Technical Sheet for Solution Implementation

Sustainable Manure Management

©S. Vilumbrales (EHU)

Thematic area:
Environmental Sustainability.

Priority: How to manage grassland in the face of the future challenges?

Need: Manure management: what storage? what use (better use of horse manure, recycling of nutrients)?

Solution EU number:
GM-07.

Content of the solution: Collection, storage, treatment, and valorization of equine manure through direct field application, composting, or external recycling pathways. The system integrates manure as a resource for soil fertilization, pasture maintenance, and circular nutrient management while reducing environmental losses and improving farm hygiene.

Reasons for Implementing the Solution

Proper manure management allows the recycling of valuable nutrients (N, P, K) back into pasture systems, supporting soil fertility, forage production, and long-term grassland sustainability. At the same time, it reduces nutrient losses, odour, parasite pressure, and environmental contamination while improving overall farm hygiene and efficiency.

Description of Solution Strategies

Manure as a nutrient resource: Equine manure represents several million tons of organic matter that can be recycled on agricultural land. Knowledge of the characteristics and agronomic benefits of equine manure is necessary to optimize its recycling on site and/or on other agricultural land.

Equine manure and compost are valuable organic fertilisers that return nutrients to the soil:

- Provide Nitrogen (N) → supports plant and grass growth.
- Provide Phosphorus (P) → supports root development.
- Provide Potassium (K) → supports leaf development and plant resilience.
- Also contribute organic matter, improving soil structure, biology, and water retention.

The agronomic values of horse manure and compost are as follows (Valfumier project, IFCE, 2023; Doligez et al., 2022).

Manure based on straw bedding

	NH4	N	P	K
HORSE MANUNRE	0.12	5.80	3.20	9.30
CATTLE MANURE	0.80	4.70	2.30	5.60

Straw-based manure compost: (2 turnings and temperature increases in the pile)

	NH4	N	P	K
HORSE COMPOST	0.10	6.80	4.30	10.1
CATTLE COMPOST	0.60	6.70	3.60	10.8

Although nutrient composition is comparable to cattle manure, only a small fraction of nitrogen (approx. 5–8%) is immediately plant-available in the first year, meaning manure acts mainly as a slow-release soil amendment rather than a fast-acting fertiliser.

Regular application:

- compensates nutrient losses from grazing and mowing.
- maintains long-term soil fertility.
- prevents soil depletion.
- improves physical, chemical, and biological soil properties.

Manure and compost therefore function primarily as soil conditioners and long-term fertility tools, not as immediate nitrogen fertilisers.

Fertilisation and application strategy: Regular application is necessary to replace nutrients exported through grazing or mowing

- Indicative application ranges (depending on system intensity):
  - Compost: ~8–12 t/ha/year.
  - Manure: ~15–20 t/ha/year.
  - Higher doses possible on longer rotation cycles.
- Leaf or grass analysis can be used to adjust P and K fertilisation needs.
- Without analysis, regular manure/compost application helps prevent nutrient depletion.

Application timing:

- Preferably autumn or winter for manure (not too fresh).
- Compost can be applied more flexibly (with minimum waiting period after turning/ hygienisation).
- Respect safety intervals before grazing, especially for fresh manure.

Manure collection and handling systems: To reduce labour and improve efficiency, different technical systems can be used:

- Manual or mechanised collection (e.g. wheelbarrows, tractors, vacuum systems, robots).
- Regular removal from stables, paddocks, and turnout areas reduces labour peaks and improves hygiene.

Storage and treatment options

a) Solid manure storage (permanent structure)

- Concrete floor + roof to prevent leaching and rainwater infiltration.
- High investment cost.
- Requires machinery (e.g. tractor) for emptying.
- Good environmental protection (reduced nutrient loss).

b) Mobile storage (containers / skips)

- Lower initial investment.
- Can be rented.
- Requires frequent emptying.
- Must be covered to prevent water contamination.
- Allows direct transport to spreading areas.

c) Composting systems

- Enhances nutrient stability and soil value.
- Improves hygiene and reduces pathogens.
- Produces stable organic fertiliser for pasture use.

d) External valorisation pathways

- Biogas plants as end-users of manure.
- Composting and recycling into agricultural fertilisers.
- Hygienisation processes enabling reuse of bedding material within farms (closing nutrient loops).

