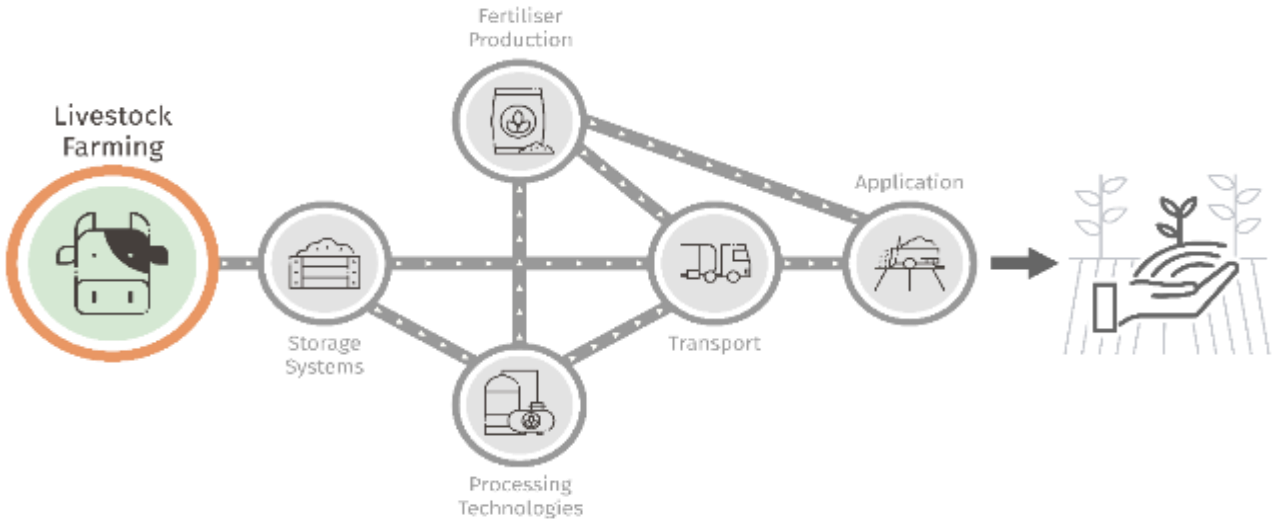
WEBINAR Nº2

Livestock farming

15th October 2024

Livestock farming: first and crucial steep for managing nutrients throughout the agro-value-chain

- Livestock is an important sector for EU economy: **134 million pigs**, **75 million bovine animals**, **59 million sheep** and **11 million goats** (Eurostat December 2022); European Union is one of the world's largest **poultry meat producers** with annual production of around **13.4 million tons**; more than **350 million laying hens** in the European Union with a production of of **eggs each year close to 6.7 million tonnes** (EU27, 2023);
- The future of livestock farming and its environmental and social sustainability are under discussing;
- **Livestock is a complex system** where nutrients management has to be integrated/related to other challenges: environmental impact, human and animal health, animal welfare, social sustainability and food security.



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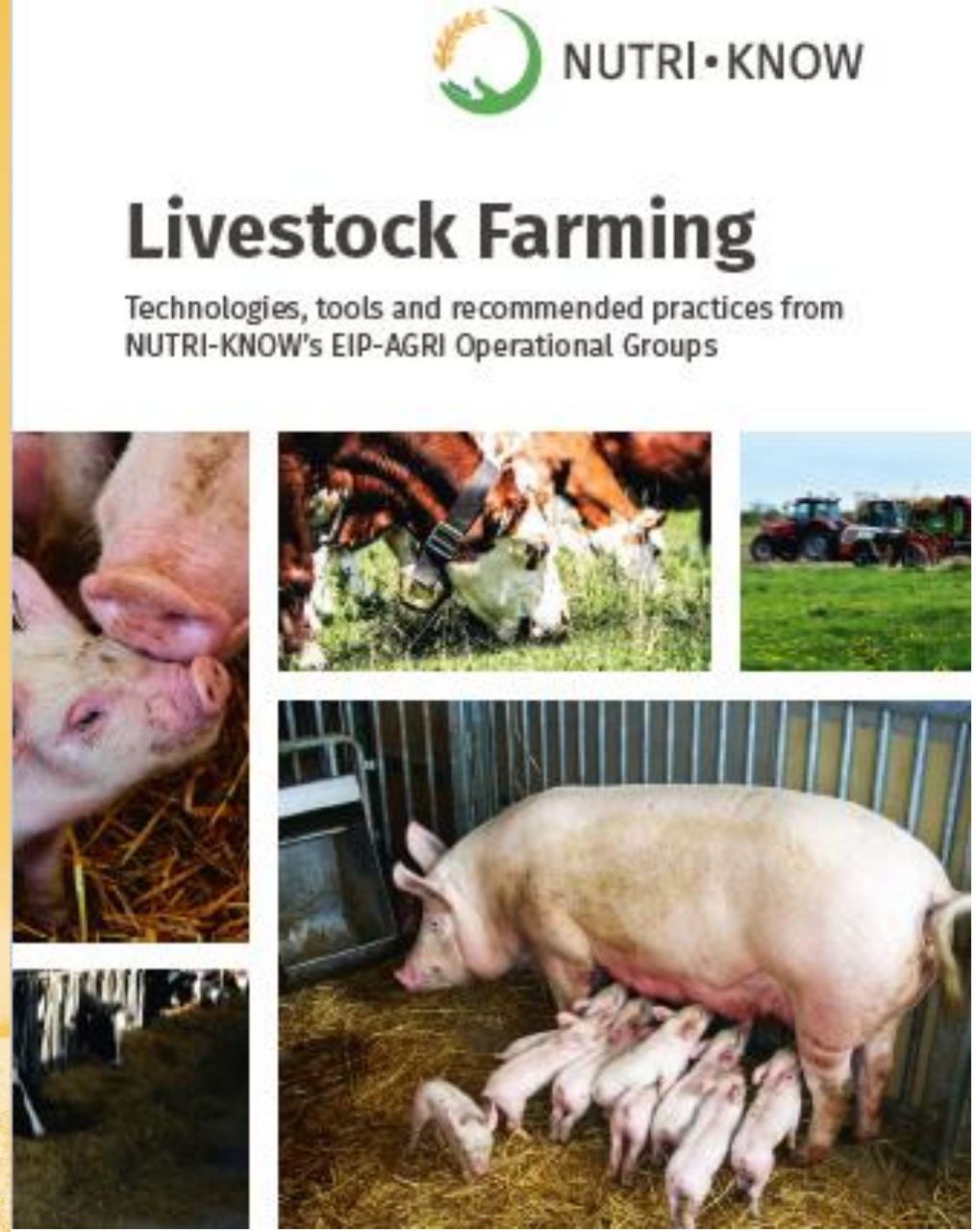

