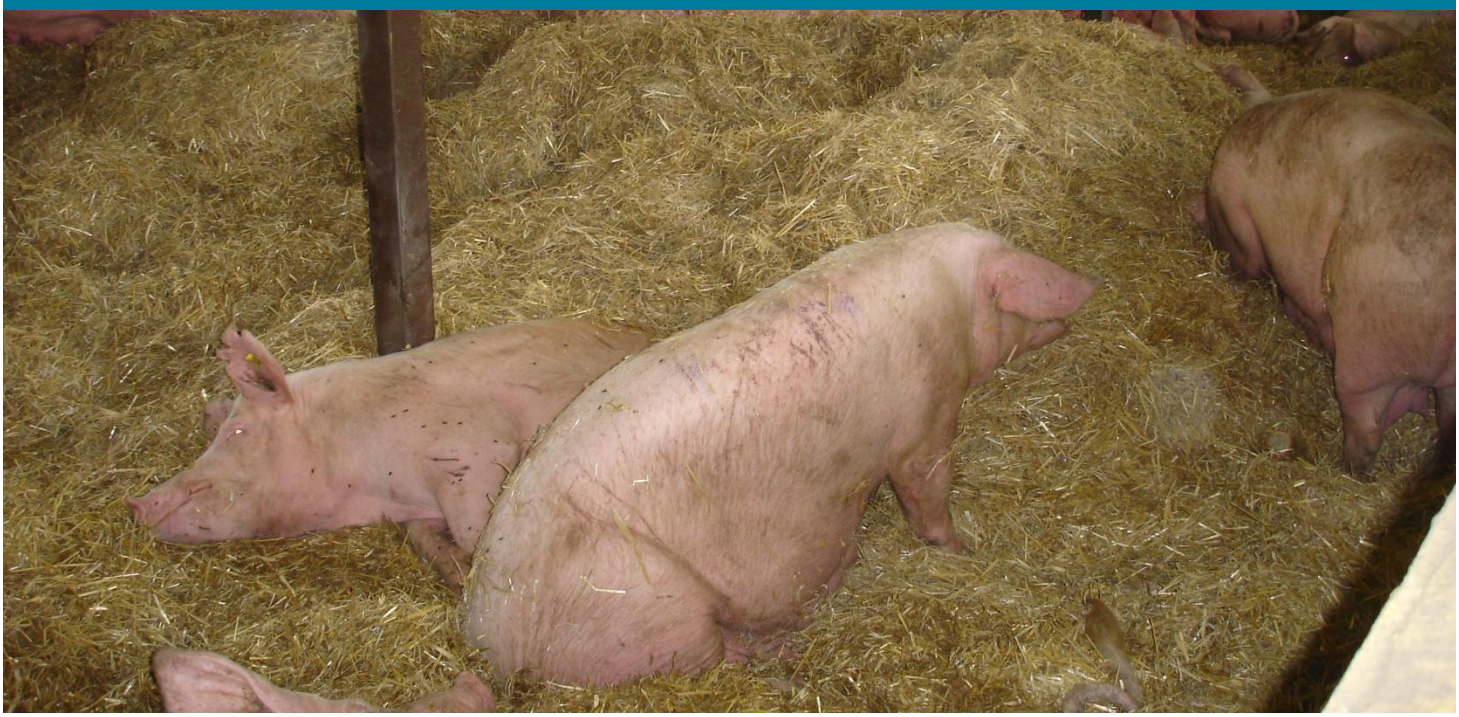
PROPOSAL TO THE REVISION OF THE IPPC DIRECTIVE AND THE REFERENCE DOCUMENT FOR INTENSIVE REARING OF PIGS AND POULTRY, CHAPTER 4

COST EFFECTIVE PHOSPHORUS MANAGEMENT MEASURES

- TO REDUCE LEACHING FROM INTENSIVE REARING OF PIGS



BALTIC SEA 2020

FOREWORD

Preventing emissions to water from intensive livestock production is a challenge for the IPPC Directive. The challenges are apparent in the Baltic Sea, which continues to be affected by nutrient loading. According to HELCOM[1] "the Baltic Sea ecosystem has degraded to such an extent that its capacity to deliver goods and services to humans living in the nine coastal states has been hampered" (Holistic Assessment of the Baltic Sea, released at the HELCOM Ministerial Meeting in May this year). The report states that "eutrophication, caused by excessive inputs of nitrogen and phosphorus, continues to be of major concern in most areas of the Baltic Sea. Further measures to reduce nutrient inputs from agriculture are of utmost importance".

This report describe cost-efficient management measures to reduce leaching of nutrients, focusing on phosphorus, from intensive pig production farms, and provides suggestions for how these measures can be implemented in national and EU legislation. The promoted management measures can, in combination with the use of cost efficient manure treatment technologies such as anaerobic treatment and separation technologies, contribute to the national commitments within HELCOM Baltic Sea Action Plan, and the objectives of the IPPC Directive.

Annex A provides concrete proposals for future amendments to the "Directive 2008/1/EC concerning integrated Pollution Prevention and Control" (the IPPC Directive) and the "Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs" (the BREF irpp document).

The main author of the report is Henning Lyngsø Foged at the Innovation Centre for Bioenergy and Environmental Technology (CBMI). Baltic Sea 2020 is initiator of the report and co-author, including the suggested amendments to the EU legislation.

This paper is part of the "Intensive Pig Production Program", initiated by Baltic Sea 2020 to reduce the negative environmental impact of nutrients leaching from intensive pig farms to the Baltic Sea. It is a follow up report to an earlier study, "Best Available Technologies for Manure Treatment – for Intensive Rearing of Pigs in Baltic Sea Region EU Member States".

Stockholm, May 2010

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The front page shows a slurry tanker belonging to Iowa Select Farms in USA, who has an annual production of more than 3 million fatteners above, and pigs at a Swedish farm (below).

This document is referred to in the following way: "Foged, Henning Lyngsø. 2010. Proposal to the revision of the IPPC Directive and reference document for intensive rearing of pigs and poultry – cost-effective phosphorus management measures to reduce leaching from intensive rearing of pigs. Published by Baltic Sea 2020."

[1] The Helsinki Commission, or HELCOM, works to protect the marine environment of the Baltic Sea through intergovernmental co-operation between Denmark, Estonia, the European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.

CONTENTS

KEY MESSAGES

Many European waters suffer from eutrophication, as does the Baltic Sea, which is one of the most polluted seas in the world. One key source to excessive nutrients is manure from intensive animal production. Cost efficient techniques to properly treat manure are necessary to prevent leaching of nutrients from manure as well as management measures to avoid risks of over-fertilisation.

Introducing management measures to avoid risks of excessive fertilisation with phosphorus at intensive pig production farms is identified as a cost efficient method to reduce phosphorus leaching to the Baltic Sea in the report "Best Available Technologies for Manure Treatment – for intensive rearing of pigs in the Baltic Sea Region EU Member States" from 2009 by Baltic Sea 2020.

Enclosing the recommendations listed below in the IPPC Directive[2] and its reference document BREF irpp[3], would increase the prevention of nutrient emissions to all European waters.
Annex A of the report suggests how this could be done.

1. Official phosphorus norms

Official phosphorus fertiliser norms should be introduced and enforced in all EU Member States when issuing environmental permits to intensive livestock farms. The norms can be determined as flat rate maximal fertiliser norms if they are combined with a phosphorus index. The flat rate phosphorus fertiliser norms should be administrated on farm level rather than on field level in order to accommodate differing needs for phosphorus fertilisation by various crops. The exact norm should be determined by each Member State according to prevailing crop rotations on land where manure from intensive pig farms are used as fertiliser.

2. Official manure standards

A pre-requisite for an efficient introduction of official fertiliser norms is that official manure standards are developed and enforced in all Member States. As a minimum they should describe the amount (tons) of livestock manure produced per animal per year or per produced animal, and provide information on the composition of that livestock manure regarding the percentage of dry matter and phosphorus content (information on nitrogen and potassium is normally a part of a manure standard as well).

3. Official phosphorus index

An official phosphorus index should be developed and used in all EU Member States as a condition for the environmental permitting of intensive livestock farms. The empirical models supporting the index should be developed regionally or country-wise by researchers, as the relevance of the parameters as well as the associated phosphorus loss-risk varies between regions and countries. The practical application of the index should be related to fields rather than field blocks or larger geographical areas. This enables farms to spread as much livestock manure and other phosphorus fertiliser as possible with a minimum of risk for phosphorus loss to the environment. The implementation and enforcement of the phosphorus index requires official standards for the different parameters in the index, set out in national regulations.

4. Certification for spreading and transporting manure

Official certification of staff dealing with transport and/or spreading of large quantities of livestock manure should be introduced and enforced in all EU Member States in conjunction to issuing environmental permits to intensive livestock farms. The certificate should be time limited and based on tests in both theoretical and practical skills connected to the latest EU and national regulations.

