Coalition Clean Baltic

FOR PROTECTION OF THE BALTIC SEA ENVIRONMENT

Report on Industrial Livestock Farming in the Baltic Sea Region – Environmental Protection Context

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Uppsala 2013

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INTRODUCTION

Dynamic development of modern agriculture, intensive livestock industry and yield maximization measures in the face of limited and definite agricultural area give rise not only to economic opportunities, but also to serious risks for the natural environment of the Baltic Sea. Intensive and unsustainable livestock production and its contribution to the eutrophication of the Baltic Sea, as well as the inland water courses and reservoirs, have become one of the most serious challenges in environmental protection and nature conservation of the Baltic Sea catchment basin, recognized by the HELCOM and addressed in the Baltic Sea Action Plan, the EU Strategy for the Baltic Sea Region, the EU the Water Framework Directive, the EU Nitrates Directive, the EU Industrial Emissions Directive, or Agenda 21 for the Baltic Sea Region (Baltic 21). These documents determine the Baltic Sea Region countries' international obligations in the area of environmental protection of the Baltic Sea in the context of agricultural activities, demanding some concrete measures to be taken.

The Baltic Sea environment has been heavily influenced also by the industry, transportation, urbanisation and tourism, which have been sources of chemical, physical and sanitary pollution, resulting in over-fishing, structural changes in the ecosystems (loss or transformation of natural habitats), diminished biocenotic diversity, and interference in the natural regulation and self-purification processes of the sea. But given its scale, continuity and specific nature of agricultural activities, whose environmental impact has always been heavy, agriculture has brought about perhaps the most serious environmental consequences for the Baltic Sea and its catchment area.

In the livestock production sector, mismanaged large-scale livestock farms (installations of strongly concentrated, intensive and industrialized animal rearing) appear to be the source of the biggest environmental burden and to exert significant individual environmental impact. As such, large-scale livestock farms should be classified as point sources of agricultural pollution, whose interactions with the environment – their intensity and scope – are completely different from diffuse sources of pollution.

Intensive animal production carries within a number of serious risks which are not limited to the farm area, but are directly related to the neighbouring areas and indirectly impact the environmental conditions of the whole Baltic Sea Region. It affects all components of the natural environment – living organisms, air, soil and water (surface water, groundwater, precipitation water). What is more, the negative consequences of industrial livestock production has not only environmental, but also social, economic, and legal connotations.

The only solution appears to be a sustainable agriculture, reconciling the needs of the present and future generations. This idea was born out of very pragmatic assumptions defined by a much broader notion of sustainable (lasting) development, safeguarding both environmental and social interests. Many examples from all over the world can be provided to demonstrate that preventing disruptions in and the future redevelopment of environmental homeostasis are perfectly feasible and that agricultural activities and the needs of the natural environment are not mutually exclusive.

What is the scale of intensive livestock industry in the region? What is the current status of the implementation of the agriculture-oriented Annex III to the Helsinki Convention? What are the main problems connected with industrial livestock production in the Baltic Sea catchment area? Are there any methods to prevent negative impact of industrial livestock farming to make it, if not friendly, then perhaps neutral to the natural environment? The authors of this paper will explore these questions, looking for possible answers, hoping to make the present report the first such comprehensive study of the issue ever made in the Baltic Sea Region.

The present report is built on the foundations established in the *Report on industrial swine and cattle farming in the Baltic Sea catchment area* published by the Coalition Clean Baltic in 2007.

1 AIMS, SCOPE, AND METHODOLOGY

1.1 Aims and scope

The main objective of the present assessment of situation of industrial livestock farming in the Baltic Sea catchment area is to provide valid and reliable data on a size of this type of livestock production, as well as information on the natural fertilisers management. Such information is crucial to monitor and evaluate implementation of the Annex III to the Helsinki Convention, which is particularly relevant, from the intensive livestock farming point of view. Mentioned evaluation was the second most important goal of the present report, that is intended for a targeted users at national and Baltic Sea Region-wide level, especially to provide input to the HELCOM and the Baltic-oriented fora at the EU level.

This in turn is necessary in order to support full implementation of the Part 2 of the Annex III to the Helsinki Convention, as well as other HELCOM objectives and actions aimed at nutrient load from agriculture. The most important initiative concerns classification of existing installations for the intensive rearing of cattle, poultry and pigs not fulfilling the requirements in the revised Annex III of the Helsinki Convention, as the HELCOM Hot Spots. Establishing a list of such Hot Spots was planned to be accomplished by 2009. However, even if this task is included in the Baltic Sea Action Plan (BSAP), adopted by all the coastal states and the EU in 2007 at the HELCOM ministerial meeting in Krakow, it was removed from the agenda due to problems with implementing Annex III.