Recycling and circular use

- Manure and compost are returned to pastures and fields to:
  - maintain soil fertility.
  - replace nutrient exports from grazing/mowing.
  - improve soil structure and vegetation resilience.
- Possible reuse of treated manure as bedding material after hygienisation (novel systems).

Technical Sheet for Solution Implementation

Sustainable Manure Management

Implementation Steps

1. Regulatory and initial planning
- Draw up a provisional manure and compost spreading plan for the farm (preferably in autumn).
- Inform yourself about national and local regulations (spreading periods, recording requirements, environmental rules).
- Seek advice from an agronomy or grassland management specialist if needed.

2. Assessment of manure resources
- Assess the total amount of manure and/or compost available on the farm.
- Select the appropriate collection and storage method (e.g. skip, solid storage, composting system).
- Install or adapt manure storage infrastructure if required.

3. Field and nutrient needs analysis
- List all farm plots and evaluate their current condition and nutrient status.
- Identify plots with the highest need for fertilisation.
- Prioritise fields based on productivity, degradation level and management goals.

4. Matching supply and demand
- Compare available manure/compost quantities with field requirements.
- Determine whether on-farm production is sufficient.
- If not sufficient, define priority plots for application.

5. Spreading plan and execution
- Establish a detailed spreading schedule (timing, field, quantity, type of product).
- Apply manure or compost preferably during appropriate periods (e.g. autumn, according to regulations and soil conditions).
- Ensure proper handling to avoid nutrient losses and environmental impact.

6. Complementary fertilisation (if needed)
- If additional fast-available nitrogen is required for grass growth, consider slurry or mineral nitrogen fertilisation as a complementary measure.

7. Recycling and system optimisation
- Consider recycling options for manure within the farm system, including fertilisation, composting, biogas production, or cooperation with external users.
- Continuously evaluate manure use efficiency, nutrient balances and storage capacity, and adjust management practices accordingly.
- Heat-based hygienization systems can sanitise manure and enable the reuse of processed material as bedding on the farm, supporting circular resource use and reducing bedding purchases. Proper hygienization is essential to avoid pathogen contamination.

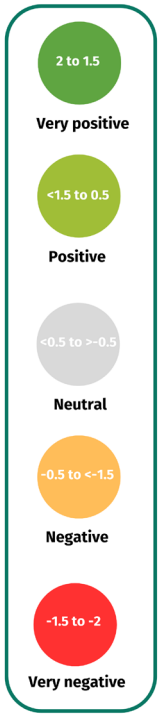
Photo: ManPas manure hygienization equipment that turns horse manure into bedding material, substrate for green houses etc. (Picture: Leena Rantamäki-Lahtinen 2025)

Pasteurized horse manure (produced via Manpas system; https://www.manpas.fi/). Picture: Leena Rantamäki-Lahtinen 2025

Sustainable Manure Management

How Will this Solution Impact the Performance of your Farm?

TOPIC	SCORE
Social	1.00
Economics	0
Welfare	1.00
Health	0.75
Environmental	1.50
Pasture access and management	0.50
Global	0.88



Traffic light explanation

Socioeconomics: This solution will support the social performance of the farm because it improves farm organisation, hygiene, and compliance with environmental regulations, enhancing the farm's reputation and demonstrating responsible nutrient management. More efficient and structured manure handling can improve working conditions, reduce labour peaks, and contribute to a cleaner and more predictable working environment, even though implementation may require adaptation and staff training.

This solution will not have effect on the economic performance of the farm because its financial benefits and costs tend to balance each other. While improved nutrient recycling, reduced nutrient losses, and better fertilisation efficiency can support long-term farm performance, these advantages are often offset by investment costs, labour requirements, storage infrastructure needs, transport constraints, and the practical challenges of manure processing and utilisation. Economic outcomes therefore depend largely on farm conditions, available technologies, and compliance requirements.