[2] Integrated Pollution Prevention and Control (IPPC) Directive

[3] IPPC Reference document on Best Available Techniques for Intensive Rearing of Poultry and Pigs

1: BACKGROUND AND PROBLEM DESCRIPTON

The Baltic Sea is one of the most polluted seas in the world. The predominant problem is the overload of nutrients (nitrogen and phosphorus) discharged from the surrounding countries into the sea. The excess nutrients cause increased algal blooms, oxygen-free sea beds and invasions of filamentous algae in shallow coastal waters. Consequently the unique and sensitive ecosystem is seriously disturbed, to such an extent that its capacity to deliver goods and services to humans is diminished, including its recreational values.

One of the key sources of nutrients in the Baltic Sea is manure from intensive animal production which is not properly managed and treated. The nitrogen and phosphorus content in livestock manure is high, 3-4 times higher than in waste water from all of the households in the region. Intensive livestock production is furthermore expected to increase as the economies in the region are growing.

Nitrogen loads from livestock manure is regulated by the Nitrates Directive, setting a maximal load of nitrogen to 170 kg N/ha and year. There is no equivalent EU regulation for maximal phosphorous loads. This poses a special challenge for national and regional authorities to regulate and minimize discharges of phosphorus from intensive animal production.

In order to reduce the negative impact of nutrients stemming from intensive livestock production, Baltic Sea 2020 initiated the project “Best Practice Manure Treatment” in 2009. The purpose was to identify the best available technologies to reduce leaching of nutrients from intensive pig production in the Baltic Sea rim states, focusing on pig production. In conclusion, three technologies were recommended in the report, “Best Available Technologies for Manure Treatment - for Intensive Pig Production in the Baltic Sea Region EU Member States”:

- Separation technologies to enable a balanced use of pig slurry as fertiliser for the crops
- Anaerobic digestion to improve the field effect (bio-availability) of the nitrogen
- Management measures to avoid risks of over-fertilisation with phosphorus and spills and incautious disposal of livestock manure

The EU IPPC directive was identified as having good potential to reduce emissions (leaching) of nutrients to water, as long as it is properly implemented within the Member States. It also requires that the listing of best available technologies in the BREF document is regularly updated.

Since phosphorous is not regulated by a directive it is important to identify cost efficient measures to reduce the risk for over-fertilisation. One such measure is to ensure that farms with intensive livestock production manage manure properly with regards to its’ phosphorus content.

2: METHOD AND ORGANISATION

This report has been produced by Baltic Sea 2020 and is based on the expert technical analysis and specifications provided by CBMI. All recommendations have been developed by Baltic Sea 2020.

The Innovation Centre for Bioenergy and Environmental Technology (CBMI) was engaged to prepare this back ground report and proposals for revising the BREF irpp, based on analysis of management measures presented in the 2009 report “Best Available Technologies for manure treatment - for intensive rearing of pigs in Baltic Sea Region EU Member States”. The objective was to present pragmatic proposals that could be incorporated into EU legislation.

In addition, a survey of P-management measures implemented in the EU Member States around the Baltic Sea was carried out (see Appendix B).

The following persons were consulted in the preparation of this document:

- Goswin Heckrath, University of Aarhus, Department of Agroecology and Environment, Research Centre Foulum.
- Hans Estrup Andersen, National Environmental Research Institute
  Department of Freshwater Ecology, Aarhus University
- Morten Toft, BioCover

3: PROPOSED MANAGEMENT MEASURES TO AVOID RISKS OF OVER-FERTILISATION WITH PHOSPHORUS AT INTENSIVE PIG PRODUCTION UNITS

This chapter describes the rationale for using the proposed management measures, how they work and any prerequisite they may have. It also recommends how they should be used and incorporated into EU and national legislation.

3.1: PHOSPHORUS NORMS

The HELCOM Convention (2008) states that "To ensure that manure is not produced in excess in comparison to the amount of arable land, there must be a balance between the number of animals on the farm and the amount of land available for spreading manure, expressed as animal density. The maximum number of animals should be determined with consideration taken of the need to balance between the amount of phosphorus and nitrogen in manure and the crops' requirements for plant nutrients." Further the Convention determines, that "The amount of livestock manure applied to the land each year including by the animals themselves should not exceed the amount of manure containing:

- 170 kg/ha nitrogen

- 25 kg/ha phosphorus

with a view to avoiding nutrient surplus, taking soil characteristics, agricultural practices and crop types into account".

3.1.1: Use of phosphorus fertilizer norms in the Baltic Sea Region

A sensible and constructive way for the HELCOM Member States to fulfil their commitments given by signing the HELCOM Convention would be to implement the compulsory use of (official) phosphorus norms in the planning of fertiliser use for crops. This has, however, not yet happened in Denmark, Lithuania, Latvia or Poland.

Annex C includes an overview of the regulated use of phosphorus norms in the EU Member States around the Baltic Sea. It demonstrates that phosphorus norms are determined as a maximal allowed, flat rate[4] phosphorus fertilisation in Sweden and Estonia. Finland and Germany have somewhat more detailed regulations; in both cases the methodologies are comparable to the combination of P norms with simple P-indices.

3.1.2: Need for official manure standards

Official manure standards are a prerequisite for the enforcement of fertiliser norms. Official norms cannot be enforced unless standards are in place, which for the major livestock types, productivity levels / feed intensities, bedding types and production systems describes:

Amount, ton of livestock manure produced per animal per year or per produced animal

Composition of that livestock manure, describing at least percent dry matter, nitrogen, phosphorus and potassium.

According to information provided by authorities in the Baltic Sea countries (see Annex C), official manure standards do not exist in Latvia (due to be issued during 2010), Lithuania or Poland. Estonia has some standards, but according to the Ministry of Environment they are in need of revision. The lack of official manure standards hampers the enforcement of the Nitrates Directive, the IPPC Directive and the Water Framework Directive since the actual amount of nutrients in manure cannot be calculated.

3.1.3: Recommendations

Official phosphorus fertiliser norms should be introduced and enforced in all EU Member States in connection with issuing environmental permits to intensive livestock farms. The norms can be determined as flat rate maximal fertiliser norms, if combined with a phosphorus index. The flat rate phosphorus fertiliser norms should be administrated on farm level rather than on field level, in order to accommodate for the different need of phosphorus fertilisation to different

[4] Flat rate meaning without dependency on crop, soil type, soil analysis or any other parameter.

crops. The exact norm should be determined by each Member State according to prevailing crop rotations on land where manure from intensive pig farms is used as fertiliser.

A pre-requisite for an efficient introduction of official phosphorus fertiliser norms is that official manure standards are developed and enforced in all Member States. The standard should, as a minimum, describe:

the amount (ton) of livestock manure produced per animal-per year, or per produced animal[5].

the composition of the livestock manure regarding the percentage dry matter and the content of phosphorus.

It is underlined that information on nitrogen and potassium also should be parts of manure standards.

3.2: PHOSPHORUS INDEX

A phosphorus index is a tool to analyse the relative risk of phosphorus loss at field level or at larger units, based on easily accessible data (see examples in 3.2.1 below). The index is an empirical model for weighing several risk parameters into a combined risk factor, which can be used as guidance for selection of field management practices. The phosphorus index is relevant to use as basis for decisions on the level of phosphorus fertilisation on a specific field, and in particular whether it is safe to spread livestock manure on that field.

Phosphorus indices were first developed in the USA in the 1990's, and are now used by advisors, specialists, farmers and environmental authorities in all states, including Iowa.

Heckrath et al. (2007) have reviewed phosphorus indexing tools in Denmark, Sweden, Norway and Finland, and concludes that "Compliance with the Water Framework Directive (WFD) will require substantial reductions in agricultural phosphorus (P) losses in the Nordic countries Denmark, Norway, Sweden and Finland. Falling P surpluses in agriculture for more than a decade and voluntary programmes of good agricultural practice have not reduced P losses to surface waters, while general regulatory measures have primarily focused on nitrogen. Without addressing the role of critical source areas for P loss, policy measures to abate diffuse P losses are likely to be ineffective."

According to Annex D, phosphorus indices have been developed and piloted in Denmark, Sweden and Finland, while Germany has gone a step further and have decided to implement a German P index from mid 2010.

3.2.1: Parameters in a phosphorus index

Researchers from different regions or countries will design their phosphorus index differently, depending on the main reasons for phosphorus loss in their region.

The following table lists examples of parameters which could be included in a phosphorus index. The list is not exhaustive nor is it in order of priority; it is rather given to illustrate what a phosphorus index is.

Table 1: Examples of parameters, which could be used in empirical phosphorus index models (different sources).

#	Parameter	High risk association
1	Phosphorus soil analysis, here under share of water soluble phosphorus	High phosphorus analysis figures and high share of water soluble phosphorus
2	Fertiliser and manure spreading method (placed on the soil surface or incorporated into the soil)	Fertiliser placed on soil surface
3	Draining	No draining in case of soil surface run-off, but, opposite, associated with high risk in case of macropore transport and leaching through the soil layers.