As essential objective is to raise general public awareness of the threats to the natural environment of the Baltic Sea, related to improperly and negligently conducted industrial livestock farming activities.

This study focuses on large-scale swine and poultry farms. For some countries where information about industrial farms keeping other farm animals (cattle, fur-bearing animals) was publicly available, short sections on these farms are included. At the same time it should be noted that definition of large-scale livestock farms adopted in this report is the same as the definition proposed in the HELCOM Baltic Sea Action Plan, Regulation 4: Environmental permits, and based on UE Industrial Emissions Directive. This definition has been fully described below.

Serious problem, in case of adopted definition, were cattle farms, as the vast majority of countries in the region do not keep statistics for farms with livestock population specified in the HELCOM definition. A similar problem arose in the case of pig and poultry farms in countries which are not members of the European Union and does not apply the Industrial Emissions Directive.

The geographical coverage of the present report includes the Baltic Sea catchment area. The catchment basin (a land area where surface and ground water flow into a single sea) of the Baltic Sea covers the area of 1.720.270 km^2 in 14 countries – Finland, Sweden, Norway, Denmark, Germany, Poland, Lithuania, Latvia, Estonia, Russia, Belarus, Ukraine, Czech Republic, and Slovakia (Fig. 1). The catchment area is made up of 14 catchment basins of large rivers flowing across different countries. As in the case of some countries, only part of their territory is located in the Baltic Sea catchment area, where it was possible information relating to this part of the country was given (for each indicator area, which it refers to, was indicated – if relevant for the whole territory there is only the country name, and if for the area belonging to the Baltic Sea catchment basin – country name preceded by 'Baltic'). This applies to the following countries: Belarus – Brest Voblast, Grodno Voblast, Minsk Voblast (Northern part) and Vitebsk Voblast, Czech Republic – Liberec Region, Olomouc Region and Moravian-Silesian Region, Denmark – Nordjylland Region, Hovedstaden Region, Sjælland Region, Eastern part of the Midtjylland and Syddanmark regions, Germany – Mecklenburg-Vorpommern (most of the state), Eastern parts of Brandenburg (Eastern part) and Sachsen (Eastern part), Norway – Hedmark Region (Southern part), Akershus Region and Østfold Region, Slovakia – Žilina Region and Prešov Region, Russia – Leningrad Oblast, Kaliningrad Oblast, Pskov Oblast, Novogrod Oblast and Republic of Karelia, Ukraine – Lviv Oblast and Volyn Oblast.

The catchment area stretches from the Carpathian Mountains and the Sudeten Mountains up to the subarctic regions, which makes it highly diversified in geographic and climatic terms. It has large numbers of lakes, mainly post-glacial ones, and other landscape forms typical for early post-glacial landscape.

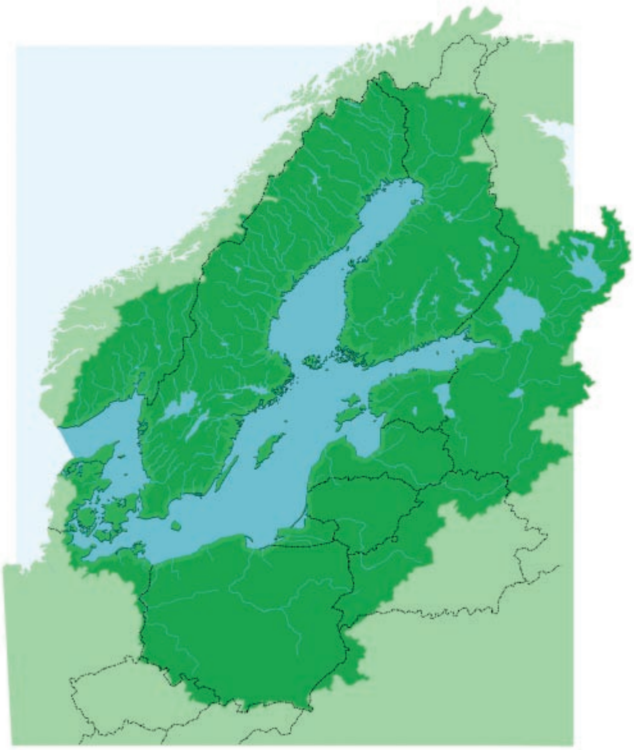

Fig. 1 Catchment area of the Baltic Sea against a political map of the region (photo: M. Thelander/Paris Grafik)