This booklet offers an overview of the EIP-AGRI Operational Groups involved in the NUTRI-KNOW that have produced innovations and good practices related to the livestock farming step of the nutrient value chain to:

- **reduce ammonia and greenhouse gas emissions during the breeding phase;**
- **improve animal welfare;**
- **reduce nutrients losses to the environment (nitrogen and phosphorus);**
- **reduce the carbon footprint of livestock**

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Outcomes from NUTRI-KNOW engaged EIP-AGRI OGs to support a shift towards more sustainable livestock systems:

Tool to evaluate the environmental benefits of reducing emissions by applying different Best Available Techniques (BATs) to the breeding phase and supporting farmers in understanding which ones best apply to their reality

FERTICOOP: A tool to assess and support farmers in BATs application;

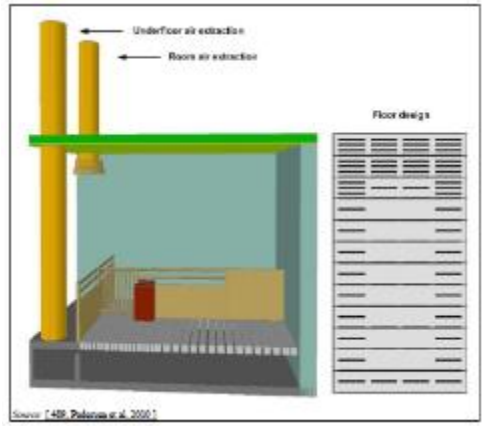
BAT technologies that reduce ammonia in pig stables and increasing animal welfare

GAS LOOP: An air washing system that removes ammonia from pig stables;

BAT 30 c. – Air treatment (biofilter, scrubbing …)

6.2.1 **Air cleaning of underfloor exhaust airflow with fully slatted floors**

Description
In addition to the room air extraction outlet, the pen is equipped with an underfloor pit exhaust above the slurry surface. Only the exhaust air extracted from the underfloor pit is treated by an



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Outcomes from NUTRI-KNOW engaged EIP-AGRI OGs to support a shift towards more sustainable livestock systems:

Innovative biorefinery converts freshly harvested grass into feed for cattle and pigs, improving nutrient efficiency and reducing the carbon footprint of livestock

BIOREFINERY GLAS: New feed source for cattle and pigs from grass;

An effective model to restore, protect and enhance water quality for future catchments to foster positive relations between farmers and households

DUNCANNON BLUE FLAG FARMING & COMMUNITIES SCHEME: Livestock farming good practices to enhance water quality;

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A tool to assess and support farmers in BATs application

FERTICOOP_GO
Grup Operatiu Innovació

FERTICOOP

Challenges to shift towards more sustainable livestock systems

- Ferticoop-GO was an operational group to execute **pilot tests**
- Consortium formed by 5 cooperatives + R&D centre (IRTA) +FCAC (coordinator)
- 3 years (2020-2022).
- 7 activities (WP)
- In fact some positive results are intangible= know-how & networking beyond the results for a final technical report from pilot tests results

Some relevant objectives of the project:

- Reduce GHG and ammonia emissions by optimising fertilisation and innovative measures in livestock manure management. (sustainable and precise)
- **Provide the cooperatives' technical advisory staff with the tools and knowledge they need to carry out recommendations based on sustainability criteria.**
- Valorise livestock manure by precise knowledge of its fertiliser content.

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Beyond the pilot tests…impacts through technical visits, meetings, conferences, networking

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FERTICOOP

RELEVANT ACTIVITIES

Activity 2. Testing and development of quick methods to estimate the chemical fertility of agricultural soils in extensive crops.

Task 2.1- Gathering information on existing field methodologies.
Task 2.2- Practical evaluation of different methodologies.
Task 2.3- Recommending methodologies to be applied in different farming systems.

Knowing the concentration of nutrients in the soil is a key factor for providing technical advisors with objective data to make fertilization recommendations.
Currently, there is still a lack of rapid and inexpensive methods that yield reliable results compared to laboratory analysis.

The objective of this activity 2 was to test and refine different field methods to estimate the content of the main nutrients (N, P, and K) in the soil of a plot.

The level of precision shoud be sufficient to classify the soils into different levels of nutrient content, leading to the establishment of various recommendations for fertilization.

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FERTICCOP: Activity 2 Testing and development of quick methods to estimate chemical fertility of agricultural soils

FERTICOOP

LAQUAtwin HORIBA: sensor for nitrate and potassium. NO_3 or in ppm of N-NO_3.

Nitracheck: Soil nitrate meter. Values in ppm of NO_3.

Imacimus NT nitrate, ammonium, pH, and electrical conductivity., etc..

Agrocares Scanner : NIR method pH, moisture (%), total nitrogen (g/kg), organic matter (%), organic carbon (g/kg), etc without the need for calibration.