[5] Normally figures are provided per animal per year, but in case the animal doesn't get one year old before finally produced, the amounts are indicated per produced animal.

4	Water saturation, irrigation, precipitation	High amount
5	Slope of the field	Steep and long slope
6	Field surface roughness of the field, here under earth barriers and vegetation	Low roughness, no vegetation
7	Distance to surface waters, including buffer strips	Short distance
8	Rate of phosphorus application (crops needs)	Higher rate than removed amount with the crop
9	Soil cultivation methods	For instance drilling row crops in same direction as field slope
10	Type of phosphorus fertiliser (mineral or organic)	Organic
11	Flooding frequency	High flooding frequency

3.2.2: Comparison with conventional fertiliser planning

From the listed parameters in the table above only parameters no. 1 and 8 would typically be considered in calculation of fertilising requirements by conventional methods, which are developed to clarify the need for fertilising of the various crops. However, basing phosphorus fertilisation on these two parameters alone results in low accuracy with regard to the risk for P loss to water from soils. P loss to water is heavily influenced by factors such as water flow and soil erosion (Mallarino et al., 2005). The phosphorus index provides a supplementary calculation of the phosphorus loss-risk associated with fertilisation and helps to observe the fertilising with phosphorus from an environmental perspective.

3.2.3: Calculation methodology

Phosphorus indices might be organised as a combined risk index, or in sub-indices with or without a combined index. For example, Heckrath (2009) has described a Danish phosphorus index which according to major phosphorus transport routes consists of four sub-indices. Whereas, Mallarino et al. (2005) see the parameters in the Iowa phosphorus index as belonging to either of three components:

- Erosion component
- Runoff component
- Subsurface drainage component

In all cases, the parameters are parts of algorithms, where coefficients express the correlation of specific parameters to loss of phosphorus. In the end the different parameters, weighed with its coefficients, are added together to express the risk of phosphorus loss from the field (or in some cases larger areas).

Algorithms have to be designed as to express the final index or sub-index on a specific scale, for instance from 0 to 5 (Iowa) or from 0 to 100 (Denmark).

3.2.4: Organisational issues

The practical application of a phosphorus index should be connected to fields or blocks of fields. A Danish study[6]) carried out under an Interreg IVB project[7], concludes that P-indices generally are considerably lower when based on field-specific data, rather than on field-block-specific data (www.NP-risikokort.dk).

A precondition for the efficient enforcement of phosphorus indices is that the used parameter values have their basis in officially established standards. The soil analyses require for instance approved laboratories and standardised analysis methods. Draining is another example where it is necessary with a clear definition of the understanding of draining, so that farms and their advisers are not left to arbitrary rules for calculation of phosphorus indices.

It is vital that the developed P indices are validated and that the uncertainties involved are assessed prior to official use in order to ensure general credibility among all stakeholders.

National regulations should determine the relation between phosphorus indices and the possible use of livestock manure as fertiliser on the individual fields.

3.2.5: Recommendations

Official phosphorus indices should be implemented and enforced in all EU Member States. Most effectively such a program is included in the procedure for providing environmental permits to intensive livestock farms. The empirical models behind the indices should be developed regionally or country-wise by researchers, as the relevance of the parameters as well as the associated the risk for phosphorus loss varies between regions and Member States. The practical application of the indices should be connected to specific fields rather than blocks of fields or larger geographical areas. Such an approach enables farms to spread as much livestock manure and other phosphorus fertiliser as possible with a minimum of risk for phosphorus loss to the environment. The implementation and enforcement of the phosphorus indices needs to be based on official standards for the different parameters in the index and be part of national regulations.

3.3: CERTIFICATION OF STAFF SPREADING OR TRANSPORTING LIVESTOCK MANURES

Today almost all intensive pig farms have stables with fully or partly slatted floors. Pig manure is consequently produced mainly in the form of slurry, which is kept in slurry tanks according to national rules until it is spread on fields as fertiliser. In some cases the slurry undergoes some processing or treatment underway.

A pig farm with 750 sows with piglets up to 30 kg[8] produces around 3,500 ton slurry per year, and 2,000 fatteners[8] around 1,000 ton slurry (Danish Agricultural Advisory Centre, 2005). Many intensive pig production farms are even larger, and the corresponding area for spreading the slurry is similarly large (around 350 ha for spreading of 10,000 ton pig slurry according to Danish regulations). Machinery with large capacities is used to handle this slurry.

The large amounts of slurry need to be transported to fields where it can be spread, and the length of the transport increases with the structural development of the pig production. Buffer tanks are used more frequently to enable the transport on public roads by conventional trucks, rather than with the spreading machinery. The transportation/spreading machinery is expensive, a slurry wagon like the one shown on the picture below with a capacity of 25 ton slurry costs € 150,000 - 300,000, depending on the exact configuration, and the tractor to pull it typically € 100,000 - 200,000. In order to obtain the lowest possible capacity costs of the machinery, it is often operated by specialised machine pools. In most countries, no special training except a drivers licence is required for the driver.

[6] Danish Agricultural Advisory Centre (Dansk Landbrugsrådgivning) and others, not dated

[7] Investing in the future by working together for a sustainable and competitive region

[8] The minimum threshold size of the production which requires environmental approval according the IPPC Directive.

Picture 1: Typical machinery for transporting and spreading slurry, here configured with band laying system with a 24 metres wide boom.

3.3.1: Conditions around transporting/spreading of livestock manure that is of environmental concern

There are several aspects connected to transporting/spreading of livestock manure that is of environmental concern and which should be clearly understood by the driver of the slurry transportation or spreader:

- It is important that the rate of application follows the fertiliser plan and is done evenly on the field. The driver needs to be familiar with adjustment of speed, dosing and capacity. Modern slurry tankers are equipped with flow metres, which via a computer guided interface automatically adjust the dosing. In those cases, the driver needs to be familiar with how the computer interface can be used to optimize dosing of N and P, in accordance of the fertiliser plan.
- Slurry, and livestock manure in general, can have great differences in chemical composition in different parts of the manure storage. The driver must therefore be familiar with possibilities for homogenising the livestock manure before loading, and with possibilities for use of quick test methods for assessing the amount of phosphorus and other plant nutrients in the manure, as well as ways to align the spreading dose to the varying chemical composition.
- Where spreading takes place on fields not belonging to the intensive pig farm where the slurry is produced, there are specific requirements to report the moving of the livestock manure to another farm. It is the livestock farmer who bear the responsibility for reporting movements to the authorities, but it is relevant that persons who transport and spread slurry are familiar with the rules and procedures for this.
- Accidental spills mainly happen in connection to loading, transport or spreading of slurry or other liquid manure. The driver must therefore understand precautions, alarm systems and safety procedures to avoid spills, as well as actions in case of spills. It can be mentioned that a search of the Danish word “gylleudslip” (In English: slurry spill) on Google gives 46,000 hits, indicating that spills of slurry is a problem of scale.
- Almost all Member States regulate the transport and spreading of livestock manure with regard to the timing (season, weekdays, holidays), temperature/climate, field slope, buffer zones/strips, distances, etc. It is crucial that the drivers are aware of these regulations.
- Innovative technology such as the acidification of slurry in connection to spreading, or the use of GPS/GIS systems during spreading, require specific knowledge and understanding from the driver, and it must be ensured he/she has skills to deal with such technology.
- Legal requirements to the spreading technology must be respected, for instance in cases injection must be used rather than broad spreading or band laying. Today, probably more than 50% of all slurry in Europe is spread with broad spreading technique, but several countries tighten the regulations about this. The driver must be aware of legal requirements and environmental consideratons in relation to spreading technology.

- Complying with traffic rules is important to avoid accidents. The machinery is very heavy, especially when fully loaded. A pre-condition for obtaining a certificate must be that drivers have a normal drivers license, or at least a tractor drivers license.
- Good management practices should be envisaged by the driver, for instance forewarning neighbours about slurry spreading although this is not legally required, as well as practices for cleaning of equipment and hindering dripping on transport roads.

3.3.2: Content of certification

The list above clarifies that drivers who transport/spread livestock manure needs to have both theoretical and practical skills, and certification therefore should contain both practical and theoretical lessons as well as tests.

3.3.3: Organisation of certification

The suggested certification can in many aspects be compared with the requirement for a field spraying licensing – see Annex E. This is for instance organised as a course with 20 lessons at institutions, who are officially accredited to perform the training and testing, and issue the licenses. In most countries the most obvious place to organise the training are agricultural colleges, who have expertise in agricultural education. In other countries the training can take place at regional agricultural departments.

In order to ensure that licensed persons get their skills updated along with the introduction of new innovative technologies, the certificates should have a limited validity, for instance 5 years.

