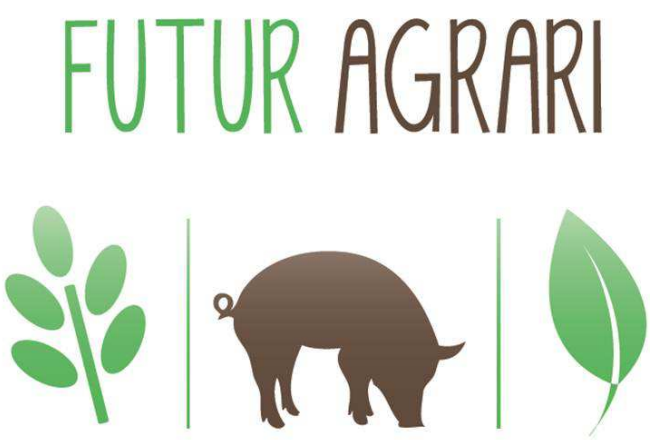


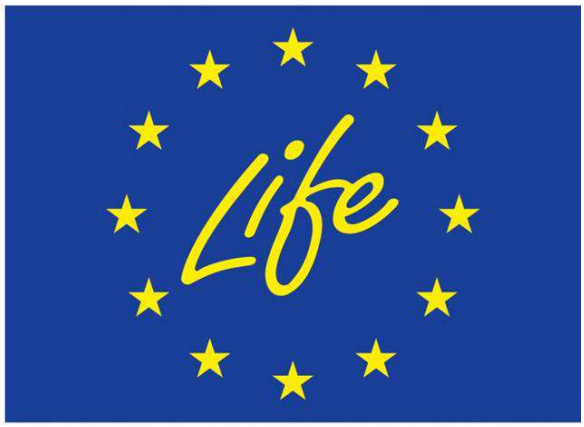


LIFE12 ENV/ES/000647

# TECHNICAL ACTIONS

# Índex de contingut

## 1. Techinical action B1

## Minimization of nitrogen and other elements (P(Cu/Zn) at pig production ferms. Water and food management

The reduction of the volume of livestock manure at source, that is to say, within the same farm, is a very important point to consider when you want to improve the management and minimize the cost associated with it. This means less amount of manure effluent (slurries) to carry and apply in agrarian soils.

This reduction can be achieved in two ways:
A proper water management to prevent pits are filling up with water coming from the troughs, by using optimized troughs. For this reason, one of the objectives of this action is to characterize different typologies of troughs at the level of the laboratory.

A proper feeding management to avoid animals excrete the excess nutrients contained in their food by eating a multiphase diet appropriate to the needs of animals optimizing production indexes and reducing the excretion of nitrogen, phosphorus, copper and zinc.

### *Objectives*

- Compiling the best practices in livestock on water and feeding management.
- Transferring knowledge and technology to improve water and feeding management at the pig-breeding farms to minimize environmental impacts and economic costs.
- Proving savings in water and feeding supply.
- Proving savings in management costs.
- Preparing a guide on methodology with the results obtained.
- Preparing a guide compiling the procedures and the improvement of facilities to optimise livestock manure at source management.

### *Development*

- Analysis of the current situation and characterization of different models of drinking troughs.
- Monitoring and evaluation of the farms in the current conditions.
- Improvement of water management.
- Improvement of feeding management.

### *Results*

Results obtained during the development of the action.

Update: 12 November 2014

## 2. Technical action B2

### Minimization of nitrogen and other elements (P/Cu/Zn) at pig production farms. Treatment technologies

The priority target of manure effluent is applying it as a fertilizer. Managing it properly is essential to improve the efficiency of fertilization, especially when the farmer does not have lands enough or they are far away.

The treatments applied to the manure effluent allow us to achieve a balance between the generation of effluent and the possibilities of its application to agrarian soils.

Taking into account the composition of manure effluent, its treatment can be a very useful tool to increase the management capacity and improve its features as a quality product with an important nutritional value for crops in certain circumstances.

The process of phase separation leads to obtain from manure effluent two different fractions: a solid phase (SP) with a solid content higher than the original effluent, and a liquid phase (LP) containing dissolved and suspended elements. The solid-liquid separation does not modify the content of components of manure effluent, but leads to a redistribution of the constituents, and, therefore, improves the management capacity.

