

Intensive livestock farming systems in use across Europe – a review of the current situation relating to IPPC based on recent data gathered by questionnaire

Final Report as the principle deliverable of Task 3 (and covering Tasks 2
relating to the production of the questionnaire) EU Project **BAT-Support** *

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SUMMARY AND CONCLUSIONS

Detailed questionnaires were prepared covering pig and poultry production across Europe. A set of three documents were prepared, one each for the housing system for pigs and (all) poultry and a combined questionnaire covering manure handling and related water and energy consumption issues. The trio of documents with covering letter were despatched to 60 targeted specialists across the EU with at least one recipient for each of the smaller countries and up to three for the larger nations. Responses were received from all the major livestock producing nations: no replies were received from representatives from eight countries. The survey was considered valid representing over 90% of European livestock production. The amassed replies were processed and augmented with available statistical data from Eurostat to describe in detail the pig and poultry livestock industry across the EU. The analysis does not distinguish IPPC farms from smaller units but it is deemed that most of the findings address such farms these representing the larger farms which dominated the data collected.

Common themes emerged to describe the housing and rearing of the main livestock types grouped as pigs and (all) poultry as defined in the IPPC directive.

Pig production is regularly subdivided into breeding (sows both dry and maternity) and fattening (growing and finishing phases). Sows are group housed until farrowing when commonly they are individually penned: they can be equally on slats or bedding producing either solid or liquid manure. Growing pigs are more often on slats (liquid manure) in groups of 20 to 100. Buildings are increasingly modern, forced ventilation with heating especially for the very young piglets. In some regions naturally ventilated buildings are also common. Diet is often optimised using both phase feeding regimes and including in many cases phytase to reduce P excreted.

Solid wastes are stored for typically 6 months before land-spreading using mechanical spreaders. One can find both stores on concrete and on earth: the former often including separate collection of liquid run off. Treatment is unusual: if done it is most often composting. Liquid manure (slurry) represents the largest volume of piggery effluent. Storage is most often in above ground tanks or (where land is available) in lagoons: other systems are also widespread. Specified capacity is six months on average running to a year in some countries: covers are also required in a few countries. Treatment is not common but there are examples of anaerobic digestion with biogas production in several countries driven by the financial incentives to encourage energy production. Less common are examples of aerobic systems for the removal of nitrogen and some separation to aid manure handling.

Poultry is mostly represented by egg production, broilers and turkeys. There is a smaller but significant production of ducks and geese. The common system for layers is still based on various cages but with increasing numbers of alternatives including aviaries and floor housing. The buildings tend to be more high-tech with removal of manure by belt sometimes with drying systems as well. Also very common are buildings with manure kept in deep pits with the consequence of higher emissions of ammonia. For all the meat birds, the most common system is rearing on the floor of large barns on litter which is removed at the end of the production cycle. The exception is ducks (and rarely geese) which can be reared on slats with the production of liquid manure. Such buildings have a very well controlled environment with artificial lighting and often air conditioning. Ventilation often is controlled, mechanical and, in a few countries, expelled air is treated to remove dust and ammonia. Diet is often optimised to meet commercial constraints demanding efficiency.

Manure management options are very limited but the solid product collected from the houses is generally less of a problem in terms of disposal (often land spreading). Some drying is done within the building. Otherwise, storage can be under cover or in outside in concrete stores: minimum periods and capacities are less well defined as for pig manure. Rarely, poultry manure is composted but otherwise no treatment is done. The exception may be considered the use of small but significant amounts in combustion projects to produce energy.

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1 INTRODUCTION

1.1 The role of the project within the IPPC directive

The BAT Support project proposal relates to the implementation of the European IPPC Directive (Council Directive 96/61/EC on Integrated Pollution Prevention and Control). The purpose of this Directive is to achieve integrated systems for the prevention of polluting emissions to air, land and water, including measures concerning waste, in order to achieve a consistent and high level of protection for the environment taken as a whole. An important sector is livestock agriculture due to its very large impact especially on the wider environment.

The successful application of a BAT (best available technology) policy requires a high degree of support for both the regulator and for the operators of industrial sites. Comprehensive advice and guidance notes are essential for effective implementation of the integrated pollution control regime in the EU Member States. For that purpose, the European IPPC Bureau (EIPPCB) located in Seville (Spain) was set up by the European Commission to organise an European information exchange in order to establish crucial Reference Documents (known as BREFs) for each of the defined categories of industrial activity listed in the directive. These BREF documents assist the regulatory authorities and the industry by describing established reference techniques for each sector which can be applied to minimise environmental impact.

The structure of BREF documents apply on a Europe-wide basis and are intended for regular updating as new technologies become available. The central procedure of BAT classification as described within the BREF requires a harmonised approach at the European level in the identification of what is BAT in each situation. In the development of the first BREF for the intensive livestock farming sector in 2003, ("Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs"), this harmonisation was lacking and many European countries used their own system and their own criteria for the evaluation of the best technologies. This led to differing results and to the inevitable call for consistent guidelines for the formulation of classification methods of BAT for intensive livestock farming.

The quality of field data availability relating to livestock and livestock waste management systems in current use varies across Europe. There is an urgent need for harmonisation of both the required data acquisition and of the procedure to identify and define systems as "Best Available Technique". For some of the New Member States, IPPC is still being implemented on an informal or localised basis due to, a lack of available data.

Intensive livestock farming is connected with a number of environmental effects such as emissions to the air (ammonia, greenhouse gases, dust and bio-aerosols), discharges to soils and surfaces water (nitrogen, phosphorus, heavy metals, organic compounds) as well as noise and odour nuisance. Nitrogen emissions from agriculture have been identified as a risk to the quality of soils, surface and marine waters. The risks relate to high levels of nitrates found in drinking waters and acidification of soils and waters. Eutrophication involves excessive algal growth and can lead to potential adverse effects on and biodiversity or human uses of waters. Furthermore, the poor management of livestock wastes is closely linked to dispersal of pathogens causing a series of health risk that affect the animals themselves, staff and local people and food quality.