3.3.4: Recommendations

Member States should establish an official certification of persons, who deal with transportation and/or spreading of large quantities of livestock manure. The certification should be based on tests in both theoretical and practical skills connected to EU and national regulations. The certification should therefore be specific in relation to each Member State. The certificate should be valid for a limited period, for instance 5 years, in order to ensure that persons who transport or spread livestock manure are familiar with handling of new innovative technologies and new legislation regarding manure management.

A combination of certification and licensing of the companies, which organise the transport and/or spreading of livestock manure could be considered. Companies take over part of the responsibility for compliance with regulations in relation to spreading/transporting livestock manure in the Netherlands (Foged, 2009) and USA (Foged, 2009). Alternatively, the certification of persons could be combined with an approval system for the equipment, similar to the system for approval of field sprayers.

4: REFERENCES

- Directive 2008/1/EC of the European Parliament and of the council of 15 January 2008 concerning integrated pollution prevention and control.
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.
- Dansk Landbrugsrådgivning, Landscentret. 2005. Håndbog for Driftsplanlægning. Landbrugsforlaget. 184 pp.
- Dansk Landbrugsrådgivning and other. Not dated. Det danske P-indeks. Markdata kontra registerdata. The Interreg IVB project "Investing in the future by working together for a sustainable and competitive region"
- European Commission. Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs. July 2003. 383 pp.
- Foged, Henning Lyngsø. 2010. Best Available Technologies for Manure Treatment – for Intensive Rearing of Pigs in Baltic Sea Region EU Member States. Published by Baltic Sea 2020, Stockholm. 102 pp.
- Foged, Henning Lyngsø. 2009. Memorandum from visit to Holland 31 August to 4 September 2009. Not published.
- Foged, Henning Lyngsø. 2009. Memorandum from visit to Iowa, USA, 12 – 20 September 2009. Not published.
- Heckrath, G., H. E. Andersen, Gitte Rubæk, Brian Kronvang, Charlotte Kjærgaard og Calr Christian Hoffmann. 2009. Et web-baseret P-indeks som miljøplanlægningsredskab: del 1 og del 2. Vand & Jord. Nr. 2.
- Heckrath, G., M. Bechmann, P. Ekholm, B. Ulén, F. Djodjic and H.E. Andersen. 2007. Review of indexing tools for identifying high risk areas of phosphorus loss in Nordic catchments. Journal of Hydrology (2008) 349, 68–87.
- Latvijas Republikas Zemkopības ministrija & Latvijas Lauku konsultāciju un izglītības centrs. 2008. Kultūraugu mēslošanas plāna izstrādes metodika. http://www.zm.gov.lv/doc_upl/Kulturaugu_meslosanas_planosanas_metodika.pdf.
- Mallarino, Antonio P., Barbara M. Stewart, James L. Baker, John A. Downing and John E. Sawyer. 2005. Background and basic concepts of the Iowa P Index.
- Ministeriet for Fødevarer, Landbrug og Fiskeri. Plantedirektoratet. Vejledning om gødsknings- og harmoniregler. Planperioden 1. august 2007 til 31. juli 2008. Revideret udgave april 2008.
- Natural Resources Conservation Services (NRCS). 2004. Iowa P Index. Iowa technical Note No. 25. Unites States Department of Agriculture.

ANNEX A: PROPOSED AMENDMENTS OF TEXTS IN THE RELATED SECTIONS OF THE IPPC DIRECTIVE AND THE BREF FOR INTENSIVE PRODUCTION OF POULTRY AND PIGS

The conclusions in section 3 of this report should be included in the IPPC Directive and in the BREF document for intensive rearing of poultry and pigs in order to ensure that phosphorus emissions from these farms are minimized.

A.1. PROPOSED AMENDMENTS TO THE IPPC DIRECTIVE

It is in line with the existing structure of the IPPC Directive suggested to list additional points in the preamble of the Directive:

(xx) Member States should take the necessary steps to develop scientifically based, official norms and indices for phosphorus fertilisation. The official methodology for calculation of phosphorus indices should take into account the major parameters that influence loss of phosphorus from fields in the region. The phosphorus norm and index should be used by intensive livestock farms parallel to the compliance with the Nitrate Directive, in order to minimise eutrophication of water. Official manure standards, describing the amount and content of plant nutrients for relevant livestock types and production systems, should be in place in each Member State in order to ensure an efficient use of nitrogen and phosphorus fertilising norms and phosphorus indices at intensive livestock farms.

(yy) Member States should take the necessary steps to ensure that persons, who are engaged with transport and/or spreading of livestock manure, through a certification scheme has proven their knowledge to relevant regulations and good practices.

A.2. PROPOSED AMENDMENTS TO THE REFERENCE DOCUMENT ON BEST AVAILABLE TECHNIQUES FOR INTENSIVE REARING OF POULTRY AND PIGS (2003)

The proposed measures in chapter 3 of this report are suggested to be included in the BREF irpp as it is being revised. The suggestions are made in the text in the current BREF irpp (2003), section 4.1.4., 4.1.2. and 4.1.3., as seen below. The amendments are marked with red.

BREF irpp Chapter 4: TECHNIQUES TO CONSIDER IN THE DETERMINATION OF BAT

*Extract: "*This chapter describes the techniques that are considered to be most relevant for determining BAT. It provides the background information for determining best available techniques in the intensive livestock farming sectors within the scope of IPPC (Chapter 5). However, it is not exhaustive and other techniques or combinations of techniques may be applied as well. Techniques that are generally seen as obsolete are not included. Moreover, it does not include all the systems and techniques that are applied on intensive livestock farms and that are described in Chapter 2.

Each section in this chapter describes systems or techniques, following the same order as in Chapters 2 and 3. However, it has not been possible to identify alternative reduction techniques for every technique that is applied on-farm. As far as possible, production systems and techniques will be described using the format as shown in Table 4.1.

Table 4.1: Information provided for each technique included in Chapter 4

Section	Type of information
Description	Technical description (if not already included in Chapter 2).
Achieved environmental benefits	Main environmental impact(s) to be addressed including emission values achieved and efficiency performance. Environmental benefits of the technique in comparison with others.

Cross-media effects	Any negative side-effects and disadvantages to other media caused by application of the technique. Environmental problems of the technique in comparison with other techniques and how to prevent or solve them.
Operational data	Performance data on consumption (raw materials, water and energy) and emissions/wastes. Other useful information on how to manage, maintain and control the technique, including animal welfare aspects.
Applicability	Consideration of how the technique may be used in practice and any limitations to its use.
Costs	Information on costs (annual investment and operation) and any savings (e.g. reduced consumption, waste charges).
Driving force for implementation	Local conditions or requirements which lead to implementation. Information on reasons other than environmental ones for implementation (e.g. consumer market, animal welfare, financial schemes, etc.).
Reference farms	Farms applying the system in Europe or in a Member State. If a technique has not yet been applied in the sector in Europe or elsewhere, a brief explanation is given.
Reference literature	Literature for more detailed information on the technique.

As described in Chapters 1 – 3, the main emphasis in the application of environmental measures in intensive farming is on the reduction of emissions associated with manure production. Techniques that can be applied at different stages of the process are linked. It is clear that the application of reduction measures in the early steps of the animal production chain can influence the effect (and efficiency) of any reduction measures applied in later steps. For example, the nutritional composition of the feed and the feeding strategy are important for the animals' performance, but at the same time they affect the manure composition and therefore influence emissions to air, soil and water from housing, storage and landspreading. The IPPC-directive puts the emphasis on prevention; hence this chapter discusses the effects of nutritional management first, followed by integrated or end-of-pipe techniques.

It is important to note that the performance of a reduction technique is closely linked with the way in which it is operated and simply applying a reduction measure may not achieve the highest achievable reduction. This chapter therefore begins with a description of the elements of good practice for environmental management, before paying more specific attention to technical measures for emission reduction. Aspects of good agricultural practice have been summarised in [105, UK, 1999] and [107, Germany, 2001] and are presented in Section 4.1.

Whenever possible, this chapter provides information from techniques that can be, or are already being implemented on farms, including information on associated costs and the context in which the technique can be used effectively.

4.1: Good agricultural practice for environmental management

Agriculture, food production and the use of the countryside are of interest and importance to everyone. Organisations of all kinds are increasingly concerned to achieve and demonstrate sound environmental performance. All organisational activities, products and services interact with and affect the environment and are linked to the health and safety of both the farmer and the animals, and to all the farm operational and quality management systems. In short, good farming management means aiming for a sound environmental performance, which has been shown to be closely linked to increased animal productivity.

The key to good practice is to consider how activities on pig and poultry farms can affect the environment and then to take steps to avoid or minimise emissions or impacts by selecting the best mix of techniques and opportunities for each site. The aim is to put environmental considerations firmly into the decision making process. A business that demonstrates good practice will take into account issues such as education and training, proper planning of activities, monitoring, repairs and maintenance, emergency planning and management. Managers should be able to provide evidence that a system is in place to take account of these issues, many of which are referred to in (so-called) "Codes of Good Practice" developed by (some) Member States [45, MAFF, 1998; 43, MAFF, 1998; 44, MAFF, 1998], [106,

Portugal, 2000] and [109, VDI, 2000]. Such action is consistent with many of the steps taken by some businesses aiming for formal accreditation under a recognised Environmental Management System.