To manage the effluents of the solid-liquid separation, it is necessary to know the efficiency of the process and the distribution of nutrients in the generated phases. This process depends on several factors: the typology and composition of the manure, type of separator, use of chemical additives, conditions of operations, etc. Futur Agrari will carry out the monitoring and evaluation of different types of solid-liquid separators installed at several farms in Catalonia.

Systems applicable to the treatment of livestock manure which will be monitored:

| TREATMENTS | PROCESS | ADDITIVES | SYSTEMS |
|---|---|---|---|
| Actuation on the physical and chemical properties | **Solid/liquid separation** | Coagulants<br>Polymers | Spindle press<br>Gravity screen<br>Trommel<br>Sedimentation<br>Centrifuge<br>Several systems combination |

***Objectives***

- Increasing the nutrient content (mainly nitrogen and phosphorus) in the distribution of the solid fraction
- Reducing the agrarian surface needed to apply the liquid fraction.
- Reducing the livestock manure management and application costs.

***Development***

- Installation and start-up of solid-liquid separator equipment.
- Evaluation of solid-liquid separation systems.
- Evaluation of obtained solid fraction.
- Evaluation of obtained liquid fraction.

## 3. Technical action B3

## Use of computer tools to aid decision in order to recommend fertilization in the initial stages of crops

Rationalizing the practice of fertilization on crops is a key point to reduce over-fertilization of agrarian soils. The use of tools developed elsewhere is inappropriate without prior adaptation. In recent years, a computer tool has been developed in Catalonia, the FertiNext, which allows the realisation of recommendations of organic and mineral fertilizing in some extensive crops.

This tool is based on the use of nitrogen balance, and includes information about the different aspects of this balance obtained in different tests developed in several agrarian systems in Catalonia. The tool permits to include data from analysis of soil that represent a complement to the information generated.

In this action, farmers who manage a total of 1,200 ha in the irrigable area of Algerri-Balaguer are advised on aspects of fertilization. The main crops of the area are maize in monoculture, with productions that can reach 18,000 kg of grain per hectare, and the rotation of two annual crops of short cycle maize, usually combined with barley for grain, both under irrigation conditions.

In practice, 21 farmers are advised on the amount of fertilizer that they have to apply before sowing and when 3-5 leaves are raised.

The recommendation ends with the production of an advisory report that is delivered personally to each farmer. In most cases, the type of fertilizer that the farmer uses is respected; in some cases, it is recommended to change strategy after evaluating all information collected.

### *Objectives*

- Adapting and improving a computer tool to aid the decision on the fertilization.
- Implementing the recommendations in the farming plots.
- Improving the chemical parameters of the plots where the recommendations are implemented.
- Adjusting the doses of fertilizer applied to crops.

### *Development*

- Characterization of the initial state of the soil in each plot.
- Annual survey.
- Determination of mineral nitrogen content of the soil at the beginning of each growing season.
- Recommendations on fertilization in the plots.
- Characterization of the state of the soil in each plot at the end of project.
- Variation in soil chemical parameters during the project.
- Valuation survey of the recommendations.

## 4. Technical action B4

## Use of remote sensing techniques to adjust N inputs in crops at an advanced phenological stage

To date, among the most popular and used tools to adjust the crop fertilization, the sampling and the analysis of soil excel, since they provide real information and easily interpretable. There are also more complicated devices, such as optical sensors, or other indirect methods that also allow realising recommendations on fertilizer needed for crops.

The introduction of the use of remote sensing in agriculture offers the possibility to get very interesting information and cover, at the same time, a large cultivated area, which increases the efficiency of the resources used.

Remote sensing is based on obtaining information about objects without physical contact. Information is got by measuring the reflectance that these objects (crops, in this case) send out at a certain time. To capture this radiation, sensor devices adapted in cameras located on aerial platforms are used. In the case of *Futur Agrari* project, three types of platforms had been chosen: satellites, manned aerial vehicles (light airplane) and unmanned aerial vehicles (drones). The purpose of using three types of platforms is to evaluate if they are technically and economically feasible to decide the need or not of the inputs of nitrogen on crops in advanced state of development.

On the one hand, the technical feasibility will be evaluated according to the effectiveness to identify, by the interpretation of the images, situations of variability on agrarian properties, either being lack of fertilization, water stress situations or other problems that are difficult to detect on ground plot. However, the project must go further and obtain spectral indices that identify variations on crops caused only by N.

On the other hand, the economic feasibility will allow getting an idea of the costs of their use per unit of surface and by each type of platform used.