The objective of the current BAT Support project is to develop a single defined procedure for the classification of livestock housing systems (including storage, treatment and spreading of manure) with the purpose of specifying “Best Available Techniques”. This includes the development and application of systems to evaluate the environmental and economic performance of different methodologies as well as the assessment of animal health and welfare implications that are specific for the intensive livestock farming sector. Even though the latter is not part of the IPPC Directive, it is subject to other EU-legislation and it is being discussed by the Member States as one of the major factors for evaluating housing systems. The costs and benefits (where they occur) for the introduction of new or improved livestock systems will be a factor in the selection of the most efficient technique *in terms of costs per unit emission reduction* (or resources saved). Furthermore the option of defining a set of *general binding rules* as a simplified procedure for application to a wide range of farms, (instead of requiring individual evaluations on each farm in turn) is being taken into account.

The product of this project is “a developed evaluation system”: this will be made available in form of guidelines to all stakeholders working with BAT definition and will support the revision of the BREFs by providing a common platform and a harmonized approach for description and assessment of the livestock systems. The main target group for the results of BAT-Support will be the experts in the Member States who are preparing the national contributions for the updating of the BREF document for Intensive Rearing of Poultry and Pigs.

1.2 Description of work packages covered by this report

Two work packages of the eleven that make up this project are covered by this report: WP2, *Design of questionnaire* and WP3, *Expert consultation and assessment of results*.

The first work package covered (WP2) related to the exercise of acquiring data in a targeted way. It had for an objective the “design of a harmonised questionnaire to establish the required livestock farming data Europe wide, ensuring that comparable expert consultation results”. Based on the available information from Member States, who were involved in the establishment of the first BREF document, the necessary topics to be taken into account in this survey were compiled and a harmonised questionnaire established (as described below). The required information, which has to be taken into account, refers to management techniques in use for housing, manure storage, treatment and land-spreading in Europe. Following discussion within the project group early in 2007, the finalised questionnaire was sent out to designated contacts in each of the 27 member states in June 2007.

Work package WP3 covers the “Establishment of updated data and information of livestock farming system in use in Europe”. This relates to the interactions with European experts by use of the questionnaire and crucially the analysis of the data collected.

Expert consultation: based on the harmonised questionnaire, experts from the pig and poultry sector (from extension services, industry, administration, research) were consulted and asked to judge the relevance of the various systems in use in their countries. The BAT SUPPORT consortium has the relevant contacts to its disposal throughout Europe to ensure that this data update can be carried out in an efficient way. Special attention was paid to the situation in the New Member States of the EU, who were not involved at the time of the first BREF publication. Thus, concerning the new Member States more input for the overview of their farming systems was necessary.

Assessment of consultation results· the results of the expert consultation have been analysed and used to document the status and distribution of different management techniques in Europe and to identify particularly advanced techniques. This is covered in later sections of this report.

1.3 Design of questionnaire

1.3.1 Overall objectives

A comprehensive questionnaire was drafted to collect two sorts of information on the European livestock industry:

- (i) To provide a general description of national livestock industry, for each Member State for the animal types listed in appendix III of the IPPC directive (96/61/EC). This would avoid excessive detail relating to each growth stage, but of importance were the trends reflected by the new and modified production units (e.g.: herd size and new building type and installed equipment);
- (ii) A description of certain technical features on the methods of animal rearing - relating to buildings and the management of the manures - from which the related impact on the environment and farm resources are evaluated in order to set out on a hierarchical basis the Best Available Techniques (BAT).

The questionnaire was drawn up starting with documents directly relating to the intensive breeding of the farm animal type of concern and the associated BAT, and drawing from certain national documents from the Member States already having a regulation specific to these activities (references 1, 2, 3, 4, 5, 6)

The questionnaire was set out and developed using Microsoft Excel software to both enable on-line (or electronic) completion and easier subsequent analysis. It comprised three separate files representing part A (animal production systems) divided into one solely for pigs and one for all poultry, and part B for technical systems for all animals.

1.3.2 Questionnaire A

Examples are given in Annexes 1 and 2.

For the pig production (Questionnaire A-Pig) production is separated according to the stages in the cycle of reproduction (post weaning, gestation and maternity), and of fattening (post-weaning, fattening and finishing). These physiological stages are set out under separate headings (Mating & Gestating Sows, Farrowing Sows, Weaners and Growers-Finishers). The housing for the animals is described starting from the management of the herd (individual, group or in some combination), the feeding regime (liquid or solid, adaptation - or not - of the feed ration with respect to one or more parameters), the type of floor (slats or solid with the use of litter), and the method of collecting the manures.

For the poultry questionnaire (Questionnaire A-Poultry), egg layers are kept separate from the meat species (divided into broilers, turkeys, ducks and geese). The questionnaire section

relating to egg layers covers the housing type (whether or not cage and the type of cage, or alternative system), and the means of collection and removal of the droppings. One particular question relates to the nature of the feed ration (whether multiphase with changes based on various parameters). For meat production birds, the questionnaire splits into web-footed birds ("Ducks" and "Geese") and land birds ("Broilers" and "Turkeys"). The categories relate to the method of confinement and some general characteristics of the buildings (type of lighting and floor) and on the method of collection of the manures which may be different according to bird species. Information on the nature of the feed ration is also requested.

Techniques to control the environment within the buildings are established by the same A-series questionnaires (relating to the pork production under pages: *Building characteristics for Breeding* and *Building characteristics for Fattening* and relating to poultry under the page *Building characteristics*). Such techniques include: the level of thermal insulation, the means for heating, the level of automation for ventilation, air conditioning and the treatment of the ventilated air. A second specific heading relates to the handling and the storage of the various effluents (under page "Manure Storage and Handling"). The required information relates to the storage capacity, the location of the manure stores relative to the animal buildings (i.e.: in the field, on farm, under the animal pens), the type and material of the store (and whether above or below ground), and the presence or not of covers. Information is also requested on possible handling and treatment of the liquid waste on farm (composting, drying, anaerobic digestion with biogas, aeration.....), and finally the type of equipment used for land spreading (method of spreading and means of incorporation).