Each of the various activities that make up farm management can potentially contribute to the overall achievement of good environmental performance. It is therefore important that someone be identified and given the responsibility to manage and oversee these activities. In larger enterprises in particular, that someone may not necessarily be the owner, but a farm manager, who has to make sure that:

- site selection and spatial aspects are considered
- education and training exercises are identified and implemented
- activities are properly planned
- inputs and waste are monitored
- emergency procedures are in place, and
- a repair and maintenance programme is implemented.

The manager and staff should regularly review and evaluate these activities so that any further development and improvements can be identified and implemented. An appraisal of alternative, new or emerging techniques would be beneficial at this stage.

4.1.1: Site selection and spatial aspects

Often the environmental impact of farms is partly due to an unfavourable spatial arrangement of activities on the farm-site. This can lead to unnecessary transport and additional activities, and to emissions close to sensitive areas. Good farming management can compensate for this to a limited extent, but is made easier if attention is paid to spatial planning of farm activities.

The evaluation and selection of a location for a new livestock farming facility, or the planning of a new installation on an existing site, can be considered as part of good farming practice, if:

- unnecessary transport and additional activities are minimised or eliminated
- adequate distances are maintained in respect of sensitive sites requiring protection, e.g. maintaining adequate distances from neighbours to avoid conflicts arising from odour nuisance as well as adequate distance to water to reduce emission of nutrients to water
- the potential future development capability of the farm is taken into consideration
- any requirements of outline construction planning or village development planning are satisfied.

Apart from the technical appraisal, the evaluation would also consider local meteorological conditions as well as any specific topographic features, such as hills, ridges and rivers [107, Germany, 2001].

For example, for mixed livestock or pig breeding facilities, the low-emission production areas could be located closer to critical sensitive sites whilst housings producing higher emissions may be located further away from those same locations.

Ambient air pollution can be avoided at sensitive sites by effectively arranging, relocating or grouping emission sources, such as in central waste air shafts. For example, it may be possible to increase the distances of the emission source to any critical sensitive sites, or to relocate the sources so that they lie in a subsidiary wind direction, or to discharge waste air through ducting pipelines appropriate distances away [159, Germany, 2001].

4.1.2: Education and training

Farm staff should be familiar with production systems and properly trained to carry out the tasks for which they have responsibility. They should be able to relate these tasks and responsibilities to the work and responsibilities of other staff. This can lead to a greater understanding of the impacts on the environment and the consequences of any equipment malfunction or failure. However, staff may require extra training to monitor these consequences. Regular training and updating may be required, particularly when new or revised working practices or equipment are introduced. Development of a training record could provide a basis for a regular review and evaluation of each person’s skills and competencies.

Regulations and good practices concerning manure management, planning for fertilizing with manure, emergency planning, repair and maintenance, etc. as mentioned below should be part of the training of persons engaged with transport and/or spreading of livestock manure in order to prevent emissions to air and water.

Machinery with large capacities is used to handle the large amounts of slurry produced at intensive pig production installations. There are several conditions connected to transporting and/or spreading of livestock manure that is of environmental concern, e.g.:

- The rate of application must follow the fertiliser plan, and be done evenly on the field. The driver should be familiar with adjustment of speed, dosing and capacity of the machinery.
- Slurry can have wide differences in the chemical composition in different parts of the manure store. The driver should be familiar with possibilities for homogenising the manure before loading and how to use quick test methods for assessing the amount of plant nutrients in the manure.
- Accidental spills happen, mainly in connection to loading, transport or spreading of slurry or other liquid manure. The driver should be able to take precaution, be familiar with alarm systems and safety procedures to avoid spills, as well as be prepared to take the right actions in case of spills.
- Spreading and transport of livestock manure is regulated with regard to time of year and week, temperature/climate, field slope, buffer zones etc. The driver should be aware of these regulations.
- Legal requirements regarding the spreading technology, e.g. when injections must be used rather than broad spreading of band laying, should be familiar be regarded by the driver.

Regular training and updating may be required, particularly when new or revised working practices or equipment is introduced. Development of a training record could provide a basis for a regular review and evaluation of each person's skills and competencies.

4.1.3 Planning activities

Many activities can benefit from being planned, to ensure that they run smoothly and carry reduced risks of unnecessary emissions. An example would be the application of slurry to land. This involves a number of tasks or actions that need to be co-ordinated, including:

- assessing the land receiving slurry to identify the risk of causing run-off to watercourses and then deciding whether to spread
- avoiding weather conditions in which the soil could be seriously damaged and/or the risk for run – off/leaching of nutrients could be significant
- agreeing safe distances from watercourses, boreholes, hedges and neighbouring properties
- identifying an appropriate application rate, taking the specific nitrogen and phosphorus concentrations of the manure into account
- checking that machinery is in good working order and properly set at the correct application rate
- agreeing travel routes to avoid bottlenecks
- ensuring that there is adequate access to the slurry store and that loading can be done effectively and without spilling, i.e. by checking the operation of pumps, mixers and sluice gates or valves
- assessing the spread areas at regular intervals to check for any sign of run-off
- ensuring that all staff are trained and educated for their responsibilities so that they can avoid accidents and take the right action if something goes wrong.

Official nitrogen and phosphorus fertiliser norms, manure standards and phosphorus indices are tools which enable the farmer to use the nutrient resource in livestock manure in the most efficient way and at the same time to minimise the risk of run-off and leaching to watercourses. The presence of official manure standards is a prerequisite for the efficient use of official norms for phosphorous and nitrogen.

These tools help the farmer to calculate balanced doses of nutrients which satisfies the needs of the plants without causing overdosing and emissions to water.

- **Official manure standards** describe as a minimum the amount (ton) of livestock manure produced per animal per year or per produced animal, and the composition of that livestock manure (percent dry matter and the content of nitrogen, phosphorus and potassium).

- **Official phosphorus and nitrogen fertilisation norms** aim to balance the amount of phosphorus and nitrogen with the crops' requirements for plant nutrients. The EU's Nitrates Directive determine that the amount of livestock manure applied to the land each year including the animals themselves should not exceed the amount of manure containing 170 kg N/ha and year. Already established regulations in several EU Member States indicate that flat-rate phosphorus norms of 22-25 kg/ha, administrated on farm level, is sufficient to comply with crops needs for phosphorus. A flat rate maximal phosphorus fertiliser norm should be combined with a phosphorus index (see below) in order to avoid phosphorus loss at individual fields.
- **The P-index** is a tool for assessing the risk of phosphorus loss from fields. The risk for phosphorus run-off from individual fields can be reduced by adjusting the amount of livestock manure and possible other phosphorus fertilisation below available flat rate P norms if appropriate. A regionally developed P-index methodology is to prefer, as the relevance of the parameters as well as the associated phosphorus loss risk varies between regions and countries.

Other activities that will benefit from a planned approach include the delivery of fuel, feed, fertiliser and other materials to site (inputs), production processes, and the removal of pigs, poultry, eggs, other products and waste materials from the site (outputs). Sub-contractors and suppliers also need to be properly briefed.

4.1.4: Monitoring

It is essential to understand the level of use of inputs and the creation of waste in order to consider whether and how changes may be made to improve profitability and to benefit the environment. Regular monitoring of water usage, energy usage (gas, electricity, fuel), amounts of livestock feed, waste arising and field applications of inorganic fertiliser and manure will form the basis for review and evaluation. Where possible, the monitoring, review and evaluation should be related to groups of livestock, specific operations or done on a field-by-field basis, as appropriate, to give the best chance of identifying areas for improvement. Also, monitoring should help in identifying abnormal situations and enable the appropriate actions to be taken.

The mineral bookkeeping system, applied in the Netherlands, is an example of how monitoring the input and output flows of minerals at a farm level can help to reduce mineral surpluses and ammonia losses. This allows Dutch agriculture to comply with the objectives and obligations of the Nitrates Directive [77, LEI, 1999].

4.1.5: Emergency planning

A contingency plan can help the farmer to deal with unplanned emissions and incidents such as the pollution of water, if they occur. This may also cover any fire risks and the possibility of vandalism. The contingency plan should include:

- a plan of the farm showing the drainage systems and water sources
- details of equipment available on the farm, or available at short notice, which can be used to deal with a pollution problem (e.g. for plugging land drains, damming ditches, or scum boards for holding oil spillages)
- telephone numbers of the emergency services and regulator(s) and others, such as downstream landowners and water abstractors
- plans of action for certain potential events, such as fires, leaking slurry stores, collapsing slurry stores, uncontrolled run-off from manure heaps, and oil spillages.