Fig. 2 Intensive rearing of poultry (photo: Wikipedia) and pig (photo: the U.S. Department of Agriculture, Natural Resources Conservation Service)

The Baltic Sea catchment basin is a highly urbanized, heavily populated and economically exploited area (14 cities with the population of over 500 thousand). It is a home to over 85 million people (UNEP, 1996), and the population density varies from 19 to 150 people/km^2. The land use structure (UNEP, 1996) is dominated by forests (48% of the total area) and agricultural areas (20%).

1.2 Defining a problem

Large-scale livestock production (intensive/factory animal farming) can be defined by referring to industrial agriculture, covering the activities of livestock breeding, rearing, and fattening at highly specialised farms (cattle, swine, poultry farms, etc.) which resemble more closely industrial settings (enterprises) than agricultural holdings in organizational, production, and legal terms. Industrial (large-scale) livestock farms can be defined by referring to both, production-related and legal aspects of agricultural activities typical for this type of settings.

In terms of their purpose, industrial livestock farms should be considered agricultural holdings, namely independent legal entities, focused on the production of marketable products. Although the legal category of an *agricultural enterprise* is missing in the legislation of numerous countries of the Baltic Sea Region, large-scale livestock farms fall into the category of an *enterprise* defined in legal acts governing the operations of this type of businesses. Business activities, i.e. striving for profits while pursuing organized and continuous activities, are inherent to the meaning of an enterprise. Finally, due to the size and means of production, large-scale livestock farms can be defined as large commercial farms of high stocking density, i.e. highly productive farms (which market all or major share of their production) focused on maximizing production and profits generated with the use of large quantities of industrial production means, low work expenditure and highly concentrated stocking (intensive, industrial agricultural production).

The key attributes of a factory farm are specialisation in large-scale livestock production, and the use of professional industrial technologies. These technologies are characterised by high stocking density, use of balanced mono-diet (mass use of highly calorific feed and feed concentrates), focus on maximum performance, intensification and high specialisation (low diversification) of production, advanced mechanisation and automation of production processes (feed supply, milking, animal residues removal, transportation, etc.), drive to reducing the production cycle, maintenance of continuous production levels and production rhythm, cyclical and modular (branch-specific) production, lower animal welfare standards, and increased energy consumption (Fig. 2).

To recap, large-scale (highly productive, industrial) livestock farms can be defined – in production-related terms – as entities which pursue organized, continuous, professional and for-profit production activities consisting in intensive, industrialized large-scale livestock farming, most commonly operating as agricultural conglomerates (agro-conglomerates) (Fig. 3).

The legal definition of large-scale livestock farming only implies environmental aspects of intensive livestock industry. The basic definition adopted in the European Union is stated in the Directive 2010/75/EU of The European Parliament and of The Council of 24 November 2010 on industrial emissions – IED (substituting Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control – IPPC Directive). According to this act of law, large-scale livestock farms (IED/IPPC farms) are defined as installations which operate under an integrated permit, with more than 40 000 places of poultry, or with more than 2 000 places for production pigs (over 30 kg), or/and with more than 750 places for sows.

In 2007, the Baltic Marine Environment Protection Commission (HELCOM), also known as the Helsinki Commission, classified large-scale industrial farms as Baltic Agricultural Hot Spots, and, apart from installations indicated in the Industrial Emissions Directive,

Fig. 3 Typical large-scale livestock farm (photo: Green Federation 'GAIA')

industrial farms are also considered to include cattle farms with livestock density of over 400 AU (Animal Unit means a standard measurement unit that allows the aggregation of the various categories of livestock – various species, sex and age – in order to enable them to be compared; HELCOM RECOMMENDATION 13/7), which do not fulfil the requirements set forth in Part 2 of the Annex III to the Helsinki Convention (HELCOM Baltic Sea Action Plan, Regulation 4: Environmental permits). The Land-based Pollution Group (HELCOM LAND) has been advocating to extend the definition of industrial livestock farms to include sheep, goats, horses and fur-bearing animals large-scale rearing installations with equivalent number of livestock to the IED farms category (HELCOM LAND 14/2008). It is worth pointing out that also large fish breeding and/or husbandry sites should be taken into consideration.