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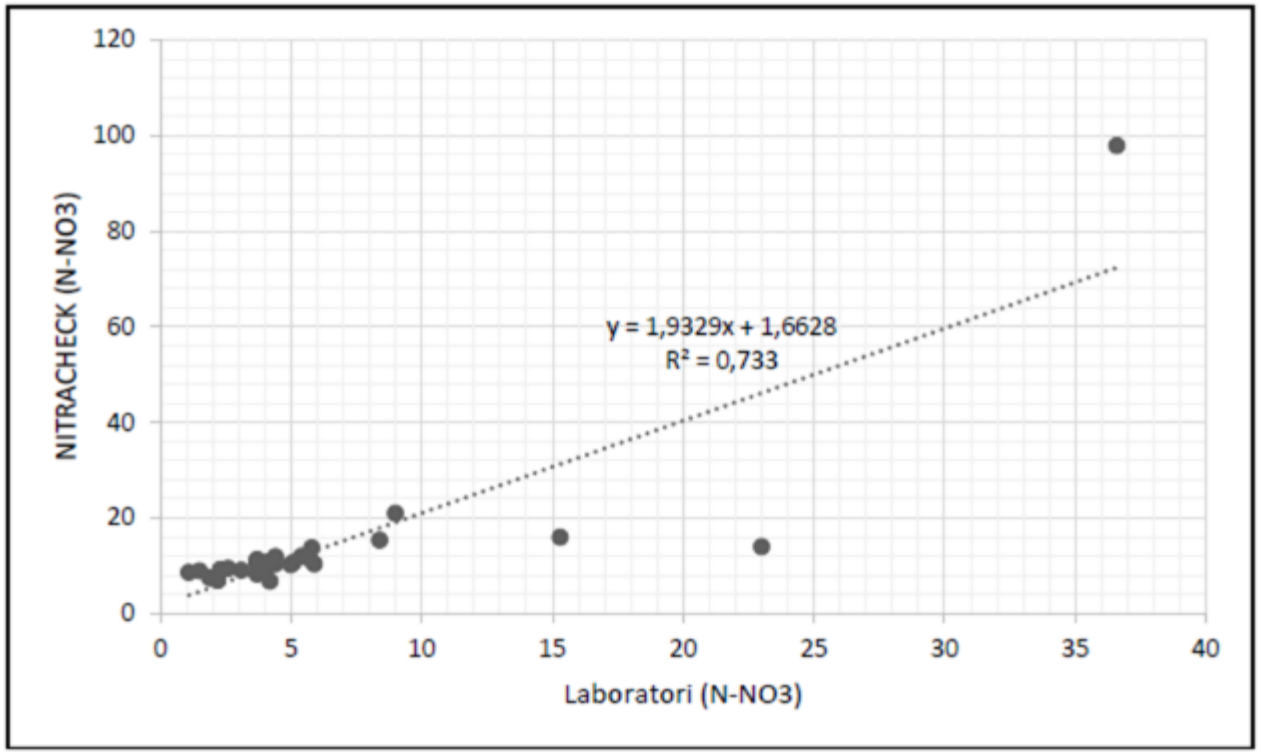
FERTICOOP

FERTICCOP: Activity 2 Testing and development of quick methods to estimate chemical fertility of agricultural soils



- For all equipments, the extract should be prepared with soil dried at room temperature for 8-10 days if an oven is not available, in order to have good correlation with laboratory.
- It is crucial to use the same standardised protocol to avoid differences in the results
- **None of the devices tested can achieve the same accuracy as an accredited laboratory, although some of the sensors may be a sufficiently accurate alternative in situations where sending samples to a laboratory is too costly or time-consuming.**

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FERTICOOP - Activitiy 5. Evaluation of ammonia emissions and greenhouse gases during the storage of slurry and other fractions extracted from it.

Pilot tests to measure the the effects of covering manure ponds with floating hexagonal plastic pieces helps to reduce the emissions.

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ACTIVITY 5. Evaluation of ammonia emissions and greenhouse gases during the storage of slurry and other fractions extracted from it.

Lindvall Hood method

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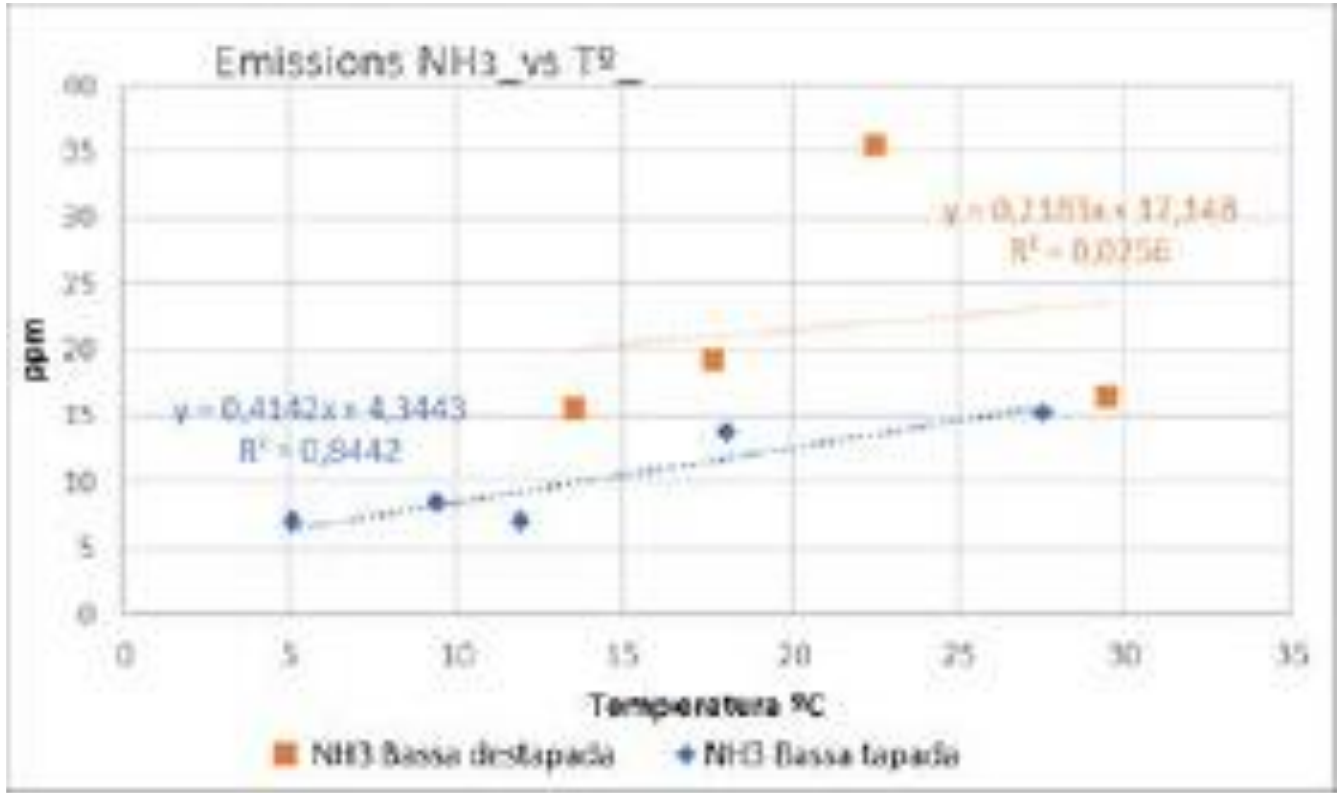
ACTIVITY 5. Evaluation of ammonia emissions and greenhouse gases during the storage of slurry and other fractions extracted from it. **Pilot test results**



***NH_3 emissions depending Temperature for covered** (blue) **and non - covered ponds** (orange)*

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ACTIVITY 5. Evaluation of ammonia emissions and greenhouse gases during the storage of slurry and other fractions extracted from it. **CONCLUSIONS**

- Based on the obtained values, the reduction in ammonia emissions with the hexagonal pieces **is around 52%,** although to confirm this, it would be necessary to intensify the measurements and conduct a longer campaign over time.