### *Objectives*

- Adapting the methodologies of use of images related to the nutritional state of crops for the recommendations of fertilization to the conditions of Catalonia.
- Providing information, based on these technologies, to the involved stakeholders (technicians and farmers) that will allow them to decide on the need or not to fertilize in advanced stages.

### *Development*

- Selection of commercial plots to evaluate different systems of remote sensing.
- Delimitation of the reference areas in each selected plot.
- Acquisition of the images.
- Recommendations on fertilization at advanced stages.
- Evaluation of the different systems.

## 5. Technical action B5

## Optimizing the application of livestock manure (purins) to the field through the use of Best Available Technology

The purpose of this action is advancing in the adoption of innovative tools for the appropriate agrarian application of livestock manure, so two specific objectives are pursued: on the one hand, providing information on the existing precision machinery, especially the application of liquid manure, and, on the other hand, improving the liquid manure agrarian management in a large farm through a computer tool for land management (GEMA).

In order to achieve the first objective, the aim of this project is to increase into the study area the use of machines for liquid manure application through hoses or hanging tubes, equipped with conductometer to instantly know the value of manure and with flowmeter to regulate the flow during application. This type of machinery which incorporates technological innovation allows the correct dosage of liquid manure, and also its better distribution, the significant reduction of volatilization losses and an instant knowledge of its fertilizer value.

Regarding the second objective, the software GEMA, developed by the public company SARGA through LIFE project ES-WAMAR in a farm that manages 12,000 pigs liquid manure in some 600 ha of surface, will be implemented. It is a management tool already tested by different entities in the autonomous community of Aragon which facilitates the efficient management and traceability of liquid manure from farmings. Optimize application distances between the different farms and receiving plots is one of the first of GEMA targeting goals, which will lead to significant savings in transport-associated costs.

### *Objectives*

- Increasing the use of liquid manure application machinery that incorporates the system of application thought hoses or hanging tubes, conductometer and/or flowmeter.
- Optimizing the livestock manure application in a farming by using the computer tool GEMA.

### *Development*

- Machinery demonstrations in the study area.
- Machinery equipment for applying liquid manure.
- Farming characterization.
- Installation of software GEMA.
- Execution of the tool.
- Evaluation of the improvements achieved with the tool.

## 6. Technical action B6
## Removal of nitrates from the soil by catch crops

The catch crops are crops whose main objective is to reduce or minimize losses by leaching of nitrogen remaining in the soil after the main crop. The planting of catch crop absorbs a part of soil inorganic nitrogen to develop, and protects the soil from erosion phenomena and from surface encrustment. It also improves the habitat of the soil microfauna and sometimes increases the landscape diversity of the territory.

This is a crop that has no productive purpose, so it must be reaped before it reaches flowering. The main profit of the crop is in the form of green fertilizer, once it has been incorporated into the soil and released nutrients to the main crop that will be planted then. However, an object of this project is to study its use as a co-substrate of biogas plants to increase its production.

This action is divided into a first stage of testing (first campaign) and a second stage of real implementation.

**a) Stage of testing**
In the experimental farming of Mas Badia Foundation, some plots will be planted with several catch crops (oats, ryegrass and rapeseed) that *a priori* might be interesting agronomically and energetically. The experiment will last for two years in order to determine correctly the crops productivity and the N extraction, and optimize its agronomic management and mechanisation.

At the same time, IRTA Torre Marimon Center's laboratory in Caldes de Montbui will make the trials on biogas production using as a co-substrate the studied catch crops.

**b) Stage of real proving**
Once finished the first experimental action and chosen the most interesting crop, a demonstration plot (25-40 ha) with the chosen crop will be used with the aim of having enough amount of substrate to introduce in the co-digestion industrial plant.

### *Objectives*

- Estimating the effectiveness of the catch crops use to minimize the N losses in the fertilization of maize based on: digested liquid manure, undigested liquid manure and mineral fertilizer.
- Comparing the effectiveness of minimizing nitrogen losses among the three tested catch crops: ryegrass, oats and rapeseed.
- Checking these crops impact on the accumulation of phosphorus, copper and zinc in the soil when it is fertilized with organic fertilizers.
- Determining the potential of nitrogen catch crops methanation according to their phenological state and preservation method (silo storage).
- Define the process variables that optimize the livestock manure anaerobic co-digestion with nitrogen catch crops (laboratory pilot plant and industrial plant).
- Getting the data to perform a life cycle analysis of the proposed strategy and to estimate its environmental impact.