Importantly, in livestock production, and especially in large-scale farms focused on intensive livestock production, a small utilised agricultural area does not necessarily reflect the scale of production. Large-scale industrial farms of very high livestock production capacity typically have relatively small arable land area.

1.3 Conditions determining the impact of industrial livestock farming on the natural environment

Agro-ecosystems are very specific fauna and flora systems shaped by the agricultural activities carried out at specific abiotic conditions (air, soil, water). They function in rural settings subject to heavy anthropopression, but also strongly interact with the natural ecosystems (trophic networks, gene flow) and can be referred to as semi-natural ecosystems.

Under such conditions, full and balanced circulation of a chemical compound can hardly take place, and is substituted with open, highly simplified biogeo-chemical cycles. By human interference, focused on accomplishing specific production performance, the cycle of biogenic elements in agro-ecosystems will always involve higher or lower losses caused by the dominating position of cultivated plants as producers, and the dominating role of human and farm animals as consumers, as well as changes in the water balance (shortening and simplification of small local water cycle) accompanying the progressive natural landscape transformation into an agricultural landscape. Anthropopression from non-industrialised and non-intensified agriculture makes room for specific self-regulating mechanisms, including the bio-geo-chemical balance of chemical elements.

Things look quite differently in large-scale and highly industrialized agricultural production – biogeocenoses and environmental formations produced by the intensive livestock industry are so heavily transformed and determined by the specifics of the agricultural activities (agricultural monocultures, highly specialized livestock production, separation of animal and crop production, production automation, large-scale interference with the growth and development process, reduced soil retention, degeneration of filtration conditions, accelerated ground water runoff, intensified leaching, heavy mineralization of organic matter) that the ecosystems they form are completely artificial, and can be only preserved this way by heavy human interference.

As a result, there are many occasions for biogenic matter losses, which leads to surplus nutrient volumes being introduced to the agricultural production cycle. Water and air erosion (nitrogen, phosphorus), surface runoff (nitrates), infiltration (nitrates) and emission from fertilisers (mainly NH_3) and land (mainly nitrogen oxides), and precipitation are the main transfer routes of biogenic matter from the agriculture to the natural environment (Fig. 4).

Negative environmental impact of large-scale livestock farming depends on the livestock type and size, the farming technology, and the handling and use of animal fertilisers.

In consideration of the livestock size and the consumption volume of products of animal origin in the Baltic Sea region, cattle, pig and poultry farming appears to have the heaviest environmental impact (Fig. 5).

In terms of farming technology, large-scale intensive livestock production causes the highest environmental burden. With reference to the animal rearing system, and the type of organic (natural) fertilisers produced, livestock farms can be divided into litter

or non-litter systems (straw-bedded or non-straw-bedded).

The most disadvantageous, from environmental point of view, is non-litter rearing system, which generates high volumes of slurry (liquid manure) (Fig. 6). Slurry is a natural liquid mixture of excreta, urine and water (used to rinse animal waste from the livestock buildings and for hygiene; it accounts for 10-20% of the total slurry volume) and feed residues. The volume and composition of slurry depend on the species, age and condition of animals, livestock population, purpose of livestock production, fattening intensity, type of feed, zoohygienic conditions, and the volume of water used.

Slurry is a rich source of nitrogen which is easily absorbed by plants. It is estimated that around 50% and 20% of nitrogen contained in slurry and solid manure, respectively, is soluble in water. Liquid manure is fast-acting fertiliser, similar to mineral ones, and is therefore less safe for the environment (high risk of over-fertilisation) than solid manure (dung).

Slurry ferments and produces gases (up to 300 L/kg of organic matter in dense slurry). Toxic anaerobic fermentation (decomposition) products, including ammonia, hydrogen sulphide, carbonyl compounds, amines, and thiols, are particularly environmentally burdensome. Absence of biothermal drying process (hygienisation) is another disadvantage of slurry – it has low temperature, i.e. 8-12 °C in the winter period and about 15-17 °C in the summer, at which pathogens and parasites are able to survive. Slurry is a highly concentrated fertiliser rich in minerals and microbiologically contaminated. Unless it is stored, landspread or disposed correctly, it can pose a serious threat to the natural environment and human health (Fig. 7).