For each technical option indicated in questionnaire A, the consulted expert is asked to mark against the choices:

- Not in use
- % of national stock
- Application on IPPC-Farms
- Application on new build farms

1.3.3 Questionnaire B

An example is given in Annexe 3.

The second questionnaire labelled **B**, attempts to describe more specifically, features of the housing and the treatment of the manure for each animal species set out in the pair of questionnaires **A**. These parameters include the prevalence of each option (common or scarce) and the trend (declining or increasingly common) as well as the expected impact on the air, surface water, soil, and the related consumption of energy. This questionnaire comprises 8 pages.

The headings on housing include various options on the type of building (level of animal containment management as individuals or as groups) and the management of the manures (page "Housing - manure removal"), the type of filtration or treatment of the entering air and of the ventilated air (page "Air treatments processes"), various options for the type of heat insulation, the management of ventilation and lighting (page "Energy"). The options given under the heading "Feeding & Diet" gather the techniques currently in place to increase efficiencies of uptake of nitrogen, phosphorus and carbon, as well as the ways of reducing the metal contamination of excreta (copper and zinc).

A section for water use deals first with the options to control consumption and the techniques of economy and recycling, as well for the water for the animal consumption and for uses specific to the building or management of the manures (cleaning/washing and cooling). The headings specific to the management of the manures initially include options concerning the collection, the removal and a first stage of treatment.

A crucial section covers technical options (pages "Separation technologies" "Solid Fraction Processes" and "Liquid Fraction Processes") relating to technologies of separations of the fractions liquid and solid (separation mechanics, by evaporation...). Technologies for treatment of the solid and liquid fractions are indicated both by options covered by the processes used (aerobic route, anaerobic route, drying, incineration) and by the indication of scale (farm-based procedure or centralized installation).

For each option in questionnaire B, the consulted expert must indicate the prevalence by indicating one of:

- Not in use,
- Only on experimental farms,
- Only a few examples on commercial farms,
- Commonly used.

And then the trend in the use of the technology:

- Declining use;
- No changes in use,
- Increasing uses.

And the impact of this option on the air, water, ground and energy use:

- Negative impact;
- No impact,
- Positive impact.

1.4 Response to questionnaire – problems arising

The complete set of questionnaires was despatched by post to 72 identified experts (including government ministries, research institutes, universities etc). A follow up despatch of the same information by e-mail way was carried out a week later.

The level of response was probably acceptable since it covered 63% of the 27 EU member countries for questionnaires A and 59% for the questionnaire B. The countries covered by the replies from the experts were indeed primarily those with large pork and poultry industries plus the Czech Republic, Cyprus, Lithuania and Latvia. Despite many requests, none of the contacts approached was able to complete any questionnaire for the following countries: Bulgaria, Romania, Slovenia, Slovakia, Malta, Hungary, Ireland, Luxembourg nor Greece (Table 1 below).

On the basis of statistical data taken from Eurostat (2005), the countries for which we received at least one response to the questionnaires represent within the EU 27:

- For pigs: 90% of the animals and 34% of the total number of farms
- For poultry: 84% of the birds and 30% of the total number of farms.

The implication from these numbers is that most of the larger farms were represented and one might assume that this includes most farms coming under IPPC. However, it is noted that there exists some uncertainty on exactly what proportion of farms indeed do come under IPPC for each country. However, clearly most of the farms overlooked were small production units. The quality of the answers varies from one country to another and from one livestock sector to another. The information was judged satisfactory for the countries where the pork production, egg production or broiler production is of special importance. The quality of information was less satisfactory for information on the production of duck and geese (with the exception of one or two countries with large volume of production).

Table 1: Extent of replies to questionnaire received – two or three contacts where approached in each country: a cross indicates that at least one reply was received.

Country	Questionnaire type		
	Type A - Pig	Type A - Poultry	Type B (pigs and poultry)
Austria	X	X	X
Belgium	Walloon region	X	
	Flanders region	X	X
Bulgaria			
Cyprus	X	X	X
Czech Republic	X	X	X
Denmark	X	X	X
Estonia	X		
Finland	X	X	X
France	X	X	X
Germany	X	X	X
Greece			
Hungary			
Ireland			
Italy	X	X	X
Latvia	X	X	X
Lithuania		X	X
Luxembourg			
Malta			
Netherlands	X	X	X
Poland	X	X	X
Portugal	X	X	
Romania			
Slovakia			
Slovenia			
Spain	X	X	X
Sweden	X	X	X
United Kingdom	X	X	X

2 ANALYSIS OF DATA

2.1 Definitions of headings used

The questionnaires included a glossary for terms used within the pig industry to avoid confusion of definitions which can easily become lost in localised jargon. The main terms were:

Mating Sows: dry sow prior to insemination

Gestating Sows: pregnant sow

Mating & Gestating Sows: referring to a method of farming when the same buildings are used for both types.

Farrowing Sows: sow with piglets

Weaners: piglet that has been weaned from the sow's milk, which can be from 3 weeks to 6 weeks or more, according to local farming methods. The live weight of weaners entering in specific building can thus vary from less 8 kg to 30 kg at the end of this period (when the pig is 10 weeks).

Growers: the status of young pigs beyond weaner grown to 60kg.

Finishers: the status of pig from the end the growing period to slaughter. Note: usually the slaughter live weight is between 90 and 110 kg, but according to the kind of desired end product and region of production, it can vary between 60 and 160 kg.

Growers & Finishers: referring to a method of farming when the same buildings are used for both types; usually describe as fattening pigs

In addition, terms within the questionnaire relating to building characteristics concern only the ways in which the ambient parameters within the building (T° , RH%,...) are controlled. The section called, Manure Storage and Handling, includes the storage facilities (material, capacity,...) and the general approach of handling and disposal methods. Options are listed. The term "Filtering" refers to the physical separation by a filter media.