- It should also be noted that, to optimize ammonia emission control, **it is essential to ensure that the pond surface is fully covered with floating pieces.**

- The partners were interested in exploring further tests with alternative materials to cover the ponds, aiming for options that are both **more sustainable and less expensive.**

FERTICOOP

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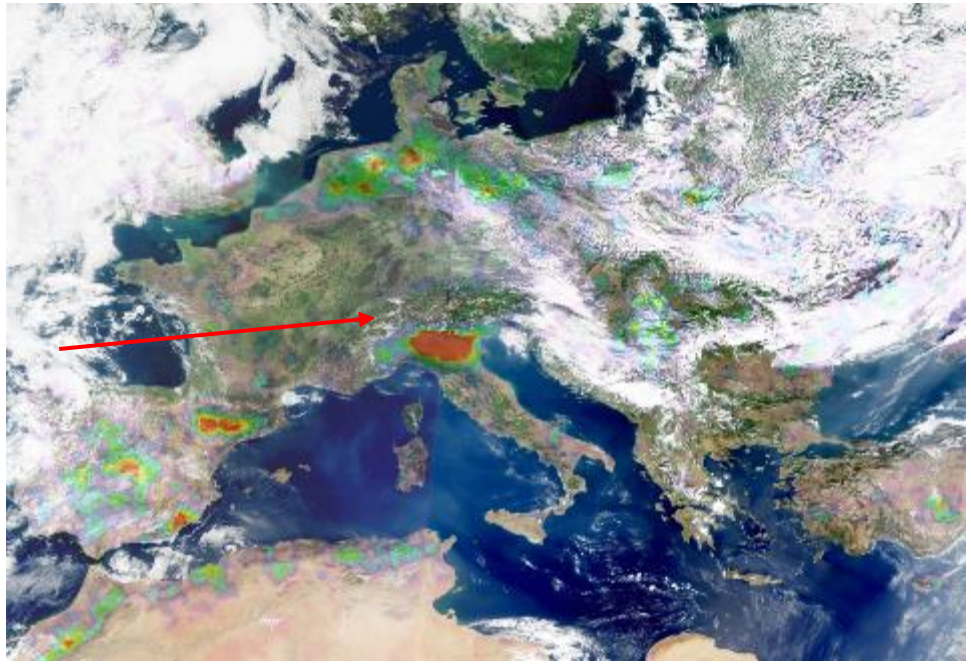
An air washing system that removes ammonia from pig stables

GAS LOOP

Ammonia distribution over Europe, measured by the MetOp satellite

Ammonia causes health problems in livestock farms, odours and it is an important precursor of fine dust (PM)

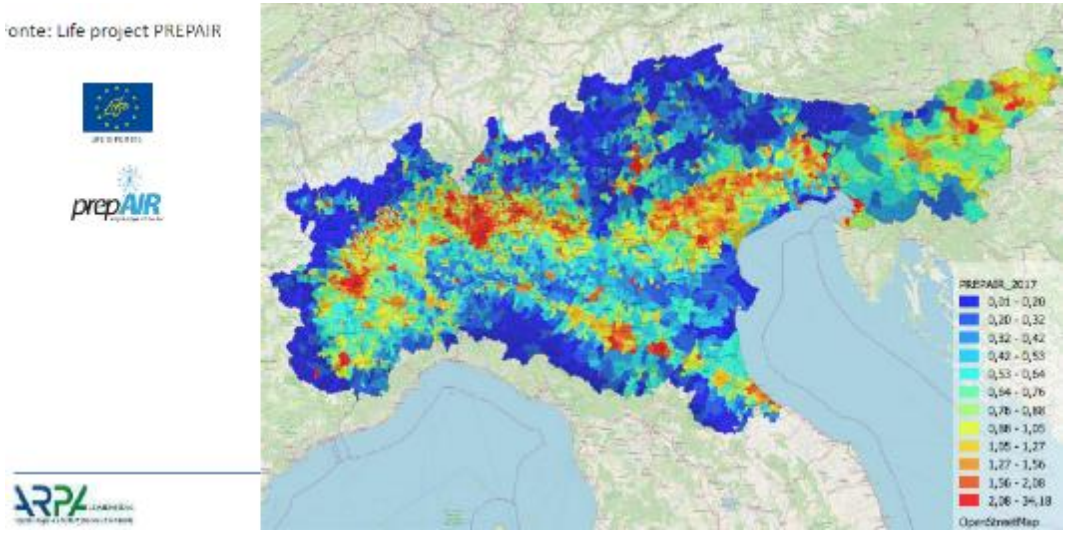
Reasons:
- ✓ emissions from industrial and housing activities
- ✓ weather and climate conditions



Po Valley (Emilia Romagna is a region of the Po basin)

The stagnation of pollutants (ammonia NH_3, nitrogen oxides NO_x and sulphur oxides SO_x) on the basin makes particularly important the reactions between them and produces a large amount of fine particulate matter.

The Po Valley basin represents one of the areas with the highest concentrations of particulate matter (PM2.5 and PM10) in Europe



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An air washing system that removes ammonia from pig stables

GAS LOOP

Ammonia emissions: from a problem to a fertilizer resource

to generate a **nitrogen virtuous cycle** (**Loop**) in the pig farming, which producing ammonium sulphate recovered fertilizer by capturing ammonia emissions, reduces chemical inputs for the farming crops and consequently GHG emissions generated by the fertilizers industrial production

Goals:

- To **develop a pilot** able to clean the air and to recover ammonia from pig livestock (TRL8)
- To **avoide ammonia emissions** and **enhance indoor air quality** for human operator and animal;
- **To produce a recovered fertilizer** (ammonium sulphate solution) in a view of Nutrient Recovery and Circular Economy;
- To **increase the animal welfare and productivity** due to better air quality inside the pig housing,