It is important to review procedures after any incident to see what lessons can be learned and what improvements implemented.

4.1.6: Repair and maintenance

It is necessary to check structures and equipment to ensure that they are in good working order. Identifying and implementing a structured programme for this work will reduce the likelihood of problems arising. Instruction books and manuals should be made available and staff should receive appropriate training.

All measures that contribute to the cleanliness of the facility help to achieve a reduction of emissions. These include drying and cleaning the feed store, the dunging, exercise and lying areas, the general and dunging passages, the housing facilities and equipment, and the outlying areas around the housing. Drinking water losses can be avoided by employing low-loss drinking techniques (e.g. nipple drinkers with drip cups in poultry keeping).

Livestock buildings may have insulation, fans, cowls, back-draught shutters, temperature sensors, electronic controls, failsafe arrangements, water supply and feed supply arrangements, and other mechanical or electrical mechanisms which require regular checking and maintenance.

Slurry stores could be checked regularly for any signs of corrosion or leakage and any faults need to be corrected, with professional help if necessary. Stores should preferably be emptied at least once a year, or as frequently as justifiable depending on the quality of the construction and the sensitivity of the soil and groundwater, so that both internal and external surfaces can be checked and any structural problems, damage or degradation put right. In some situations where visual inspection of such constructions is limited it is advisable to monitor the groundwater as an indicator of leakages.

Operating manure spreaders (for both solid and liquid manures) can be improved if they are cleaned and checked after periods of use and any repairs or refurbishment carried out. Regular checks should be made during operational periods and appropriate maintenance carried-out as described in the manufacturers' instructions.

Slurry pumps, mixers, separators, irrigators and control equipment will require regular attention and manufacturers' instructions should be followed.

It is sensible to have a supply of the faster-wearing parts available on-farm in order to carry out repairs and maintenance quickly. Usually routine maintenance can be carried out by suitably trained farm staff but more difficult or specialist work will be carried out more accurately by professional help." (*End of extract)*

ANNEX B: SURVEY

A survey of P-management measures implemented in the EU Member States around the Baltic Sea was carried out for this report. The following questions were asked:

1. Is the use of official Phosphorus norms (regulation of maximum amounts of P in livestock manure applied to land each year including by the animals themselves) compulsory in fertilizer planning?

   If so, how are they defined?

2. Have official manure standards been established in the legislation (definition of the N/P/K content/ton manure from different animals, taking into account bedding type, feed intensity and stable system)

3. Has P indices been developed on research level? Has it been tested for functionality and relevance? Has it been taken into use by farmers or administrations?

4. Are there any official educational requirements for becoming owner of a farm? Would it be feasible to offer certification in connection to this education? Are there other current ways of organizing certification of staff working within farming industry?

ANNEX C: DETAILS CONCERNING IMPLEMENTATION OF PHOSPHORUS NORMS

The following table show the present official use of phosphorus norms in eight EU Member States in the Baltic Sea Region. The table is based on a survey made in connection to the preparation of this report.

Table C.1: Overview of official phosphorus fertiliser norms and their definition in eight EU Member States in the Baltic Sea Region.

Country	Is the use of official Phosphorus norms (regulation of maximum amounts of P in livestock manure applied to land each year including by the animals themselves) compulsory in fertilizer planning? If so, how are they defined?	Legal document
Denmark	**No**, recommendations only.	Ministeriet for Fødevarer, Landbrug og Fiskeri, 2008
Sweden	**Yes**, 22 kg P per ha	Förordningen om miljöhänsyn i jordbruket, 1998:915, JV föreskrifter 2009:82 (2004:62)
Finland	**No/Yes**. P norms are voluntary, but they must be complied with in order to receive environmental support. The P limits are based on crops grown and the soil P content. If only manure is used as P-fertilizer then 15-30 kg of manure total P can be spread depending on crop and soil P content (unless the soil P content is not very high, then spreading is prohibited).	• 931/2000: Statsrådets förordning om begränsning av utsläpp i vattnen av nitrater från jordbruket • Förbindelsevillkor för Miljöstöd för Jordbruket 2010
Estonia	**Yes**. 25 kg/ha year + mineral fertilizer depending on the crop..	The Estonian Water Act
Latvia	**No**	-
Lithuania	No, but plans to introduce a maximum of 40 kg P_2O_5[9] per ha in Lithuania	-
Poland	**No**	-
Germany	**Yes**. P balance of 20 kg P_2O_5 per ha as average of last 6 years. This value may be exceeded if soil content of P is underserved. There is no distinction between organic or mineral P origin.	German regulation on fertilizer use (Düngeverordnung, §6)

***Sources**: Innovation Centre for Bioenergy and Environmental Technology (Denmark), Swedish Board of Agriculture, The Central Union of Agricultural Producers and Forest Owners (Finland), Estonian Ministry of Environment, Latvian Union of Farmers Parliament, Lithuanian Environment Protection Agency, Polish Ministry of the Environment, the State Agency for Agriculture, Environment and Rural Areas of the State Schleswig-Holstein.*

The table illustrate that phosphorus norms are determined as a maximal allowed, flat rate phosphorus fertilisation in Sweden and Estonia, while Finland and Germany have taken a more developed regulation into use, in both cases methodologies that actually are comparable to the combination of P norms with simple P-indices. Phosphorus fertiliser norms in Denmark, Lithuania, Latvia and Poland are recommendations only. It should be noted that there is much difference between official and recommended (phosphorus) fertiliser norms:

- Official norms describe the maximally allowed use of the plant nutrient, while the typical farmer perception of a recommended norm is that it describes how the crops as a minimum should be fertilised in order to give an expected yield.

[9] $P = 0{,}4364 \times P_2O_5$

- Official norms are built into the legislation, and enforced via control and sanctions, while recommended norms are to be considered as advices.

The recommended norms are normally more advanced than the official, flat rate norms. This is for instance evidenced from the recommended norms in Latvia (ZM & LLKC, 2008), where the phosphorus fertiliser norm for a field depends on the following parameters:

- Crop
- Yield level
- Previous permanent grasslands
- Soil type
- pH
- Soil analysis
- Soil incorporated green manure from previous crop
- Livestock manure after effect from previous two years
- Balance in the soil (if previous years fertilising was not following the norms)

The following pages show an extract of Danish authorities' recommendations to Danish farmers (Ministeriet for Fødevarer, Landbrug og Fiskeri, 2008). The first page contains mainly grain crops for harvest, for instance No. 11: Winter wheat. The second page contains mainly oil seed crops, for instance No. 22: winter rape seed. The third page contains mainly fodder crops, for instance No. 257: Permanent grass without clover.

The information in the different columns is:

1. Crop code
2. Crop
3. Preceding crop N effect
4. Is this preceding effect taken into account

5-14. Expected yield and corresponding nitrogen norm for five different soil types (coarse sand, fine sand, irrigated fine sand, sand-mixed clay soils, clay soils)
15. Nitrogen correction for deviation in expected yield
16. Recommended fertilising with phosphorus
17. Recommended fertilising with potassium

The recommended phosphorus norms in Denmark, and the parameters for calculation of the phosphorus needs according Latvian methodology illustrates that different crops have different phosphorus needs, and that these needs furthermore depends on parameters like soil analysis and more.

The recommendation to use official flat-rate phosphorus norms, despite the illustrated variation in crops' need for phosphorus, is based on the following prevailing conditions:

- Flat-rate norms are already taken into use in five of the eight observed EU Member States around the Baltic Sea. The easiest implementation is secured by continuing practice as usual in the Member States who already took the flat-rate norms into use.
- The HELCOM Convention 25 kg phosphorus as a maximal phosphorus fertilisation is also a flat-rate norm.
- Methodology based norms are complicated to enforce legally.

The recommendations to use official flat-rate phosphorus norms are made with the following prerequisites:

- A parallel use of phosphorus indices on individual field basis, to minimise the risk for phosphorus loss.
- Flat-rate norms are administrated on farm level rather than on field level, because, as illustrated by the Latvian and Danish examples, that the actual needs are different for the different crops and due to other parameters. Administration of a phosphorus norm on farm level rather than on field level is comparable with the way the 170 kg nitrogen flat level, given by the Nitrates Directive (1991), is administrated; this is not a limit per field, but a limit in average for the entire farm.

It would in connection to the introduction of an official flat rate phosphorus fertiliser norm be relevant to consider whether the norm should be split into two norms:

- Overall, official flat-rate phosphorus fertiliser norms, irrespective of phosphorus fertiliser type; and
- Official flat-rate phosphorus fertiliser norms for the part of the fertilisation that is provided through livestock manure – this norm would logically be lower than the overall norm.

It appears from the survey that Estonia and Finland have chosen to implement the second type of norm, regulating loads of phosphorus in livestock manure only. However, it might be insufficient, seen from an environmental point of view, to have a norm only for the fertilisation with livestock manure, if fertilisation with phosphorus in mineral fertiliser is without official limits. An official flat rate flat-rate phosphorus fertiliser norm, irrespective of phosphorus fertiliser type, is to prefer.