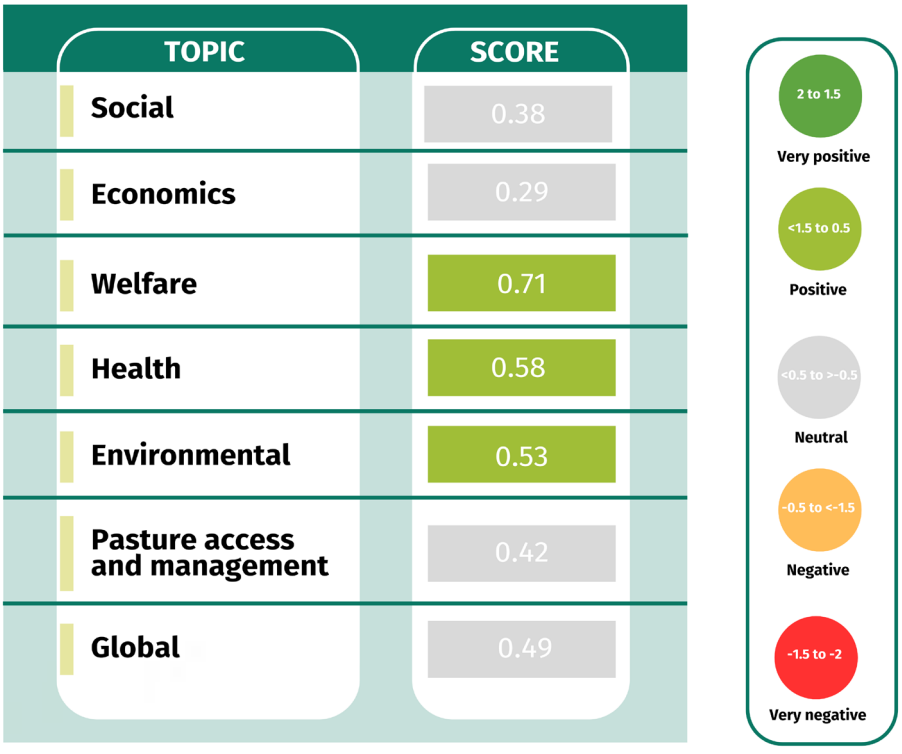
Health & Welfare: TThis solution will support the everyday farm's health performance by helping to maintain low levels of pain, mortality, and drug use if the manure will be regularly cleaned. Clean, fresh bedding reduces the pathogens, so the equines are less exposed to potential health issues. Also, manure management like composting reduces the exposition to pathogens.

Sustainable Manure Management

This solution will support equine welfare performance by maintaining a positive emotional state and provision of welfare-friendly housing conditions, since the horses benefit from fresh bedding, especially the straw, which may be eaten or searched of hay remnants, which increase the time mouth activity. This occupation is critical to ensure one of 3F criteria, the foraging behaviour, so contributes to appropriate emotional state in animals.

Environmental sustainability: This solution will support on the environmental performance of the farm because it reduces nutrient losses, improves fertilisation efficiency, and thus supports climate change adaptation and mitigation. It also protects water quality and supports soil fertility and biodiversity. The solution also strengthens environmental reputation and regulatory compliance. This solution will support on the land access or management performance of the farm because integrates manure into long-term farm operations.

How Will this Solution Impact the Resilience of your Farm?



Socioeconomics: This solution will not impact social performance of the farm facing external challenges assessed because sustainable manure management mainly improves technical organisation, hygiene, and environmental compliance rather than directly changing the farm's social functioning during crises. Although better manure handling can slightly ease work organisation during pandemics, improve farm image

under stricter welfare standards, and support knowledge exchange on environmental good practices, manure management often remains labour-intensive and technically constrained by infrastructure, regulations, weather conditions, and limited land availability.

This solution will not impact economic performance of the farm facing external challenges assessed because improved manure recycling mainly provides indirect and long-term benefits through better nutrient efficiency, soil fertility, pasture productivity, and reduced dependence on external fertilisers or feed inputs. These advantages can strengthen resilience during inflation, drought, or restricted grassland access, while supporting biosecurity and hygiene during disease outbreaks. However, the solution also requires investments in storage, mechanisation, and infrastructure adaptation, and its effectiveness remains constrained by labour requirements, regulatory obligations, transport limitations, and manure utilisation opportunities.

Health & Welfare: This solution supports the farm's health performance, as it reduces the need for medication when the farm is exposed to external pressures. The animal health may be maintained if the manure is composted and recycled, and clean fresh bedding is provided, thus the spread of the pathogens is limited.

This solution has positive effect on farm welfare performance, as it improves health and welfare-friendly housing conditions and promotes a positive emotional state when the farm is subjected to external pressures as it provides pathogen-free facilities, the lying comfort and additional feeding activity.