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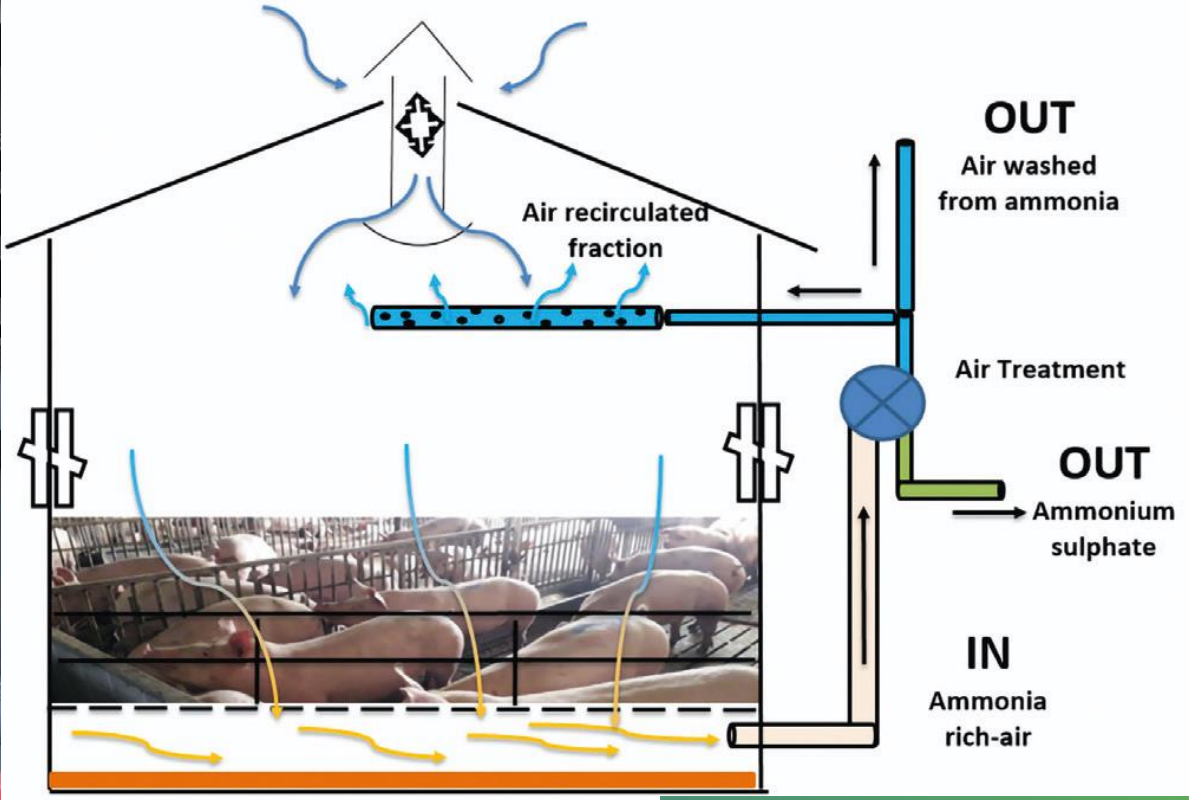
Air washing system

GAS LOOP

Fattening pig rooms for Parma Ham DPO
from 45 to 175 kg of pig weight (heavy pig)

- ✓ Air flow treated: 1800 – 2000 Nm^3/h
- ✓ process pH: 4.5
- ✓ washing acid solution of sulphuric acid (H_2SO_4)



Ammonia Washing Machine layout

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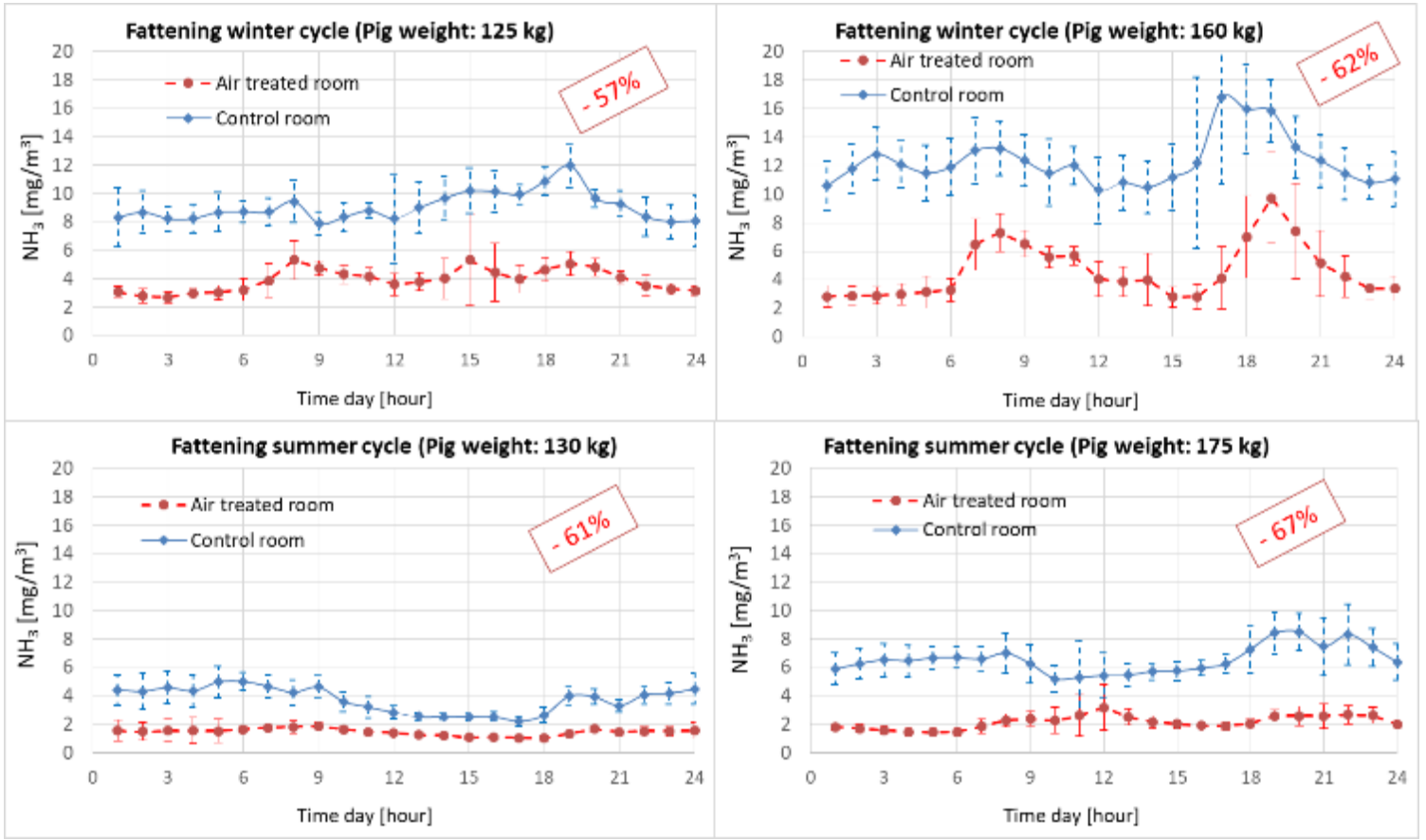
Air treatment efficiency

GAS LOOP



Daily trend of ammonia concentration in the air treated rooms and control rooms (values calculated as the average of the concentrations measured at the same hour the same hour in the different days of the monitoring period).