Tabel 1: Landbrugsafgrøder og grønsager på friland, kvælstof-, fosfor- og kaliumnormer

Kvælstofnormer og retningsgivende normer for fosfor og kalium i kg pr. ha for 2007/08

Normerne angiver total mængde kvælstof på årsbasis. For grønsager på friland, hvor der er fastsat en artsspecifik kvælstofnorm, gælder normen pr. kultur.

Afgrødekode	Afgrøde	Forfrugtsværdi	Indregning af forfrugtsværdi i afgrødens kvælstofnorm	Uvandet grovsand JB 1 + 3		Uvandet finsand JB 2 + 4 og 10 – 12[1]		Vandet sandjord JB 1 – 4		Sandblandet lerjord JB 5 – 6		Lerjord JB 7 – 9		Korrektion for udbytte	Retningsgivende normer for fosfor og kalium[16]	
		kg N/ha	Ja/Nej	Udbyttenorm hkg/ha	Kvælstofnorm kg N/ha	Udbyttenorm hkg/ha	Kvælstofnorm kg N/ha	Udbyttenorm hkg/ha	Kvælstofnorm kg N/ha	Udbyttenorm hkg/ha	Kvælstofnorm kg N/ha	Udbyttenorm hkg/ha	Kvælstofnorm kg N/ha	kg N/hkg	kg P/ha	kg K/ha
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Vårsæd til modenhed																
1	Vårbyg [2]	0	Ja	39 (43)	117	46 (51)	114	51 (56)	133	58 (64)	121	62 (69)	130	1,5	22	50
2	Vårhvede [2]	0	Ja	36 (40)	116	42 (47)	112	47 (52)	132	53 (59)	119	57 (63)	129	1,7	21	60
3	Havre	0	Ja	42	96	49	92	54	111	55	90	58	100	1,5	26	70
4	Andre kornarter, vårsået	0	Ja	43	97	50	94	55	112	55	91	59	100	1,5	23	55
5	Majs til høst ved modenhed	0	Ja	50	132	64	137	68	155	80	149	85	160	1,5	40	100
7	Korn + bælgsæd, vårsået, maks. 50 pct. bælgsæd	9	Ja	42	62	45	50	48	65	51	44	53	49	0,5	21	45
Vintersæd til modenhed																
10	Vinterbyg [2]	0	Ja	49 (54)	149	53 (59)	140	57 (63)	157	72 (80)	151	77 (85)	161	1,2	18	54
11	Vinterhvede [2]	0	Ja	49 (54)	151	63 (69)	154	67 (74)	171	81 (90)	165	86 (95)	175	1,3	20	70
13	Vinterhvede, brødhvede [2]	0	Ja	49 (54)	186	63 (69)	194	67 (74)	213	81 (90)	211	86 (95)	223	1,7	20	70
14	Vinterrug [2]	0	Ja	40 (44)	115	53 (59)	115	52 (58)	127	65 (72)	119	69 (76)	127	1,2	18	70
15	Hybridrug [2]	0	Ja	48 (53)	123	63 (69)	126	63 (69)	139	74 (82)	128	79 (87)	138	1,2	22	85
16	Triticale [2]	0	Ja	41 (45)	141	53 (59)	140	53 (59)	153	61 (67)	140	65 (72)	149	1,2	21	70
17	Andre kornarter, efterårssået [2]	0	Ja	41 (45)	116	53 (59)	115	53 (59)	128	61 (67)	115	65 (72)	122	1,2	20	70

Afgrødekode	Afgrøde	For-frugts-værdi	Indregning af forfrugtsværdi i afgrødens kvælstofnorm	Uvandet grovsand JB 1 + 3		Uvandet finsand JB 2 + 4 og 10 – 12[1]		Vandet sandjord JB 1 – 4		Sandblandet lerjord JB 5 – 6		Lerjord JB 7 – 9		Korrek-tion for udbytte	Retningsgivende normer for fosfor og kalium[16]	
		kg N/ha	Ja/Nej	Udbyt-tenorm hkg/ha	Kvæl-stof-norm kg N/ha	Udbyt-tenorm hkg/ha	Kvæl-stof-norm kg N/ha	Udbyt-tenorm hkg/ha	Kvæl-stof-norm kg N/ha	Udbyt-tenorm hkg/ha	Kvæl-stof-norm kg N/ha	Udbyt-tenorm hkg/ha	Kvæl-stof-norm kg N/ha	kg N/ hkg	kg P/ha	kg K/ha
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Oliefrø																
21	Vårraps	27	Ja	16	114	19	104	21	119	22	99	23	105	1,5	22	60
22	Vinterraps	27	Ja	23	162	31	172	31	172	36	179	38	181	1,5	27	90
23	Rybs	27	Ja	18	115	20	105	22	120	23	100	24	105	1,5	22	60
24	Solsikke	27	Ja	18	157	20	145	22	157	23	136	24	140	0	22	60
25	Sojabønner	19	Nej	45	0	45	0	45	0	45	0	45	0	0	36	110
180	Gul sennep	27	Ja	19	116	21	105	23	121	23	100	24	105	1,5	24	70
181	Anden oliefrøart	27	Ja	19	116	21	105	23	121	23	100	24	105	1,5	24	70
Bælgsæd																
30	Ærter	19	Nej	45	0	45	0	45	0	45	0	45	0	0	27	70
31	Hestebønner	19	Nej	45	0	45	0	45	0	45	0	45	0	0	33	95
32	Sødlupin	19	Nej	30	0	30	0	30	0	30	0	30	0	0	25	50
215	Ærtehelsæd [13]	19	Nej	47	0	55	0	64	0	71	0	71	0	0	27	150
35	Flerårig bælgsæd	19	Nej	45	0	45	0	45	0	45	0	45	0	0	27	65
36	Anden bælgsæd til modenhed	19	Nej	45	0	45	0	45	0	45	0	45	0	0	27	65
Hør og hamp																
40	Oliehør	27	Ja	15	86	15	73	15	86	15	65	15	69	0	18	40
41	Spindhør	27	Ja	90	54	90	41	90	54	90	32	90	37	0	23	50
42	Hamp	27	Ja	120	132	120	119	120	132	120	111	120	115	0	24	110

Afgrødekode	Afgrøde	Forfrugtsværdi	Indregning af forfrugtsværdi i afgrødens kvælstofnorm	Uvandet grovsand JB 1+3		Uvandet finsand JB 2+4 og 10–12[1]		Vandet sandjord JB 1–4		Sandblandet lerjord JB 5–6		Lerjord JB 7–9		Korrektion for udbytte	Retningsgivende normer for fosfor og kalium[16]	
		kg N/ha	Ja/Nej	Udbyttenorm FE/ha	Kvælstofnorm kg N/ha	Udbyttenorm FE/ha	Kvælstofnorm kg N/ha	Udbyttenorm FE/ha	Kvælstofnorm kg N/ha	Udbyttenorm FE/ha	Kvælstofnorm kg N/ha	Udbyttenorm FE/ha	Kvælstofnorm kg N/ha	kg N/netto FE	kg P/ha	kg K/ha
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Græs, permanent[18]																
250	Permanent græs med meget lavt udbytte [4]	19	Nej	800	26	800	26	800	26	800	26	800	26	-	4	30
251	Permanent græs med lavt udbytte [4]	19	Nej	1800	68	1800	68	1800	68	1800	68	1800	68	-	8	60
252	Permanent græs med normalt udbytte [4]	19	Nej	3000	132	3000	132	3000	132	3000	132	3000	132	-	13	100
255	Permanent græs, under 50 pct. kløver omlagt mindst hvert 5. år [4+7+18]	87	Nej	6100	240	6900	242	8300	253	7300	244	7300	244	-	29	240
256	Permanent græs, over 50 pct. kløver omlagt mindst hvert 5. år [4+7+18]	87	Nej	5200	64	5800	64	7000	64	7000	64	7000	64	-	25	215
257	Permanent græs, uden kløver omlagt minimum hvert 5. år [4+18]	19	Nej	6600	308	7800	316	9500	342	8500	325	8500	325	-	33	240
259	Permanent græs til fabrik minimum 6 tons udbytte [2]	19	Nej	6	179	6	179	6	179	6	179	6	179	30	17	115
272	Permanent græs/kl. græs til fabrik, omlagt mindst hvert 5. år [3]	19	Nej	12	268	14	319	16	370	15	344	15	344	30	41	310
273	Permanent lucerne til fabrik, omlagt mindst hvert 5. år [3]	87	Nej	11	0	13	0	15	0	14	0	14	0	-	34	300

The following table shows whether official manure standards exists definition in eight EU Member States in the Baltic Sea Region. The table is based on a survey made in connection to the preparation of this report.

Table C.2: Overview of official manure standards in eight EU Member States in the Baltic Sea Region.