Fig. 4 Surface runoff of precipitation water from arable land (photo: the U.S. Department of Agriculture, Natural Resources Conservation Service)

Livestock production intensification and industrialisation makes the use of non-litter systems more and more common. As a result, liquid animal waste can be more easily (as compared to solid manure) mechanically collected and disposed from animal housings. However, slurry utilisation is more problematic. In the majority of cases, present-day large-scale livestock farms do not have sufficient area of land for landspreading. Slurry on-farm treatment is an alternative, however, it can be a serious technical challenge (mechanical, chemical and biological treatment methods are necessary, large volumes of slurry need to be transported, and a dedicated on-farm slurry-treatment-plant need to be built) and a financial invest-

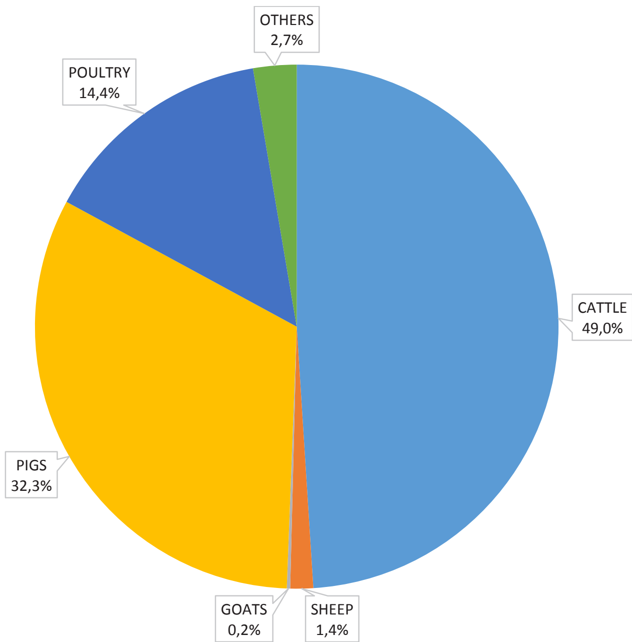

Fig. 5 Share of farm animal species in total livestock (%) in Belarus, Norway, Ukraine and the EU Member States of the Baltic Sea catchment area (EuroStat 2010, FAOSTAT 2010)

Fig. 6 Non-litter pig husbandry (photo: the U.S. Department of Agriculture, Natural Resources Conservation Service)

ment (this is the most expensive utilization method), whereas the treatment effectiveness continues to be low (purified slurry is rich in biogenic substances and microorganisms, up to 23 000/1 mL).

There can be a shallow bedding system (where waste is regularly removed and stacked in heaps or disposed into a reception pit with a below-ground tanker) or a deep litter system (the animal waste accumulating in livestock buildings is typically removed twice a year). In the first case, solid manure and fermented urine are produced, in the second case – solid manure only.

Solid manure, a composition of excreta, urine and litter, contains much more solid organic matter (around 20-30% dry mass) and its temperature of up to 60-75 °C is much higher than that of slurry (conditions for pathogens and parasites growth are much less favourable) and as such, it is considered much more friendly for the natural and agricultural environment.

Manure composition depends mainly on the animal species, age and rearing conditions, as well as type of feed, volume and quality of litter, as well as the manure storage method and period. 60% of organic matter contained in manure is the so-called active humus, which makes solid manure, if used properly, a highly effective organic fertiliser which is safe for water and soil.

In shallow bedding systems, solid manure is collected outside livestock buildings, in manure slabs which

Fig. 7 Correctly (left; U.S. Department of Agriculture, Natural Resources Conservation Service) and incorrectly (right; photo: photo: M. Manske/Wikipedia) secured slurry tank

have a leak-proof slightly inclined floor so that precipitation water can wash the solid manure (manure water) down to the proper storage tank (Fig. 8).

From the environmental protection point of view, biothermal purification is the most favourable characteristics of manure as it eliminates all microorganisms contained in it. Biothermal purification is most effective in manure with the humidity levels of 70%, which is properly layered and stored. Biothermal processes release some ammonia, methane, carbon dioxide and hydrogen sulphide; however, the environmental burden and air pollution are much lower than emission levels from slurry, fermented urine, or solid manure produced in a deep litter system.

Deep litter system produces much more solid manure, mainly due to low organic matter losses (including nitrogen and phosphorus), higher litter content and full urine absorption. The accumulated manure is compacted by animals. Deep litter releases large volumes of ammonia, hydrogen sulphide and carbon dioxide, which significantly deteriorate the sanitary conditions of livestock housing. If manure is stored incorrectly, nitrogen losses can be as high as 40%.

Poultry litter is a special type of natural fertiliser as it has a different composition. Poultry litter contains high share of dry mass and organic matter and highly concentrated minerals. Poultry manure has the highest NPK (nitrogen-phosphorus-potassium) content. This is due to two reasons – firstly, bird droppings include urine in the form of solid uric acid, and secondly, large amounts of undigested organic compounds (mainly phosphorus) are excreted, due to unbalanced diet.