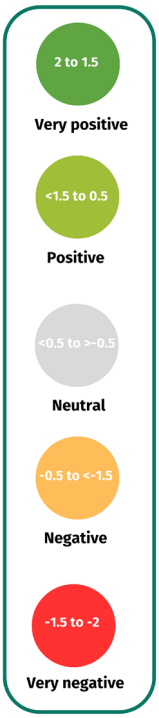
Environmental sustainability: This solution will support environmental performance of the farm facing external challenges assessed because it enhances long-term soil resilience and reduces runoff and, thus, supports climate change mitigation adaptation, halting biodiversity loss and water management. The solution requires protection of manure storage from rain and flooding.

This solution will not impact land access or management performance of the farm facing external challenges assessed because it promotes grassland over all grassland management, but does not significantly support farm's recovery during the crisis although compost improves soil structure and water retention during drought.

Sustainable Manure Management

How can this solution help your farm to face specific external challenges to be more resilient?

CHALLENGES	SCORE
Inflation	0.46
Pandemic	0.42
High welfare standard	0.67
High infectious diseases	0.33
Extreme weather event	0.65
Loss/limited access to grassland	0.42



Inflation & Social Crises: Social challenge: This solution will not impact the global performance of the farm facing pandemics because sustainable manure management mainly supports operational continuity, hygiene, and pasture management rather than directly protecting farms from labour shortages or income losses caused by pandemics. While improved manure handling can slightly facilitate farm organisation, maintain horse health and welfare, and reduce dependence on external inputs during supply disruptions, the equine sector remains highly dependent on human labour and service activities. Economic challenge: This solution will not impact the global performance of the farm facing inflation because better manure recycling and composting mainly generate gradual savings through improved soil fertility, reduced fertiliser dependency, and more efficient pasture productivity. Although these effects can strengthen long-term resilience and reduce some input costs, the solution still requires investments in storage, equipment, labour, and energy, which may limit its short-term economic benefits during inflationary periods.

Welfare & Diseases: This solution does not directly enhance the global farm performance nor does it provide effective protection during an outbreak of infectious disease, although maintaining stables free from manure-related pathogens is essential for equine health. However, it may support the farm's global performance to increasingly stringent animal welfare regulations, as proper manure management together with continuous access to fresh bedding and supplementary fodder are key components of maintaining high welfare standards.

Climate Change & Access to Land: Environmental challenge: this solution will support the global performance of the farm facing abnormally high or low temperatures, draught, excessive raining, windstorms and/or flood because composted manure improves soil structure and increases organic matter, which enhances water retention during drought periods. This directly supports pasture productivity and good maintenance (3F). Better soil fertility reduces dependence on external feed under hay shortages, contributing to economic stability. Improved soil health strengthens long-term adaptation capacity, while environmental benefits such as reduced runoff and better water infiltration become particularly relevant under extreme weather conditions. If rainfall increases, it is important to ensure that water does not enter the manure pit. Rain and floods make manure handling more difficult

Land access/management challenge: this solution will not impact the global performance of the farm facing loss or limited access to agricultural land because effects are two-folded. When access to community grasslands is restricted, improved nutrient efficiency helps maximise productivity of the remaining available land. Composting enhances soil fertility and supports pasture regeneration on owned or leased plots. Better soil structure and organic matter improve land resilience, allowing more efficient use of limited grazing areas. While the solution cannot replace lost access to external grasslands, it strengthens adaptive capacity by improving the quality and sustainability of the land that remains under the farmer's control. However, if there is a lack of land, manure handling can become difficult. The options are reduced.

Cost-benefit Analysis

Costs

Socioeconomics:

- Investment costs for manure management infrastructure, including impermeable storage platforms, collection systems, covered storage, composting facilities and spreading equipment.
- Possible construction permits and administrative requirements.
- Costs for equipment maintenance, transport and manure processing.
- Additional labour and time for manure collection, compost monitoring, spreading plans and record keeping.
- Costs for leaf analysis and complementary mineral fertilisation if rapid nitrogen availability is required.
- Short-term financial pressure due to initial investments and operational costs.
- Processing technologies (e.g. manure hygienisation, energy recovery) may still be expensive or economically challenging for small farms.
- Bureaucratic requirements and transport logistics can complicate manure valorisation systems.