Country	Have official manure standards been established in the legislation (definition of the N/P/K content/ton manure from different animals, taking into account bedding type, feed intensity and stable system)	Legal document
Denmark	**Yes**	Ministeriet for Fødevarer, Landbrug og Fiskeri, 2008
Sweden	**Yes**, regulations for max number of livestock for complying with the limit of 22 kg P per ha	”Allmänna råd, riktlinjer för gödsling och kalkning” and in ”Gödsel och miljö”
Finland	**No**, but it is possible to use table values or own analyses in applications for environmental support	-
Estonia	**No**, there are no official regulations standards regarding manure standards. There are decrees by the Environmental Ministry and the Ministry of Agriculture regarding water standards; however they need to be revised.	-
Latvia	**No**, standard was elaborated already at 2008, but still it is not approved by official authorities.	Currently document works as recommendations. http://www.zm.gov.lv/doc_upl/1_standarts.pdf
Lithuania	**No** official manure standards have been established in the legislation. Only scientific data is established.	-
Poland	**No**, fertilizer plans for IPPC installations should be based on “Code of Good Agricultural Practice” (GAP) where general rules for manure management are set. In this code some general information and requirements concerning manure standards and NPK index is available. Code of GAP is only obligatory for farmers operating IPPC installations.	Code of Good Agricultural Practice
Germany	**Yes**. In the German regulation on fertilizer use are standards for each animal concerning N. These standards are differentiating in animal species and performance group (Leistungsgruppe), but there is no differentiation to stabling. The feeding intensity is globally calculated on the bases of the performance group (e.g. on milk performance) or on the basis of specific feeding systems (e.g. N-P-reduced pig feeding). The expected amount of slurry or liquid manure is predefined. In the German Criteria System for Sustainable Agriculture (KSNL) - over and above German regulations - a farm balance (Hoftorbilanz) is calculated on the basis of natural P freights, so fodder P is included.(Düngeverordnung appendix 5) On Federal State level Germany has comparable regulations for P as part of the Federal State explanations to the German regulation on fertilizer use.	German regulation on fertilizer use (Düngeverordnung, §5)

***Sources**: Innovation Centre for Bioenergy and Environmental Technology (Denmark), Swedish Board of Agriculture, The Central Union of Agricultural Producers and Forest Owners (Finland), Estonian Ministry of Environment, Latvian Union of Farmers Parliament, Lithuanian Environment Protection Agency, Polish Ministry of the Environment, the State Agency for Agriculture, Environment and Rural Areas of the State Schleswig-Holstein.*

Summing up, there are only official manure standards for phosphorus in two of eight EU Member States (Denmark and Sweden) in the Baltic Sea Region, while Germany and Estonia also have some regulations concerning the phosphorus loads from livestock production.

ANNEX D: DETAILS CONCERNING USE OF PHOSPHORUS INDICES

The following table shows the situation concerning development and implementation of phosphorus indices in the eight EU Member States in the Baltic Sea Region. The table is based on a survey made in connection to the preparation of this report.

Table D.1: Overview of use of phosphorus indices in eight EU Member States in the Baltic Sea Region.

Country	Has P indices been developed on research level? Has it been tested for functionality and relevance? Has it been taken into use by farmers or administrations?	Legal document
Denmark	**Yes**, developed on research and pilot basis. Not implemented in practice.	-
Sweden	**Yes**, a Swedish model for P index exists, developed at Swedish University of Agricultural Services (SLU). It is tested in pilot cases but not yet implemented in practice.	-
Finland	**No**. Probably some pilot research has been made.	-
Estonia	**No**, there are no P-indexes used, maybe when Water Act is improved in the future.	-
Latvia	**No**, mainly N is analyzed at research level and also used by farmers and administration, since regulation of Cabinet of Ministers No.531 regulates nitrate issues, especially for nitrate vulnerable zones, in relation with Nitrate Directive.	-
Lithuania	**No**.	-
Poland	**No**, fertilizing plans are checked by competent Agricultural/Chemical Stations where content of NPK in organic fertilizers is checked and compared with results of soil analysis. There is also appropriate norm for P content in various soil types. Those measures are used in every case, not only for IPPC installations.	-
Germany	**Yes**. Concerning risk of erosion and corresponding P discharge, starting 01.07.2010 the farmer has to do field specific risk assessment. Parts of the field (Feldblöcke) get categories of risk of erosion levels (CC-water 1, CC-water 2, CC-wind). Category dependent usage restrictions (Nutzungseinschränkungen) are defined. Noncompliance is sanctioned according Cross Compliance rules.	-

***Sources**: Innovation Centre for Bioenergy and Environmental Technology (Denmark), Swedish Board of Agriculture, The Central Union of Agricultural Producers and Forest Owners (Finland), Estonian Ministry of Environment, Latvian Union of Farmers Parliament, Lithuanian Environment Protection Agency, Polish Ministry of the Environment, the State Agency for Agriculture, Environment and Rural Areas of the State Schleswig-Holstein.*

Summing up, only one of the eight countries has decided to use phosphorus indices (Germany), while Denmark, Sweden and Finland has developed and pilot tested phosphorus indices.

ANNEX E: DETAILS CONCERNING ORGANISING CERTIFICATION OF PERSONS THAT TRANSPORT AND SPREAD LIVESTOCK MANURES

The following table shows the situation concerning the existence and enforcement of farmer educations in the eight EU Member States in the Baltic Sea Region, and the possibility to implement a certification for transporting and spreading livestock manure in connection with that. The table is based on a survey made in connection to the preparation of this report.

Table E.1: Overview of farmer education and certification in relation to the possibility for implementing a certification for transporting and spreading livestock manure in eight EU Member States in the Baltic Sea Region.

Country	Are there any official educational requirements for becoming owner of a farm? Would it be feasible to offer certification in connection to this education? Are there other current ways of organizing certification of staff working within farming industry?	Legal document
Denmark	**No**, not after 2010, where a new agricultural law is introduced. Education exists and the certification could be offered in connection to that. A similar certification of persons spraying with pesticides exists, and also for obtaining a tractors divers license.	-
Sweden	**No**. Previously there were training requirements for buying a farm, but not any longer. Training is conducted at SLU and several Agricultural Colleges. Requirements for certification exist concerning spraying with pesticides, use of chain saw, driving tractor, etc. There are optional courses for spreading manure on fields, skills training through the "Focus on nutrients".	-
Finland	**Yes/No**. In order to qualify for farm subsidies, an agricultural education of 20 credits/weeks is required (160 credits required for a university degree, for comparison). Certification is required for use of pesticides. The certification is managed by ex. schools and agricultural branch institutes as well as advisory organizations. There are no certification requirements in relation to manure management.	-
Estonia	**No**, there are no official educational requirements to own a farm / be a farmer. If a farmer wants to get financial support / subsidy from a governmental organization, obligatory and specialized training hours must be fulfilled.	-
Latvia	**No**, there are no specific education requirements to become a farmer (owner of farm). There are few requirements for personnel certification for specific issues: work security; plant protection chemicals application; transport of dangerous substances. For the future it would be interesting to discuss development of certification of farming personnel. For example – 1-2 days course once in 5 year period, with certificate.	-
Lithuania	**Yes**. If you want to get the certificate of the farmer, you have to have the education in the field of agriculture or to pass the training on farming. No training is needed if your age is more than 50 years. If you have not the certificate on farming the approach to EU funding is impossible.	-
Poland	**Yes**. Educational requirements are stated in Polish legislation. Every fertilizer user is required an appropriate certificate. Only graduates from Agricultural Universities are exempt from this requirement.	-
Germany	**No**, Germany has no restrictions becoming owner of a farm. Restrictions are existing for sub-areas: • using machines, tractors, etc. one need a driver license • applying pesticides requires a user certificate or a job training with associated degree	-

Germany, (cont.)	• safety at work: one have to attend specific seminars getting a certificate or one have to contract external specialists • instructing trainees: one need a job training with an associated master degree or an university degree The degrees are controlled within the CC regulations.

***Sources**: Innovation Centre for Bioenergy and Environmental Technology (Denmark), Swedish Board of Agriculture, The Central Union of Agricultural Producers and Forest Owners (Finland), Estonian Ministry of Environment, Latvian Union of Farmers Parliament, Lithuanian Environment Protection Agency, Polish Ministry of the Environment, the State Agency for Agriculture, Environment and Rural Areas of the State Schleswig-Holstein*.

The conclusion is that only Poland and Lithuania has educational requirements to become owner of a farm, which means that slurry tankers like the one on the picture in section 3.3 can be driven by anyone. However, Finland and Estonia has also some educational requirements, which are linked to the obtaining of subsidies.

All countries have requirements to specific certification for pesticide spraying, while some have similar requirements for labour safety, tractor drivers' license, chain saw license, and for transport of dangerous substances. This means that it would be possible to organise a certification in transport and spreading of livestock manure in ways that are similar to existing certification schemes.