Manure produced at fur farms is environmentally burdensome as well. Manure produced by fur-bearing animals (which are predominantly carnivorous) have to be composted for at least one year because of the presence of parasites (like *Echinococcus granulosus* eggs). In addition, excreta, urine and feed of animals kept in cages fall down onto the ground, which increases the risk that biological impurities and biogenic substances are leached to the soil. Because of high water content (bathing water, process water, feed, litter), it is also challenging to make use the manure produced by coypu (nutria) kept in cages with access to water ponds.

Although around 95% of farm animals in Poland are kept in litter systems, manure production declines due to progressive livestock production industrialization. It takes much work and time to remove and handle solid manure, and the solid manure handling process is difficult to automate. For example, if produced and handled in a traditional manner, solid manure handling can take 10-12% of total farm work load.

1.4 Applied methodology

The report is based on a survey with 108 questions concerning statistical data, management of fertilisers, zones vulnerable to nitrates, problems connected with industrial livestock farming, legal issues and recommendations for reduction nutrient runoff from industrial livestock farms in the Baltic Sea catchment area. Questionnaire was filled by the national coordinators, giving extensive database for the final report compilation. Survey has been prepared in such a way as to serve obtaining knowledge about the situation of large-scale animal farms not only in the EU member states, but also countries outside of the Community. The questionnaire was implemented in 10 Baltic Sea Region countries: Sweden, Denmark, Germany, Poland, Ukraine, Belarus, Russia, Lithuania, Latvia and Estonia. Additionally, publicly available information regarding other countries in the region – Finland, Czech Republic, Slovakia and Norway, were analysed.

The assessment is therefore based entirely on official, publicly available data, obtained from the authorities and public institutions, on the basis of requests for public information and information about the environment and its protection (environmental information), analysis of source documents (statistical and scientific reports and articles), field trips and interviews with representatives of local communi-

Fig. 8 Storage of solid manure on a reception pit (left; photo: A. Kozłowska) and improper storage, directly on land (right; photo: L. Meloures/Wikipedia)

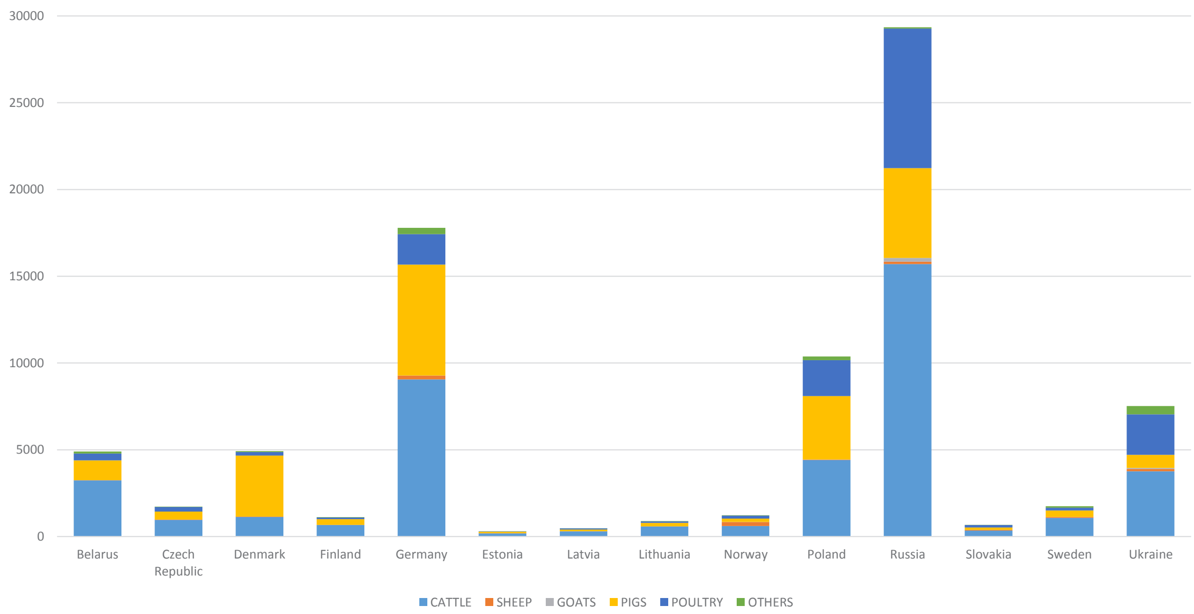

Fig. 9 Livestock population, expressed in the livestock units (1000 LSU), in the Baltic Sea catchment basin countries (EuroStat 2010, FAOSTAT 2010, Federal State Statistics Service of the Russian Federation 2013)

ties, agricultural and environmental authorities as well as owners of large-scale livestock farms, decision-makers at municipal and governmental level, agricultural self-governing bodies, farmers associations and advisory bodies, agricultural research centres and universities.