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Nitrogen recovered – Ammonia emissions avoided

GAS LOOP

N recovered	14.5	Kg N/year per t live weight
Ammonia emissions avoided	17.6	Kg NH_3/year per t live weight
Ammonia emissions reduction	1.94	Kg NH_3/animal place per year

Chemical characterisation of ammonium sulphate solution produced		average	max
pH	-	3.4	4.0
TKN – Total Kjeldahl Nitrogen	*% in weight*	***4.9%***	***6.4%***
NH_4^+-N – Ammonia nitrogen form	*%TKN*	*99%*	*99%*
TOC – Total Organic Carbon	*% in weight*	*1.2*	*1.3*
Ammonium sulphate production	*Litres/year per ton of live weight*	230	300
GHG reduction due to replacement of N industrial fertilizers (*)	*kg CO_2eq/year per ton of live weight*	66	

(*) JRC: Giuntoli J, Agostini A, Edwards R, Marelli L, Solid and gaseous bioenergy pathways: input values and GHG emissions. Calculated according to the methodology set in COM(2016) 767, EUR 27215 EN, doi:10.2790/27486, 2017)

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Animal welfare and productivity

GAS LOOP

Note: the trials were carried out in a pig livestock which already adopt an high animal welfare standards and complain to the DPO Parma Ham disciplinary

Main results		Air treated rooms	Control rooms
Average Daily Growth	kg	0.782	0.758
Feed Conversion Index	n.	3.75	3.84
Feed yeld	%	27.06	26.08
N efficiency	%	26.12	25.89
Absence of lung injuries at the slaughterhouse	**%**	**45%**	**37%**
Pigs tested	n.	162	160

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Conclusions

GAS LOOP

- Air treatment with ammonia recovery as fertilizer was **technically feasible,** the system has been up to a technological maturity level equal to Technology readiness level (TRL 8);
- In pig farm with a total live weight of 1155 t (with an average pig weight of 110 kg and 10,500 animal place), results **N_recoverable of 16.8 t N/year** with consequently ammonia emissions avoided for 20.3 t NH_3/year;
- Ammonia concentration in the livestock rooms is reduced by up 57-67% and **ammonia emissions reduced** compared to control rooms: **better animal welfare** and worker's health and higher yields;
- N recovered in the ammonium sulphate solution could be valorized as a mineral **N fertilizer** in the pig farm or in an external trading **(Nutrient Recovery and Reuse)**;

but

- The **impact on the pig production costs** of the innovation for reducing ammonia emission is problematic: cost increase of 7.3% for kg of meat produced (today the value of the live weight heavy pigs for the DPO Parma Ham chain is 2.32 €/kg);
- as is often the case, systems to reduce environmental impacts produce more costs for the farm than economic benefits: funding support may be welcome;

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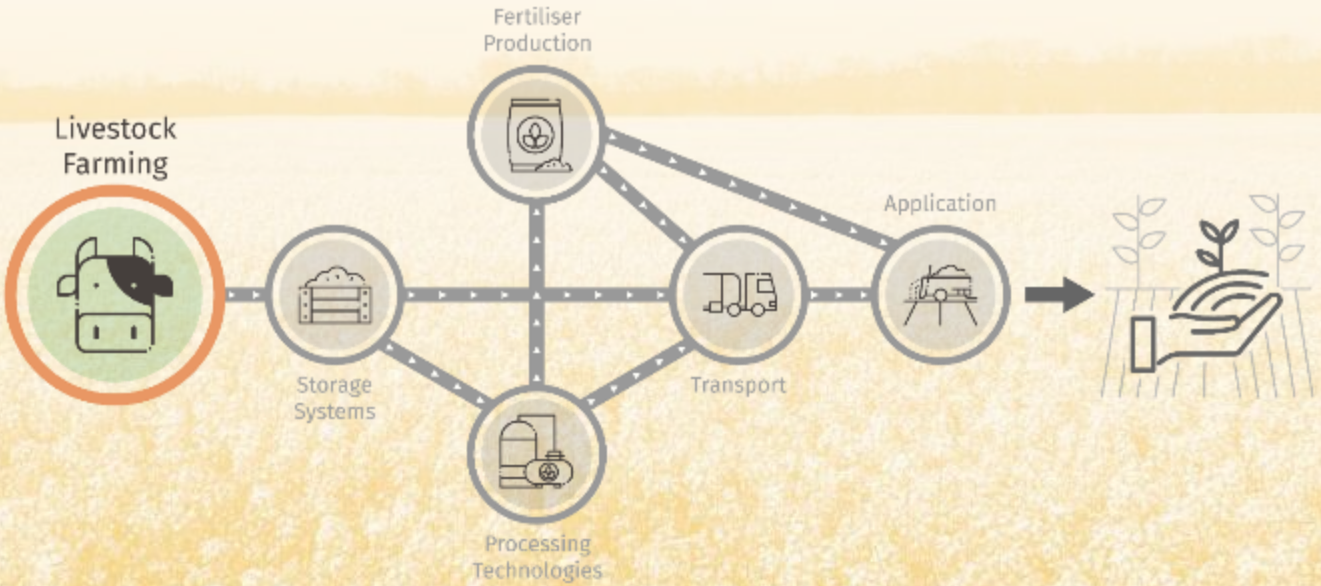

Alternative Animal Feed from Grass.

Biorefinery Glas

- Operation group (OG) 10
- South West Ireland.
- Pilot scale.

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Biorefinery Glas

BIOREFINERY GLAS

- Processes grass into four products.
- Refines unused protein.
- 50% into press cake.

- + 40% usable Pr/Ha.
- N and P losses -25%.

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Press Cake Silage.

- Alternative animal feed from grass.
- Grass silage supplementation.
- NUE increase

- Reduces methane concentration in the rumen
- Reduces N and P excreted..
- Increases grass value.