### *Development*

- Field experimental testing with nitrogen catch crops.
- Laboratory testing of biogas production with catch crops as co-substrates.
- Proving experiences of catch crops real production.
- Pilot test at an anaerobic digestion plant.

## 7. Technical action B7

## Removal of nitrates from the soil through agroforestry systems

Agroforestry systems are based on intercalating, into an agrarian field, tree species with the aim of increasing the global production of the plot, diversifying production and improving the environmental quality of the farming.

The trees spread their roots beneath the roots of the crop, so that they benefit from the management applied on the agrarian part (weed treatments, fertilizations, etc.). For this reason, the trees in agroforestry systems grow faster than if they had been planted in an only-forestry plantation. Meanwhile, the agrarian part benefits from the presence of the trees, which reduces wind speed and improves the microclimate (more humidity, extreme temperatures softened).

Trees absorb nutrients not used by the agrarian production, and also water and other nutritional resources that return to the system later as organic matter (leaves, bark, etc.), as well as improving soil structure and permeability. The trees that are planted in these proving experiences are producing quality hardwood species; for example, walnut, ash, sycamore or maple and princess tree.

### *Objectives*

- Implementing agroforestry systems properly in two farmings, according to similar actions observed in southern France.
- Evaluating the effect of planting agroforestry systems in terms of nitrogen capture efficiency and estimating the costs / benefits associated with introducing this measure in an agrarian tillage.

### *Development*

- Plantations design.
- Agroforestry systems plantation.
- Annual monitoring.
- Annual maintenance.

## 8. Technical action B8

### Removal of nitrates from the soil by riparian vegetation (green filters or riparian buffers)

This proving experience consists of making linear plantations of woody species to create a border between agrarian uses and waterways when the riparian vegetation has been removed by the advance of the agrarian frontier.

To ensure the success of the proving experiments, it is essential to use species adapted to the conditions of high temperatures and pH. They have a deep and dense root system to take advantage of the groundwater level, and a large tolerance to high concentrations of nutrients. The chosen species have to tolerate also waterlogging conditions because they will often be subject to flash floods and to variations of the groundwater level.

#### *Objectives*

- Implementing the riparian vegetation properly with results of growth and nitrogen extraction similar to other experiences in northern Europe.
- Evaluating the effect of planting riparian vegetation in terms of nitrogen that ends up in the river course.

#### *Development*

- Plantations design.
- Riparian vegetation plantation.
- Annual monitoring.
- Annual maintenance.

## 9. Technical action C2
## Life cycle analysis

The life cycle analysis, LCA, studies the environmental aspects and potential impacts throughout the life cycle of a product or activity. A complete LCA attributes to products the environmental effects derived of:

- The consumption of raw materials and energy needed for its manufacture
- Emissions and waste generated in the production process
- The environmental effects from the end of the product's life when it is consumed or can no longer be used.

Therefore, LCA is a type of environmental accounting where the adverse environmental effects generated throughout their life cycle, properly quantified, are charged to the products.

The complexity of the LCA requires a protocol to which all LCA studies must conform. This Protocol is established in the regulations drawn up by International Standards Organisation, ISO 14040 (2006) and ISO 14044 (2006). In March 2010, these regulations have been complemented with the Guide by International Reference Life Cycle Data System (ILCD). This Guide aims to standardise the different methodological options in order to obtain more precise results on ILCD (2010) quality and consistency.

*Futur Agrari* aims to carry out the environmental evaluation of three of the actions developed in the project related to the removal of nutrients:

- B6. Nitrogen catch crops
- B7. Agroforestry systems
- B8. Riparian vegetation

### *Objectives*

- Carrying out the environmental evaluation of the nitrogen catch crops full cycle (oats, ryegrass and rapeseed) including subsequent use as co-substrates in biogas production processes.
- Carrying out the prospective environmental evaluation of agroforestry crops cycle, including the obtention of wood for furniture manufacturing.
- Carrying out the environmental evaluation of crops cycle which include riparian vegetation, including the obtention of biomass for energy purposes.

### *Development*

*Futur Agrari*, in accordance with the methodology proposed by the ISO 14040 standard, divides the LCA into four phases:

- Objectives and scope of the study.
- Inventory analysis.
- Impact analysis.
- Interpretation.