2.2 Description of procedure to abstract data and to prepare summaries

The main objective of analysing the returned questionnaires was to provide a picture of the dominant livestock systems for pig and poultry production across Europe. However, it must be pointed out that a detailed statistical analysis of the data was not required - rather trends and general observations have been described.

For each country that has answered, the replies to questionnaire A with respect to pig and poultry production were extracted and grouped under the same file to enable the reading and analysis of the replies. For each production category, 2 new files were similarly created and grouped the replies within the fields, « % of national stock » and « Application on IPPC-Farms ». These new files set out in Annexes 6 to 11 enable compilation of information for each country by the predominant system of production.

For questionnaire B in relation to livestock housing, waste treatment, prevalence of the technology (rare or common) and the trends (redundant, declining or growing interest) of the options arising, the expert replies were equally grouped together in the same file. In order to draw out a general direction for Europe, the prevalence of applied techniques (categories: Not in use, experimental farms, few examples on commercial farms, in common use) and the trend

in usage (declining use; no change in use, increasing use) were determined based on the corresponding number of replies for these fields (Annexes 12 to 16).

2.3 Use of supplementary data from Eurostat for general numbers

A great deal of statistical information on European agriculture has already been collected, principally by the Eurostat agency as well as other established organisations at national and international level including EPER (the European Pollutant Emission Register) accessible at <http://eper.eea.europa.eu/eper/faq.asp>. The questionnaire was not intended to duplicate this data but in places, some figures are clearly included in the analysis provided in this report.

2.4 Basis of prioritization of factors in relation to IPPC – influence of each parameter on the various pollution impacts

The livestock system is divided into (a) practices concerning the animal housing and (b) those relating to the collection, handling and disposal of the manures produced. Clearly, not all information gathered will have equal importance on the definition of best practice. Overall, the central questions are the impact on the production of pollution streams and the related water and energy consumption. Essentially, better measures are rated by a lower pollution produced but must not imply excessive energy or water consumption. In addition they must not compromise animal welfare and, needless to say, they must not incur unreasonable or excessive costs to the farmer.

Measures and parameters of particular significance include (a) the control of housing environment and the related impact on aerial emissions via ventilation (dusts, pollutant gases, and pathogens), (b) the management of manure within the building (especially those measures limiting emissions such as drying), (c) the system for the collection and removal of manures in that emissions can be thus reduced as a consequence, (d) the outside handling of manures relating to storage and movements (again especially with special attention on the gas emissions produced as well possible liquid leakages) and (e) the treatment and collected manures to meet specific objectives. The final landspreading off the manures is not really within the scope of this study: nonetheless, the application method, timing and dosages are also crucial in the overall impact on the wider environment from the nutrients contained.

2.5 Factors not considered important for IPPC evaluation

It would be difficult to completely eliminate any factor as having no impact on the pollution produced by a livestock farming activity. However, certain methods, especially amongst the housing and animal management options clearly have a limited impact although they may remain important in other terms such as animal welfare, or economic considerations. In addition, there are some techniques such as heating or air conditioning that will have a large impact on energy and/or water consumption that still have little influence on the overall polluting potential of the farm. Conversely, it would be fair to say, especially for any method that increases water consumption that the increased effluent produced as result would also be of concern when considering pollution impacts.

Amongst the housing factors, the size and nature of pens, the general configuration of the building and the means of grouping the animals all have little overall effect on the emissions (as gas or liquid) to the environment. Animal diet control can reduce both excreted nitrogen

(by phase feeding) and phosphorous (by the inclusion of phytase) but by modest amounts: furthermore, more often feed and feed regime are commercially optimised and rarely a factor that distinguish farms.

Outside housing, type of storage (pit, lagoon, steel or concrete tank) is a relatively minor factor so long as it is adequate in volume and implies no leakage.

3 OVERALL EUROPEAN FIGURES

The raw data has been analysed on a national basis for the 27 countries of the EU (including some estimates for those not represented amongst the replies received for the questionnaires). Brief (one page) reports have been prepared to give a summary for each country for their pig Industry (Annexe 4) and for their poultry industry (Annexe 5). These summaries include overall statistics relating to the livestock industry and most importantly, the most common techniques in use for the main animal categories.

3.1 Pig numbers

Using data from Eurostat (2005) set out below in Table 2 we note that 70% of pig production (based on the numbers of head) is accounted for by six countries.

Table 2 : Pig production in EU 27

	All pigs		Pigs - piglets under 20 kg		Pigs - breeding sows over 50 kg		Pigs - others	
	Head	Number of holdings	Head	Number of holdings	Head	Number of holdings	Head	Number of holdings
Belgium	6318210	7720	1661340	4590	592530	4850	4064340	7390
Bulgaria	931970	190860	239230	19010	109320	20460	583420	175670
Czech Rep.	3018640	14590	956030	3110	341060	3640	1721550	13750
Denmark	13534440	9020	4185760	4410	1403090	4630	7945580	8890
Germany	26857820	88680	7129880	33890	2541620	33680	17186320	83790
Estonia	355240	4710	127380	1890	34210	630	193650	3280
Ireland	1660320	840	488210	480	169390	580	1002720	700
Greece	1017120	44510	362760	15500	137990	13710	516370	31380
Spain	22776700	115760	6061800	19090	3380920	41010	13333980	95610
France	14792820	41890	5407390	12990	1281720	12840	8103700	38920
Italy	8757640	102780	1760010	8240	703310	13650	6294310	100890
Cyprus	423570	600	133270	210	53650	250	236650	520
Latvia	430110	39050	105960	5160	46600	4480	277550	36370
Lithuania	1200190	151830	267430	29820	112920	28180	819850	135850
Luxembourg	90150	210	34690	140	8160	120	47300	180
Hungary	3859720	316480	843710	26000	326530	54410	2689480	304610
Malta	73170	140	21760	130	9500	130	41900	140
Netherlands	11311560	9690	4562990	3880	1116810	3990	5631760	9550
Austria	3147230	52350	754190	10460	305030	11180	2088010	50980
Poland	17716940	701660	5853900	309740	1880330	425140	9982710	577420
Portugal	1833880	82620	540230	13050	262650	23890	1031000	68200
Romania	4935660	1753420	895050	337370	595950	285910	3444660	1393280
Slovenia	505160	33950	157460	4180	55580	6130	292120	32900
Slovakia	1004960	41670	287820	2040	110550	5110	606600	40890
Finland	1401040	3080	450990	2030	176700	2170	773350	3000
Sweden	1811220	2790	537800	1640	185420	1770	1088000	2540
UK	4860410	11470	1316520	4720	533860	6720	3010030	9690
EU 27	154625890	3822370	45143560	873770	16475400	1009260	93006910	3226390

