



Project reference: ENV.B.1/ETU/2010/0007

# MANURE PROCESSING ACTIVITIES IN EUROPE



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Final Report to the European Commission, Directorate-General Environment



Title Final Report to the European Commission, Directorate-General Environment, Manure Processing Activities in Europe - Project reference: ENV.B.1/ETU/2010/0007

Front page photos  
Upper left: Decanter centrifuge for after-digestion separation of digestate.  
Upper right: Composting of separated solid fraction of slurry in roofed store.  
Lower left: Dried and pelletized separation fraction from biogas plant.  
Lower right: Reception facilities at biogas plant.

Disclaimer This report was produced with financial support of the European Union. Its content is the sole responsibility of Agro Business Park in cooperation with GIRO Centre Tecnològic. The report is an internal working paper, and will not be published.

## PREFACE

This Final Report is prepared to the European Commission, Directorate General Environment, as part of the regular project reporting deliverable in the project “Manure Processing Activities in Europe”, project reference: ENV.B.1/ETU/2010/0007.

The main purpose of the Final Report is as described in the tender specifications:

- “Final report: to be received by the Commission eleven months after the signature of the contract. It shall include an executive summary containing a brief presentation of the methods used and of the main results of the work. The contractor shall provide the Commission with five copies in paper format and 1 electronic version, in both Word and PDF format.”

Tjele, 28 October 2011



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# EXECUTIVE SUMMARY WITH A BRIEF PRESENTATION OF THE METHODS USED AND OF THE MAIN RESULTS OF THE WORK

## Presentation of the methods used

### General

We have in the past eleven months carried out the project, largely as planned according the Inception Report.

On 5 September 2011, it was decided to apply for an extension of the project, till 28 October 2011. This was due to a misunderstanding on the start date of the contract.

### Task 1 – Inventory of manure processing activities

We delivered together with the First Interim Report a draft report on “Inventory of Manure Processing Activities in Europe”.

It was decided, however, with the acceptance from DG ENV, to postpone the finalisation of the technical report for task 1 concerning Inventory of Manure Processing Activities in Europe, until September, justified by the fact that this would enable the completion of the report with a higher quality. The decision to deliver the report as a draft was among other motivated by the fact that French data were missing. A draft final version of the report was like technical reports II, III and IV distributed to the participants in the roundtable discussions in Brussels on 12 October 2011. The report was afterwards updated once again, among other because we were informed about more manure separation activities in Italy.

The Technical Report No. I: “Inventory of manure processing activities in Europe” is submitted in final version as a separate annex to this report. The report suggests on the basis of compilation and analysis of data from EU Member States that manure processing currently has reached an average level of 7.8% of the livestock manure production, with a big variation from country to country. The processing comprises 108 million ton, containing 556,000 ton nitrogen and 139,000 ton phosphorus. 168 million ton livestock manure and other products are processed, whereof around 60 million ton (168 minus 108 million ton) is end and by-products from other processes and non-livestock manure biomasses. The largest share of the livestock manure production is being processed in Italy, Greece and Germany, with 36.8, 34.6 and 14.8% respectively. Anaerobic digestion is by far the most used manure processing technology; 88 million ton of livestock manure and other products are processed in this way. 11 of 45 considered technologies do not exist in commercial operation, for instance struvite (magnesium ammonium phosphate) precipitation and partial nitrification - autotrophic anammox denitrification.

### Task 2 – Describe operational techniques

We delivered together with the Second Interim Report a draft report related with task 2 of the project. The report provides a detailed characterization of processes and technologies applicable to manure treatment. In this report, 45 unitary processes have been identified and explained. Some of these processes can be found standing alone if they are sufficient for solving the problem that motivated their adoption. Others must be combined for reaching a given objective. Common combinations have been identified at every unitary process description section and a synthesis of these main combinations is presented.

The Technical Report No. II: “Manure processing technologies” is submitted in final version as a separate annex to this report. Anaerobic digestion is found to be a key process in strategies dealing with nutrients

recovery. The relevance of the technologies as BAT's in relation to the definition and methodology adopted by the Industrial Emissions Directive (2010/75/EEC) were considered.

### **Task 3 – describe end and by-products**

A draft report related with task 3 of the project was submitted together with the Second Interim Report. The report is dealing with types, amount and qualities of end and by-products from livestock manure processing as well as their opportunities for marketing.