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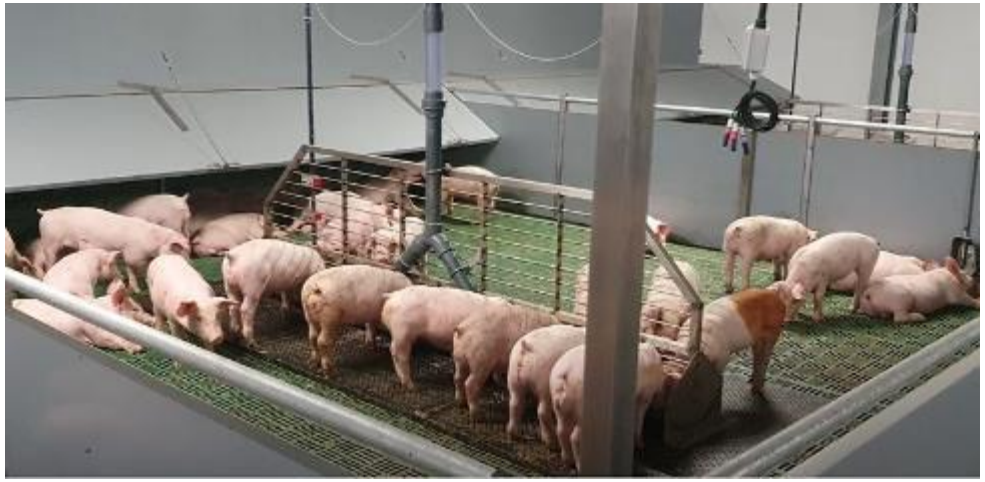
High Protein Pig Feed.

- Higher-than-average daily intake
- Higher than average daily gain
- Replaces up to 50% of soya in diet.



- Reduces transport distances and import cost
- Reduced emissions.
- Increased farm efficiency and income.

BIOREFINERY GLAS

Biorefinery Glas

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Product Streams

- High-value sugars (fructo-oligosaccharides)
  .
- Biobased fertiliser Grass Whey.

Future.

- Integrate grass biorefinery with anaerobic digestion

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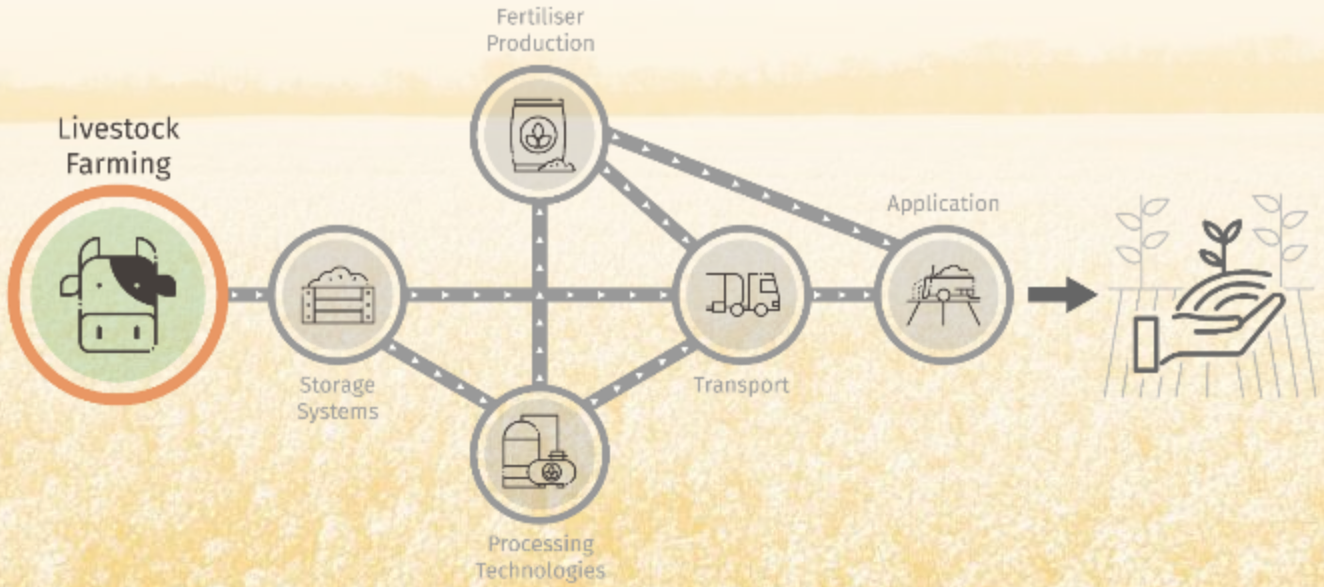

Good Livestock Farming Practices to Enhance Water Quality.

Duncannon Blue Flag Farming & Communities Scheme

- EIP Operational Group

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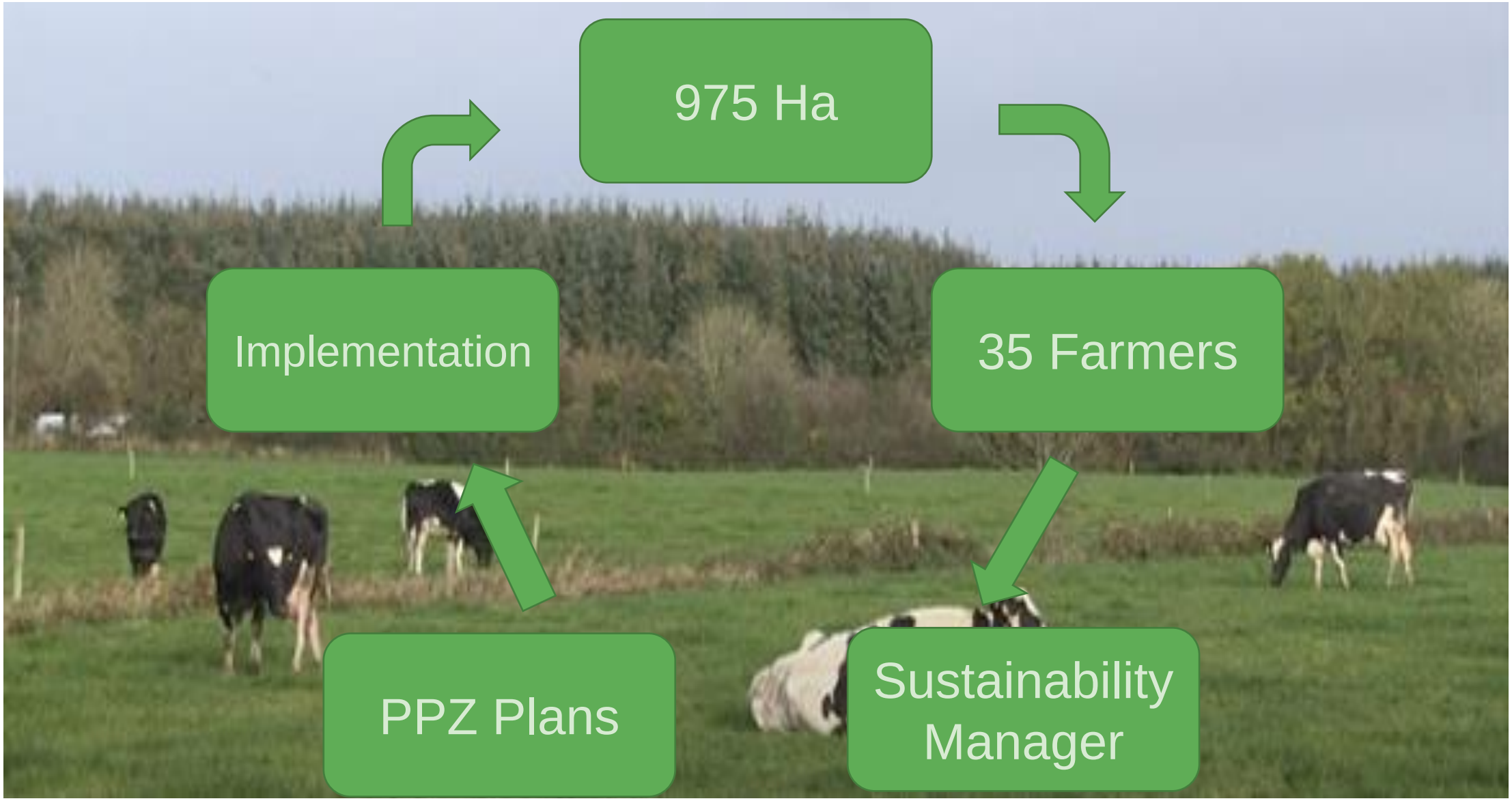
Duncannon Blue Flag Farming & Communities Scheme