The largest producer is Germany with 17.3% of animals followed by Spain (14.7%), Poland (11.5%), France (9.6%), Denmark (8.8%) and then The Netherlands (7.3%). However, production is less concentrated in Poland where there exists many small farms. One notes that the number of pig units of this country represents 18.4% of such farms recorded in the EU-27 whereas the number of units of the four other biggest producers, together only comes to 6.9% of the total for the EU.

3.2 Poultry numbers (by class)

The figures describing the poultry industry across the EU27 are laid out in Table 3 below using data from Eurostat.

Table 3 : Poultry production in EU 27 (Eurostat, 2005).

	Total poultry		Poultry - broilers		Laying hens		Poultry - others	
	(1000 heads)	Number of holdings	(1000 heads)	Number of holdings	(1000 heads)	Number of holdings	(1000 heads)	Number of holdings
Belgium	35570	5430	21070	1280	13310	4280	1190	1130
Bulgaria	19670	380720	7950	51580	9180	369140	2550	91580
Czech Republic	26570	19590	16170	650	9110	18850	1290	5250
Denmark	17580	3600	11910	360	5120	3200	560	810
Germany	120560	83400	56760	9820	50500	78870	13290	13180
Estonia	2130	12510	980	350	1120	12250	30	1660
Ireland	12290	9950	8080	1150	2460	8470	1750	4140
Greece	32380	349880	21540	181770	9910	319310	930	44560
Spain	174350	196870	96970	61730	59980	188570	17400	19130
France	283330	163280	125360	75820	77210	134970	80760	69670
Italy	149090	74640	90390	43680	36120	66470	22580	12030
Cyprus	4340	9450	3380	3740	750	8940	210	4490
Latvia	4040	60410	1170	1230	2750	58860	120	11910
Lithuania	9810	172510	4020	31240	4350	163350	1440	73500
Luxembourg	80	620	10	80	70	590	0	140
Hungary	41600	394070	9770	870	15960	355970	15860	310660
Malta	1050	1100	580	130	470	1010	10	40
Netherlands	95470	3060	44500	760	48420	2100	2550	260
Austria	11940	65500	5580	2740	5730	60860	620	13400
Poland	151430	1319520	83280	665040	48580	1156200	19570	480790
Portugal	29230	193250	18120	122820	9280	173890	1840	50600
Romania	81700	3296010	16560	273100	44780	3007250	20360	2633870
Slovenia	3290	45510	1710	4350	1070	43820	510	19780
Slovakia	11880	43590	7380	1030	4260	42830	240	8070
Finland	10540	1920	5470	140	4550	1620	510	330
Sweden	14390	5310	7500	230	6760	5030	120	340
UK	173890	42450	111480	1970	49010	35930	13400	20470
EU 27	1518200	6954150	777690	1537660	520810	6322630	219690	3891790

As noted for pig production, most (70%) of poultry production is centred across six countries with 18.7% of birds produced in France, 11.5% in Spain, 11.5% in the United Kingdom, 10% in Poland, 9.8% in Italy and 7.9% in Germany. Again, the production in Poland is less intensive spread over many farms representing 19% of the total for Europe whereas the production of the other four big poultry-producing countries together comes to only 8.1% of the total number of farms. Breaking down the overall figures, the main production of broilers (meat production) comes from France (16.1% of all such birds), the United Kingdom (14.3%) and Spain (12.5%). For egg production, the main producing nations are France (14.8% of all such birds), Spain (11.5%) and then Germany (9.7%).

4 CURRENT PRACTICE AND TRENDS IN USE OF TECHNOLOGIES IN EUROPE

All analyses relating to pig and poultry production have been based on the replies to the questionnaires given for the national production: that's to say, for all farms whether or not they come under the IPPC Directive. However, to help distinguish the distribution of the different techniques, the questionnaire requested answers indicating relevance to both IPPC farms (general, common or rare) and to new build farms only (as opposed to all farms) with the latter requiring only the answer applicable or not. The analysed data is arranged accordingly.

All farms (no distinction): poultry (Annexe 6), pigs (Annexe 9); application to IPPC farms: poultry (Annexe 7), pigs (Annexe 10); application for all new build farms: poultry (Annexe 8), pigs (Annexe 11).

Specific information the prevalence of pollution abatement and manure treatment techniques and methods enabling a reduction of the consumption of energy and water on the different stages of pig and poultry production (Questionnaire B) is set out in Annexes 12 (summary for all Europe) and Annexes 13 to 16 (showing national trends for each of the main animal types).