Important sources of information were official websites of statistical offices (i.e. EuroStat, FAOSTAT), EU databases (i.e. European Pollutant Release and Transfer Register, E-PRTR) and information published on the official websites of various authorities and institutions.

For each analysed indicator (statistical data) it is indicated whether the specified value refers to the whole country or only an area covered by the Baltic Sea catchment area. In a few cases, due to the inability to obtain reliable and authoritative data, some countries were omitted.

2. DATA ANALYSIS AND FINDINGS

The data were collected and then processed in response to the previously indicated problems. Two fundamental goals drove the collection of the data and the subsequent data analysis. Those goals were to develop a base of knowledge about the current situation of the industrial livestock farming in the Baltic Sea catchment area, and to determine the actual influence of this agricultural sector on the natural environment of the region. Therefore, data were analysed both quantitatively and qualitatively, and the results of data analysis were used to formulate final recommendations concerning mitigation measures decreasing the runoff of nutrients from intensive livestock farms.

2.1 Size of the industrial livestock production in the Baltic Sea catchment area

The size of intensive livestock production can be measured by several indicators, of which the most reliable are direct measures and their variants: total livestock population kept for intensive livestock farming purposes, total number of large-scale livestock farms, industrial livestock farms density expressed as number of industrial livestock farms/farmland acreage. There are also indirect measures, of less importance, like: total livestock population per country, livestock density expressed as livestock units (LSU, EuroState reference unit which facilitates the aggregation of livestock from various species and age as per convention, via the use of specific coefficients established initially on the basis of the nutritional or feed requirement of each type of animal, while 1 LSU correspond to the grazing equivalent of one adult dairy cow producing 3 000 kg of milk annually, without additional concentrated foodstuffs) per utilised agricultural area, number of livestock farms classified to the greater economic size category.

The total swine stock in the Baltic Sea catchment basin is estimated at 67.3 million, cattle stock – 35.6 million, poultry – 189.8 million (Gren et al. 2008). Livestock in the EU Member States within the Baltic Sea catchment basin and Norway is approximately 40.0 million LSU (EuroStat 2007) (Fig. 9).

The degree of industrialization (intensification) of livestock production in the country is best reflected by the percentage of animals kept on large-scale farms in the total livestock population of the country. Respective percentage, calculated for different livestock species and for the whole country-territory, is shown in the Fig. 10 (Monteny et al. 2007).