Benefits

- Improved nutrient efficiency can reduce expenditure on mineral fertilisers.
- Better nutrient management supports long-term soil fertility and pasture productivity.
- Compost and manure can be transformed into valuable soil improvement products.
- Potential development of innovative valorisation pathways such as compost heat recovery, bedding recycling or biogas use.
- Improved compliance with environmental regulations may reduce the risk of penalties or subsidy reductions.
- Shared equipment and regional manure processing solutions can reduce individual farm costs.
- Sustainable manure management can strengthen farm image and long-term economic stability.

Health & Welfare:

- Temporary disturbance to horses during construction or installation of manure management infrastructure.
- Improperly hygienised compost may pose contamination risks from pathogens such as E. coli, Salmonella or Enterococcus.

- Regular manure removal improves hygiene in stables, paddocks and pastures.
- Reduced pathogen accumulation and lower contamination pressure on grazing areas.
- Better ground conditions in high-use areas.
- Improved hygiene contributes to disease prevention and herd health stability.
- Reduced health risks may indirectly lower veterinary costs.

Sustainable Manure Management

Costs

Environmental Sustainability:

- Incorrect spreading timing or excessive application rates may increase nutrient losses and pollution risks.
- Overfertilisation may negatively affect botanical diversity, particularly legumes.
- Compost turning, transport and mechanised treatment systems require energy and may generate emissions.
- Construction materials such as concrete platforms have an environmental footprint.
- Potential ecotoxicological impacts linked to residues from veterinary treatments (e.g. deworming products).

Cooperation between Farms:

- Administrative burden and documentation requirements for manure transfer between farms.
- Coordination and traceability requirements when exporting or importing manure.
- Additional time needed for communication and organisation between partners.

Benefits

- Reduced nutrient leakage and improved nutrient cycling within the farm system.
- Increased soil organic matter and improved soil fertility.
- Better manure management reduces ammonia emissions and nitrate leaching.
- Sustainable fertilisation supports productive and species-rich grasslands, including legumes.
- Improved grassland management contributes to biodiversity, ecosystem services and attractive agricultural landscapes.
- Appropriate use of mineral nitrogen and legume-based systems can optimise forage production while limiting environmental impacts.
- Compost and manure application support long-term maintenance of grassland productivity and soil health.

- Shared use of spreading equipment and manure processing infrastructure can reduce costs.
- Surplus manure can be transferred to farms with nutrient needs, improving regional nutrient balance.
- Compost can be exchanged or marketed as a soil improvement product.
- Cooperation between farms can strengthen local networks and resource efficiency.
- Joint manure management solutions may improve economic and environmental sustainability at regional level.

Additional Resources

Websites

- https://www.encyclopediapratensis.eu/product/guide-paturage/fertiliser-les-prairies/
- https://www.encyclopediapratensis.eu/product/reducing-inputs/optimising-fertilisation/organic-nitrogen/quelle-fertilisation-organique-pour-les-prairies-paturees/
- https://idele.fr/?eID=cmis_download&oID=workspace://SpacesStore/9720fe84-44fd-4da8-b959-8cd9813a6ecd
- https://www.ifce.fr/ifce/connaissances/webconferences/infrastructure-et-equipement/valorisation-des-effluents-equins-sur-sols-agricoles/
- https://valorisation-fumier-ifce.chambres-agriculture.fr/references-documentaires
- Manpas: https://acsess.onlinelibrary.wiley.com/doi/10.1002/jeq2.70099
- https://www.ifce.fr/tag/valfumier/
- Nutrient losses from manure left in the paddocks: https://doi.org/10.1080/09064710.2022.2121749
- The use of horse manure: https://doi.org/10.1080/09064710.2022.2121749

Publications

- Doligez, P., Bouchart, V., Chartrain, S., Fontaine, C., Lagrange, H., Le Roux, C., Marcovecchio, F., & Minguez, L. (2022). Caractéristiques du fumier et du compost équins. Journées sciences et innovations équines 2022, IFCE, Jun 2022, Saumur, France. Hal-03690315.

Funded by the European Union

This project has received funding from the European Union under Grant Agreement No. 101086551.

Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Technical Sheet for Solution Implementation

Sustainable Manure Management

Annex

Ideas to Animate a Workshop About the Solution

- Ask advisors, manure management specialists, composting companies, grassland experts, or agricultural equipment suppliers to support or sponsor the workshop.
- Organise the workshop on a model farm using manure composting, nutrient recycling, or innovative manure storage systems.
- Invite participants from equine farms, mixed livestock farms, advisory services, municipalities, and environmental organisations.
- Complete the required tasks and let the participants take part in these demonstration tasks so that they can get to know the system. Possible demonstration activities could include:
  - assessing manure storage and compost quality,
  - calculating spreading quantities and nutrient balances,
  - identifying suitable spreading periods and plots,
  - demonstrating manure spreading or compost turning equipment,
  - comparing different manure management systems,
  - discussing practical solutions for nutrient recycling and cooperation between farms.

Proposed Struct.ure for the Workshop on Sustainable Manure Management in Equines Farms

1. Introduction to Sustainable Manure Management
- What is manure management and manure valorisation in equine farms?
- Key components: collection, storage, composting, hygienization, spreading, recycling
- Types of systems:
  - solid manure systems (straw-based manure).
  - composting systems.
  - covered vs. uncovered storage.
  - skip-based or container systems.
  - advanced systems (biogas, hygienization technologies, bedding recycling).

2. Benefits of Sustainable Manure Management in equine farms
- Improved soil fertility through recycling of nutrients (N, P, K).
- Reduced need for mineral fertilisers and improved long-term pasture productivity.
- Better hygiene in stables and paddocks (reduced pathogen and parasite pressure).
- Environmental protection (reduced nutrient leakage and groundwater pollution).
- Opportunity for circular farm systems (manure → compost → pasture → forage → manure).

3. Practical applications on equine farms
- On-farm collection from stables, paddocks, and exercise areas.
- Use of different storage systems (solid platforms, covered storage, skips, compost heaps).
- Composting and turning practices to ensure proper decomposition.
- Application on pastures according to nutrient needs and timing.
- Cooperation with other farms for manure exchange or external valorisation.
- Optional: hygienization and reuse of manure as bedding material.

4. How to choose the most suitable manure management system
- Assessment of farm size, number of horses, and manure volume.
- Evaluation of available infrastructure (storage space, machinery, labour).
- Choice between storage systems (covered, uncovered, mobile, fixed) - be aware of legislation.
- Consideration of composting vs. direct spreading vs. external processing.
- Compliance with regulations on storage, spreading periods, and hygiene.
- Cost comparison: investment, labour requirements, transport logistics.

5. Hands-On Demonstration
- Demonstration of manure collection and storage methods.
- Compost pile construction and turning techniques.
- Demonstration of spreading equipment and application on grassland.
- Comparison of different manure management systems (well vs. poorly managed).
- Hands-on calculation of manure quantities for a pasture area.

6. Maintenance and Troubleshooting
- Management of compost piles (moisture, aeration, temperature control).
- Cleaning and maintenance of storage systems and equipment.
- Avoiding nutrient losses, leachate, and odour problems.
- Identifying and solving common issues (flies, odours, poor decomposition).
- Monitoring compost quality and hygiene status.

7. Case Studies and Real-World Examples
- Examples of farms using composting or manure recycling systems.
- Successful cooperation models between horse and crop farms.
- Use of manure in biogas or nutrient exchange systems.
- Lessons learned from practical implementation (labour, costs, benefits).
- Examples of hygienized manure reuse as bedding material.

8. Cost Analysis and Return on Investment (ROI)
- Initial investment costs (storage, composting infrastructure, equipment).
- Ongoing costs (labour, transport, maintenance, monitoring).
- Savings from reduced fertiliser purchase and improved pasture productivity.
- Potential income from manure valorisation or cooperation agreements.
- Long-term economic benefits from improved soil health and farm efficiency.

9. Q&A Session
- Open discussion on farm-specific manure management challenges.
- Questions on regulations, infrastructure, and practical implementation.
- Exchange of experiences between participants.

10. Wrap-Up and Resources
- Summary of key principles of manure management and recycling
- Guidance documents on composting, spreading, and nutrient management
- Contacts for advisors, equipment suppliers, and cooperation partners
- Information on funding schemes for manure management infrastructure
- Access to best-practice examples and further training opportunities