4.1 Pig production

Intensive pig production is characterised by different housing systems corresponding to different stages of production: dry sows, pregnant or sucking, weaning, fattening/finishing. Description of current practice follows the structure of the questionnaire A and covers the following items:

- Housing (including herd size, floor design and manure removal system)
- Building characteristics (type and control of ventilation, heating, inlet air and waste air treatment)
- Feeding regime (feeding type, diet control, nutrient supply, use of additives)
- Manure storage and handling (type and capacity of storage; treatment and land application)

Breeding pigs (mating and gestating sows, farrowing sows)

For the rearing of dry sows, individual and group housing systems are common across Europe. Group housing seems predominant especially in the northern States (SE, FI and DK). The housing of sows combined in an open yard is only rarely applied in Europe with the exception of the Czech Republic, where rearing in a "Combined Yard" is cited as the most common method. Partly slatted floors are commonly applied, whereas fully slatted floors and solid floors with bedding are only commonly or rarely applied in some states (FR, IT, CZ, parts of BE and PT and DK respectively).

Liquid slurry systems with slatted floors are most commonly applied over Europe; the slurry is either stored underground in deep pits or it is removed frequently by a vacuum system. In some of the countries where group housing is most common, production is also done on litter which is removed by scraping (e. g. SE, DK, CZ, CY, FI). Other systems like flush channels, gutters or pipes using fresh or treated slurry, reduced manure pits are only rarely applied in Europe.

Buildings given over to reproduction are generally well insulated, or, less frequently, partly insulated. Open climate housing is only rarely applied on IPPC-farms. Heating whether electric or gas/oil is applied locally above the animals, to a defined area of the housing or by preheating of the incoming air.

Only in some states (esp. CY, DK, DE) do we find air conditioning or the pre-treatment of incoming air to the housing where cooling or water spraying is commonly applied. The ventilation for the pens is mostly by mechanical means (fans). Natural ventilation does not play an important role.

Outlet air treatment only seems to play a more or less important role in NL and BE-W, but virtually not at all in the other states.

The feeding regime for dry sows is similar. The foods are supplied either as dry or as liquid rations. Controlled feed diets and phase/multiphase feeding adapted to the needs of the animals are widespread across Europe. The addition of supplements (amino acid, phytase and/or inorganic digestible phosphate) to reduce the release of nitrogen and phosphorous is also widespread but to different extents according to the country.

Fattening pigs (weaners, growers and finishers)

The rearing of piglets is commonly done in groups smaller than 20 animals in most European countries. However we also find farms using a group size of up to 100 animals are also common. With the exception of EE, piglets are rarely raised in larger groups. Rearing is achieved both on completely slatted floors and on partial slats, which are mainly used in CZ, SE, FI, PL, DK and EE. Both systems for the storage of slurry are common: underground deep pit and frequent removal by channel systems. Deep litter systems are rarely used.

As for weaners, fattening pigs are reared in most countries in groups fewer than 20 animals, but larger groups are common in several countries, and even larger than 100 animals in EE. Partly slatted floors are dominating in Europe, as in NL, CZ, IT, SE, CY, FI, PL, DK and PT. In other countries like DE and BE, flooring is essentially fully slatted except in Spain where the proportion of slats can be both partial or total and in the United Kingdom where straw bedding is common. Both systems for the storage of slurry are common: underground deep pit and frequent removal by channel systems. Deep litter systems are rarely practised, with a few examples in IT.

Both, the feeding of piglets and of fattening pigs is practised either by liquid or solid diets. The feeding regime of fattening pigs is more controlled than for piglets. Phase and multiphase regimes are widespread for piglets and fattening pigs as much as the use of feed supplements to reduce the amounts of waste.

Buildings are in general well insulated and usually heated (depending on the country). Heating is mostly by either electricity gas or oil and sometimes by a mixture of all sources of energy. Heating is either applied locally within the housing or by hot air. Mechanical ventilation of buildings is the main option in effectively all countries. Nonetheless, the use of controlled natural ventilation is of importance in some countries including IT, DE, CY, PL, PT, FR. In ES, FI and DK air conditioning is commonly applied, in the other states only rarely. Ventilation with pre-treated air is used in ES, PL and DK. With the exception of DK outlet air treatment is only rarely applied.

Manure storage and handling (pig breeding and fattening)

According to the floor type of the housing, manures are removed and stored either as slurry or as farmyard manure (FYM). For solid manure a storage capacity 4 – 6 months is usual over all of Europe. In the north (SE, FI) even larger storage capacities are generally applied.

Storage of FYM on floors made of concrete (with or without sidewalls) is most common. However, field storage is still often practised. Measures for leakage control and a separate storage of seepage water are applied only in few countries (CZ, IT, DE). FYM is not often treated: however, if it is, composting, drying and anaerobic treatment can all be used. For field application methods, all types of mechanical spreaders are in use but there is little difference in the environmental impact.

Usually slurries are stored in tanks made of concrete or steel panels above or below ground. Also deep pit storage within the housing and externally lagoons are still in common use. Only in some states (e. g. NL, DK) the storage facilities are generally covered by tents or roofs. Open storage is still very widespread along with the use of natural or artificial crust forming. A storage capacity of 6 months seems to be a common standard in Europe, but also shorter (4 months; CZ, ES, PL) and even longer storing times are common (NL, DK, DE, SE, FI).

The treatment of slurry is of minor importance if we look on Europe as a whole. In some southern countries (IT, CY, PT) solids separation seems of practical importance possibly because of the value ascribed to the organic matter recovered. Amongst all other treatment techniques, anaerobic and (to a lesser extent) aerobic treatments have some use. Anaerobic digestion has increased interest due to the rewards of biogas production.

For field application all types of techniques are applied (splash plate, band spreader, trailing hoses/shoes, injection) but especially splash plate. Irrigation systems are only in IT commonly in use.

6.2 Poultry production

An analysis of the stocking density used within the industry on a national basis is set out in table form in Annexe 17.

Laying hens

The bulk of egg production is still achieved from birds kept in compact “battery” cages, but due to consumer demands and animal welfare reasons alternative systems like floor housing or aviary systems are increasing (e.g. in DE). In the new member states, “stair step” and “flat deck” cages are still in use. The handling of wastes produced as droppings is mostly by the frequent removal using a conveyor belt. The pre-drying of droppings is also used in certain countries such as the UK, NL, DE, IT, BE and PT. Various other management systems are used interchangeably in FR, NL and ES (e.g. slurry systems storage in deep pits over the whole production cycle). In CY, the management of wastes is based on a daily removal of droppings and drying outside.

