisation of nitrogen inputs in crops with the consequent minimisation of nitrate losses due to leaching and precise applications to the soil.
- Minimisation of emissions and discomfort due to bad smells, have a consequent positive impact.



Current status:

The development project is finalised, and the decision support system is used by involved farmers, but is not available in the market.



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

Digestate Less Emissive if Treated by Struvite Process

Digestate from biogas plants must be stored and applied to crops when there is a need for its excellent content of plant nutrients. However, the downside is the high emissions potential from the liquid digestate during the storage phase. Ammonia emissions are high because there is a significant amount of nitrogen in ammonia form in the digestate, and greenhouse gases (methane) are emitted due to the high organic matter content, even if it is less than in untreated slurry. The goal of the Struvite Operational Group was to reduce the nitrogen and phosphorus content in the digestate by producing struvite, a fertiliser product consisting of ammonium, phosphorus, and magnesium in a stable crystalline form.

Recovering nutrients from digestate into a stable, small-volume product (precipitated) resulted in a clarified treated fraction characterised by reduced nitrogen, phosphorus, and organic matter content compared to the untreated digestate.



Digestate treated and stored



Tests proved that struvite treatment with the prototype was effective in reducing ammonia and greenhouse gas emissions, particularly methane, from stored treated digestate compared to emissions from stored untreated digestate.

Benefits

- Struvite produced contributes to recycling phosphorous and nitrogen.
- Facilitates the relocation of nutrient surplus from high livestock areas to areas in need of mineral fertiliser.
- The reduced ammonia nitrogen content in the treated digestate reduced ammonia emissions by 42% from the storage.
- The limited organic matter content in the treated digestate resulted in an 86% reduction in methane emissions from the digestate liquid storage phase.
- Tests at real farm scale were conducted and technology implemented to ensure the accurate dose to make the process more efficient.



Current Status

The project has ended - The prototype for the crystallisation of struvite was installed at the Colombaro farm for the treatment of pig digestates.



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



Summary

Tools that **Help Farmers Select Storage System**

- Select the optimal storage systems to minimise pollution (ammonia and greenhouse gas emissions) and enable the application of manure on land with high and predictable plant nutrient uptake, thereby reducing the risk of pollution from leachates.
- Use additives efficiently to improve composting processes and provide estimates of the final quality of composting after substrate addition.
- Evaluate the biogas production potential when storing slurry in flexible cover ponds.

Technologies and Recommendations to **Reduce Emissions from Manure**

- Reduce the emission of gases by adding acids to the slurry, covering the slurry with straw, or store it in impermeable bags.
- Optimise reactor technology to efficiently produce crystal struvite, which consists of ammonium, phosphorous and magnesium. Struvite is an efficient nitrogen and phosphorous fertiliser. The production of struvite will contribute to reduced ammonia emissions.

Future Benefits

- Introduction of novel products for liquid or solid manure may reduce ammonia and greenhouse gas emissions.
- Tests show that cleaning slurry channels and pits reduces methane emissions from livestock barns and potentially reduces emissions from manure storage facilities.







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