The Technical Report No. III: "End and by-products from livestock manure processing - general types, chemical composition, fertilising quality and feasibility for marketing" is submitted in final version as a separate annex to this report. A large number of datasets of the chemical compositions of end and by-products were gathered via survey and desk studies, and these are made publicly available via the web page <http://agro-technology-atlas.eu/endandbyproducts.aspx>. The report concludes, that presently there are three types of manure processing products being marketed at considerable volume, namely "separation solids", "manure compost" and "dried manure and pellets". Two more end and by-products, namely "Ash and charcoal", and "Manure concentrates" could gain importance if the interest in manure processing continues to grow. However, the market is suffering from lack of infrastructure such as a standardised classification and price statistics, the fact that products have low market value in comparison to their fertilising effect, and lack of transparent and acknowledged regulation.

### **Task 4 – Assess economic feasibility and environmental performance**

A technical report related with task 4 of the project, was submitted in draft format as a separate annex to the draft final report. The report assesses the economic feasibility and environmental performance of the most common techniques for both large and small scale installations for processing of livestock manure. The findings and conclusions are to a large degree based on seven case studies, i.e. commercially operating livestock manure processing plants, which were carefully selected so that they make a good representation of sizes, locations, ownership structures and technological configurations of current livestock manure processing plants in EU.

The Technical Report No. IV: "Assessment of economic feasibility and environmental performance of manure processing technologies" is submitted in final version as a separate annex to this report. On basis of the seven case studies, the report suggests that there is a huge variation in economic and environmental performance of livestock manure processing plants, and that the individual farmer or the individual plant chooses the most feasible and cheap technology configuration for processing of livestock manure, depending on the surplus of nitrogen in the area, combined with regional framework conditions and other matters of importance for decision making.

### **Task 5 – Estimate future trends**

Task 5 has the objective to estimate future trends of manure processing, taking into account the entry into force of the Directive on renewable energies (RE Directive - 2009/28/EC) which may be a driver for the energy recovery of manure and the further implementation of the Nitrates Directive (ND – 91/676/EEC), the Water Framework Directive (WFD - 2000/60/EC) and the Industrial Emissions Directive (IED - 2010/75/EU).

A roundtable discussion was organised in Brussels on 12 October 2011, with participation of 27 experts with a widely diversified perspective on manure processing due to their different technical and geographical background. The agenda for the roundtable was organised in three blocks:

- Background information and facts, a brief presentation of the technical reports I-IV, which were made available to the participants in draft form on beforehand.
- Introduction to and discussion of five defined key topics.

- Participants' formulation of future trends – “The way it goes or the way we want it to go”. The participants provided on basis of their impressions some written statements to 4 themes: The technology, the market, EU's legislation and intensive livestock production and the society. The written statements were afterwards summarised.

A Technical Report No. V concerning “Future trends for manure processing activities in Europe” is submitted together with this Final Report as a separate annex, heavily based on the mentioned roundtable discussion. The report suggests that locally based biogas production (anaerobic digestion of livestock manure) is a focal technology in the future, because it aims at better recycling of nutrients while in the same time having other benefits, such as production of renewable energy. There should be introduced product standards as a way to support the development of the market infrastructure.

## Main results of the work

We have in the last ten months produced the following key results:

- Task 1:
  - A digitalised survey at <http://enagro.eu/asppoll/21010.asp> has been prepared, data gathered by assistance of livestock manure experts from EU Member States, and data validated and analysed.
  - The Technical Report No. I: “Inventory of manure processing activities in Europe” was submitted in draft form together with First Inception report, and is submitted in final version as a separate annex to this report.
- Task 2:
  - The Technical Report No. II on “Manure Processing Technologies” was submitted together with the Second Interim Report, and is enclosed in final version as a separate annex to this report.
- Task 3:
  - A draft Technical Report No. III on “End and by-products from livestock manure processing - general types, chemical composition, fertilising quality and feasibility for marketing” was submitted with the Second Interim Report. The report is enclosed in final version as a separate annex to this report.
  - A MS ACCESS database with 131 datasets that describes qualities of end and by-products of livestock manure processing, as well as 107 datasets that describes qualities of raw / unprocessed livestock manure has been prepared. The datasets are published at <http://www.agro-technology-atlas.eu>, which is established in connection with Task 3, and is intended to develop as a platform for data, information and tools from several projects concerning agro-environmental technologies and the biomass they handle.
- Task 4:
  - A draft Technical Report No IV: “Assessment of economic feasibility and environmental performance of manure processing technologies” was submitted with the Draft Final Report. The report is enclosed in final version as a separate annex to this report.
- Task 5:
  - A draft Technical Report No V: “Future trends on manure processing activities in Europe” is submitted as a separate annex to this report.

## ABBREVIATIONS AND ACRONYMS

ABP	Agro Business Park A/S
DG ENV	European Commission, Directorate-General Environment
EU	European Union
GIRO	Fundació GIRO Technical Centre
MS	Member State of the European Union