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Results based rewards scheme.

Duncannon Blue Flag Farming & Communities Scheme

- PPZ :Pollution Potential Zone
- PPZ Scorecard.
- Financial Incentive.

1. RISK - the ***number*** of PPZ's (pollution potential)
2. RESULTS: Overall Farm-level ***status*** assigned (red, yellow, green)- management

Farm-level PPZ Status	No. of farm PPZ's		
	High	Moderate	Low
Red	€0	€0	€0
Yellow	€2,000pa	€1,500pa	€1,000pa
Green	€4,000pa	€3,000pa	€2,000pa

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Water Protection Improvement works

- Watercourses (15.5km)
- Drinking points
- Water troughs (20m)
- Soil sampling & NMP (100%)
- Buffer zones (10m)
- Sediment traps
- Farm roadways
- LESS
- Riparian zones (native)
- Hedgerow planting
- Arable Grass margins (1.2km)
- Winter cover crops

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Duncannon Blue Flag Farming & Communities Scheme

Results, Benefits and Performance

- Reduction in Bacterial Pollution.
- Improvement in Ecological Quality.
- Efficiencies increase on farms.
- Importance of staffing.

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Thank you.

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Livestock farming: first and crucial steep for managing nutrients throughout the agro-value-chain

Outlooks and Q&A

- The European livestock sector is seeking knowledge and innovation from research to face future challenges.
- Nutrient management to combine food security, resilience and sustainability in livestock farming?
- How in EU should be the research, innovation and policy initiatives?

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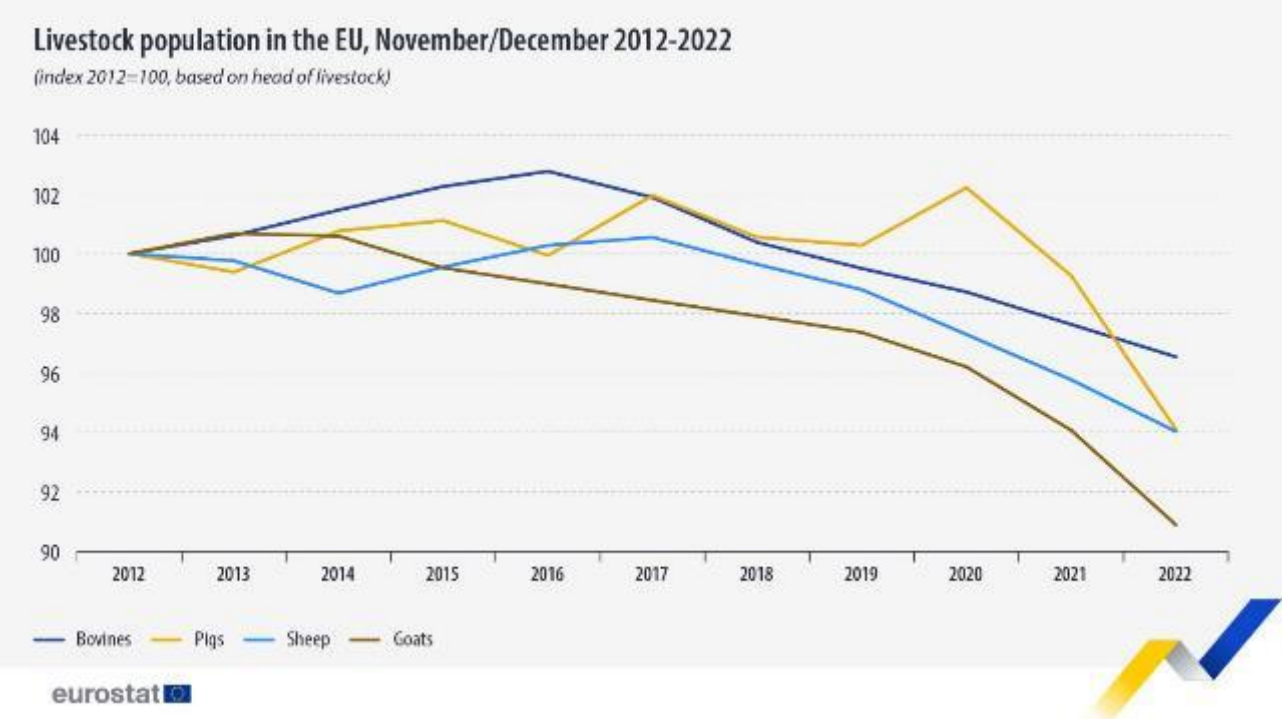
Livestock farming: first and crucial steep for managing nutrients throughout the agro-value-chain

Outlooks and Q&A

- EU livestock population continued to decline in 2022….



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