Rearing birds in the alternative systems (floor housing, aviary system, on managed cage or free range systems) is common in UK, NL, IT, DE, SE, CY, FI LT, PL, DK and FR. The

management of wastes is effectively done by conveyor belt for the managed cage and the aviary system option. For the floor housing and free range systems, various management options are indicated: a system on partially slatted floors and deep pit or a system based on perches with the storage of wastes in a pit or removed by conveyor.

Both, phase and multi-phase feed regimes adapted to the needs of the animals are widespread as much as the addition of supplements (amino acids, phytase and/or the use of digestible inorganic phosphorous) to reduce N and P losses. The use of additives (such as essential oils, saponins, enzymes and vitamins) is reported in the CZ, DE, PT.

Broilers

Broiler (meat) poultry production is mostly carried out on litter in closed buildings with forced ventilation, the exceptions being CY, PT and F where natural ventilation is commonly used with the option of forced ventilation. Artificial lighting of buildings is commonly used in the UK, NL, CZ, CY, FI, LT, BE, PL and DK. As for natural lighting, this is used in the EU countries of the middle and south (IT, ES, CY and PT) as well as Sweden. Both methods of lighting are used in FR and DE. In all countries, the management of excreta, in the form of litter, is by the removal at the end of the bird crop.

The use of a phase and multi-phase feed regime for an improved feed conversion is widespread. The feed supplements to limit the release of nitrogen and phosphorous are similarly used in the NL, CZ, IT, DE, ES, FI, PL, DK, PT and FR).

Turkeys

Turkey production is largely done in closed buildings using litter with forced ventilation the exceptions being NL, IT, DE, SE, PT, F where natural ventilation with the availability of mechanical means is also applied. Lighting of the buildings is mostly artificial or as in IT, and PT or both as in DE and FR. Generally, accumulated excreta and litter are removed at the end of the crop when the building is cleaned prior to the next cycle.

The use of a phase and a multi-phase feed regime for an improved feed conversion is widespread. The feed supplements to limit the release of nitrogen and phosphorous are similarly used all over Europe.

Ducks

In those countries where duck rearing is important (UK, NL, CZ, DE, PL and F), production is done essentially in closed building with forced ventilation. The building floor is managed as litter in DE whereas in FR, the slatted system is used. In the UK, production is on litter or on floors with part slating. In PL, the buildings work on litter or slats. With slatted floor systems, wastes are collected in an external pit and for the litter system, manure is removed from the building at the end of each crop. Concerning feeding, only multi-phase regimes are in common use.

Geese

Geese production is mostly based in FR, PL and DE. Production is essentially done on alternative systems: the building is part open with rearing on litter with this being collected at

the end of each crop. However, PL rears geese in closed buildings under artificial and natural lighting. As for duck rearing, only multiphase feed regimes are in use.

Building characteristics

Overall, poultry buildings are well insulated and heated with gas/oil with a predominance of radiating heating elements set up above the animals. The heat is principally used to rear chickens (egg layers and broilers) in closed buildings. The ventilation of these buildings is mostly forced and mechanical. The use of air conditioning for ventilation is common in the NL, IT, ES, CY, DK and FR and used particularly for rearing egg layers and broilers.

Manure storage and handling

Although there appear to be differences between countries, the analysis of the questionnaire indicates that for the storage for poultry waste it is mostly as solids (farmyard manure or as droppings). In the majority of countries, poultry waste is removed to the outside of the buildings. When the manure store is located at the production unit, a minimum of four months storage is observed with uncovered heaps kept in the field. However, in certain countries such as DK, NL, DE, CZ, IT, ES, CY, LT, PL, DK, PT and FR the management of wastes is equally done in concrete areas with or without covers.

The management of liquid manures (slurries) in LT, PL, DK, PT and FR is based around a minimum storage of 4 to 8 months in an external concrete pit with the formation of a natural crust in the case of SE and PL. Any sort of treatment of wastes prior to land spreading is not common. The land spreading of solid wastes is done by one or more techniques according to the country.

4.3 Pollution abatement and manure treatment measures in current use and trends

Questionnaire B targeted especially those methods enabling a reduction in the consumption of resources (water and energy) and/or in the environmental impact for each of the different stages of pig and poultry production. The main options identified are summarised below. It is noted that in very few cases any manure management technique (that goes beyond simple collection and spreading) can be considered common.

Animal housing

- Pig production is almost entirely within buildings with an overall trend in the increase in the size of the housing and the group size.
- It will be noted in the first place that egg production is mostly done in large units, that this is the current trend that smaller units are in decline. Free range egg production although limited, shows as much an increasing trend as alternative systems like aviary and floor housing systems.
- Broilers, turkeys, ducks and geese are produced almost entirely in large, closed buildings and no significant development away from this type of housing is expected.

Manure removal systems

- For pigs, measures to enable the reduction in environmental impacts are few: the most common are the use of additives and covered manure stores.
- Collection of droppings on belt, already well established, progresses, and drying equipment, within or outside (already well used) of laying buildings, follows this trend.
- For meat poultry no changes were evident.
- Flushing technology although well-proven is relatively rare.

Technologies for liquid/solid separation for manures

- Technologies to separate manures into liquid and solid fractions relate mostly to pig production. Systems already in use or coming into use are similar and relate to established systems such as centrifugation (decanter centrifuges), screw press or roller presses. Technologies implementing stages of sedimentation/decantation are receiving renewed interest. The use of membrane technologies is virtually non-existent.

Treatments of the solid fraction:

- The different treatment technologies for solid fractions are implemented without following any particular technology arising from the study. Poultry production systems don't tend to include such treatment systems.
- Pig manures are treated either by composting, at the farm level in the majority of cases, or by methanisation (biogas production). Similar systems exist for centralised facilities and those at the farm.
- For egg laying poultry, the levels of treatment are less developed and translate essentially by the setting up of drying systems, with a few cases of methanisation and incineration.
- Incineration (combustion for energy production) is a technology present in reality and growing within broiler production ; it brings a revenue by cogeneration

Treatments of liquid fractions

- The applied technologies relate to little or none of poultry production. For treating pig slurries, aerobic and anaerobic (methanisation) processes were equally represented in the responses to the study. Amongst the relatively few examples, continuous aerobic treatments are in the process of declining use in favour of intermittent processes (SBR – sequential batch aeration). The supply of air is achieved mostly by surface aerators or by fine bubble diffusers. The approach of treatment by methanisation is more often better done on centralised sites, with co-digestion, under mesophylic conditions with the re-cycling of some of the heat produced by the cogeneration

Air treatments

- Treatments applied to *incoming* air (principally for animal welfare reasons) comprise principally dust removal, cooling and/or humidification, for all animal production systems targeted in this study. Radiation treatment is hardly used and this only applying to pig production. The development of treatments for ventilation air to a building is more pronounced in pig production.

- Treatments of air leaving livestock buildings are still relatively uncommon, and their application is focused on pig production (only slurry based systems) in DE, NL, and DK. They are aimed at essentially ammonia emissions, odours and dust by the use of biofilters, biological or chemical air scrubbers or systems combining all technologies.

Energy use in buildings

- In order to reduce energy costs, technologies of insulation, controlling of ventilation, and artificial light are chosen, that have a low energy demand.
- A benefit in the efficiency of feed in terms of nitrogen is systematically researched within all animal groups covered by this study. This leads as a priority to the reduction in the quantities of crude proteins in the feed with the trend to reduce crude proteins by the use of synthetic amino acids: the use of additives (enzymes or others) is often cited.
- Research of the efficiency in phosphorous uptake leads to, for the relevant animals, both the use of enzymes and also by the use of mineral phosphorous that is more easily digestible.
- The reduction in concentration of copper and zinc progresses, as well as the inclusion of additives enabling a better control and better food conversion efficiency.

Water use

- The importance given to water use translates both by the use of drinking systems fitted with devices to reduce wastage and also by the search for leaks (with eventual repair), on water distribution circuits. The checking of water distribution systems, although already largely established, is still in the process of implementation.
- The use of high pressure cleaning equipment is widespread.
- The recording of the water consumption is done essentially for drinking systems but is being extended to include other large applications such as the cleaning of buildings.
- There are a few systems to collect rainwater for re-use for cleaning, and no trend to extend this approach was identified, for any of the animal production systems covered by this study.

5. MAIN OPERATING SYSTEMS AND PRIORITIES FOR EACH COUNTRY

5.1 Common themes on a European level

Pigs (all growth stages)

- Mating and gestating sows: group housing system, partly slatted floors (slurry systems), vacuum system with frequent manure removal controlled solid or liquid diet with nutritional management.
- Farrowing sows; individual pens, fully or partly slatted floors (slurry systems), etc. Well insulated housings with forced ventilation.
- Weaners: group size 20-100, fully or partly slatted floor (slurry systems).
- Fatteners: group size < 20 – 100, fully or partly slatted floor (slurry systems), vacuum system, closed.

Pig housing and manure handling

- Well insulated housings with forced ventilation
- Solid manure storage capacity for minimum 6 months: storages with concrete floors with or without walls
- Slurry storage tanks with a capacity for minimum 6-8 months; with simple covering (floating natural or artificial straw crust) or floating membranes, roofs or tents in a few cases.

Poultry (all types)

- Layers: still cages (up to 2012); manure conveyors with frequent removal or drying, increasingly alternative systems (aviary, floor housing).
- Broilers/Turkeys: floor housing systems, litter removal after harvest, closed, windowless well insulated housings, mechanical ventilation.

Poultry housing and manure handling

- Move towards modern high performance buildings for egg production: removal of manure (droppings) by belt (for layers) and at the end of the production cycle (for meat production birds).

5.2 Common themes on regional level (two or more countries)

Pigs: mating and gestating sows

- individual housing system (IT, CY, DK)
- fully slatted floors (IT, BE, FR)
- solid floor with bedding/deep litter (IT, SE, BE, DK)
- Underground deep pit storage (NL, IT, ES, FI, BE, PT, FR)
- Flushing systems (IT, PL, DK, EE)
- Reduced manure pit (IT, BE)
- Scraper (SE, CY, FI, PL)

Pigs: farrowing sows

- Solid floors with bedding, deep litter (FYM system; CZ, PL).

Pigs: weaners

- Solid floor with bedding, deep litter (FYM system; CZ, IT, DE, PL).

Pig housing and manure management

- Natural ventilation (DE)
- Inlet air treatment (cooling) (DE)
- Waste air treatment (NL, DK, north-western regions of DE)
- FYM/slurry storage with leakage control (DE)
- Anaerobic manure treatment (biogas) (DE)

Poultry (all types)

- Layers: enriched cages with manure belt (DE cage systems are forbidden from 2009 on; projected also in NL and DK).
- Broilers/Turkeys/Ducks: natural ventilated housings with mechanical options (DE, SE, LT, PT, FR) – depending on the kind of poultry - Combined ventilation systems (DE, PT). Inlet/Indoor air treatment (spraying, fogging) (DE, etc.)

Poultry housing and manure management

- Combustion for energy production (UK, NL).

5.3 Specific themes unique to certain countries

Pigs (all growth stages)

- Mating and gestating sows: group housing systems with a yard (DE)

Pig housing and manure management

- Open climate housing (DE)
- Anaerobic digestion of liquid manure for biogas production (DE)
- Aerobic treatment of liquid manures to reduce nitrogen load (FR)

Poultry (all types)

- Free range (organic) production (UK)

Poultry housing and manure management

- Waste treatment : biological and physical/chemical techniques (DK)

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