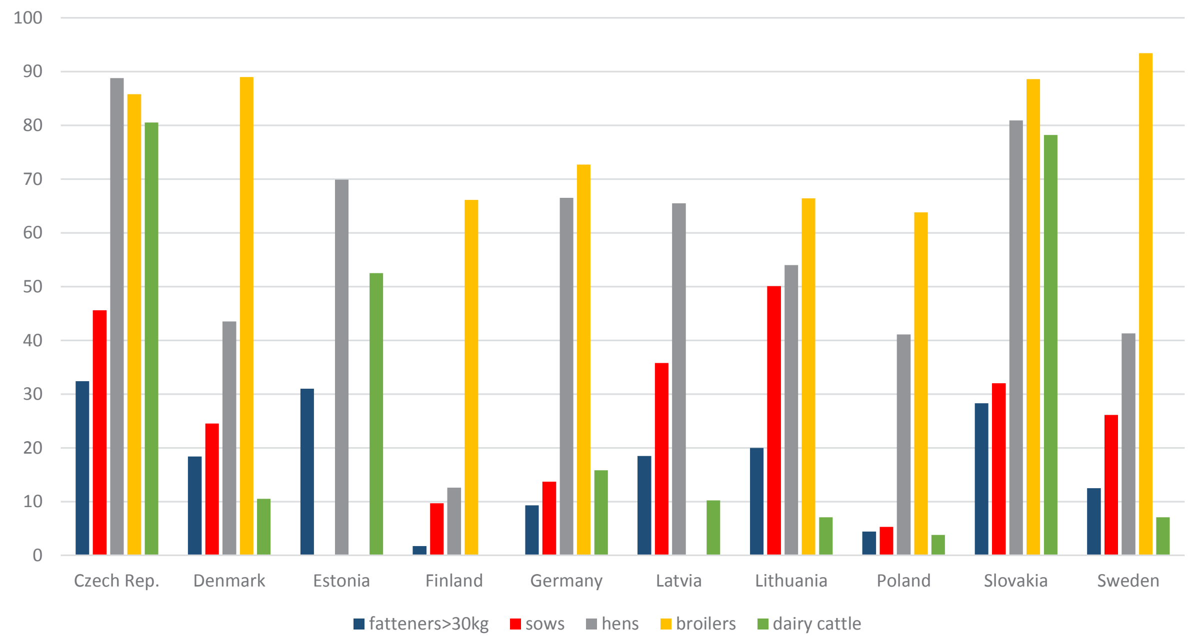

Fig. 10 Percentage of animals covered per EU Member State for the HELCOM large-scale farm thresholds (IE Directive requirements and >400 units cattle) (Monteney et al. 2007)

According to the project's findings, currently there are 1475 industrial pig and poultry farms (520 pig farms and 955 poultry farms) in the Baltic Sea catchment area (Fig. 11). Number of installations for industrial cattle, fur-bearing animals, horses, goats and sheep rearing is much more complicated or, in case of many countries, impossible to determine. The same applies to large-scale aquaculture facilities, although their environmental impact is equally significant. The total number of farms with over 100 LSU in the EU Member States within the Baltic Sea catchment basin is around 74.4 thousand (EuroStat 2008).

Location of industrial farms in the Baltic Sea catchment area located in each country is shown on the maps below (Fig. 12-33).

57% of all large-scale poultry and pig farms located in the Baltic Sea catchment area is located in Poland. Other countries include only 7% – Belarus, 6% – Germany, 5% – Lithuania, Finland and Sweden, 4% Denmark and Russia, and all other countries together account just for 7% (Fig. 34).

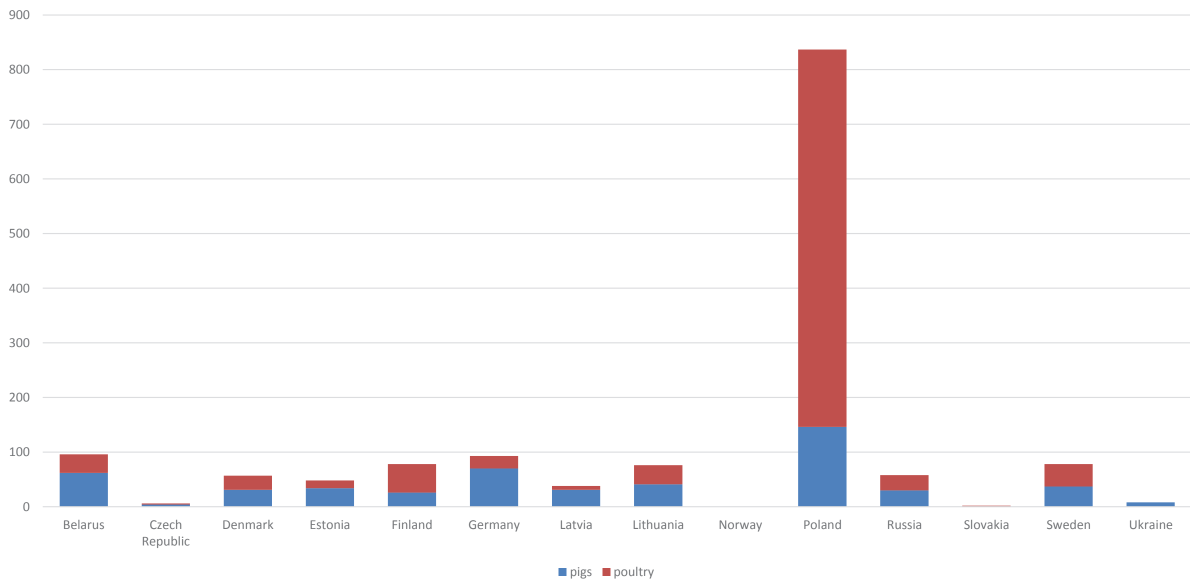

Fig. 11 Number of industrial swine and poultry farms in different countries of the Baltic Sea catchment area (including only country-territories located in the catchment basin)

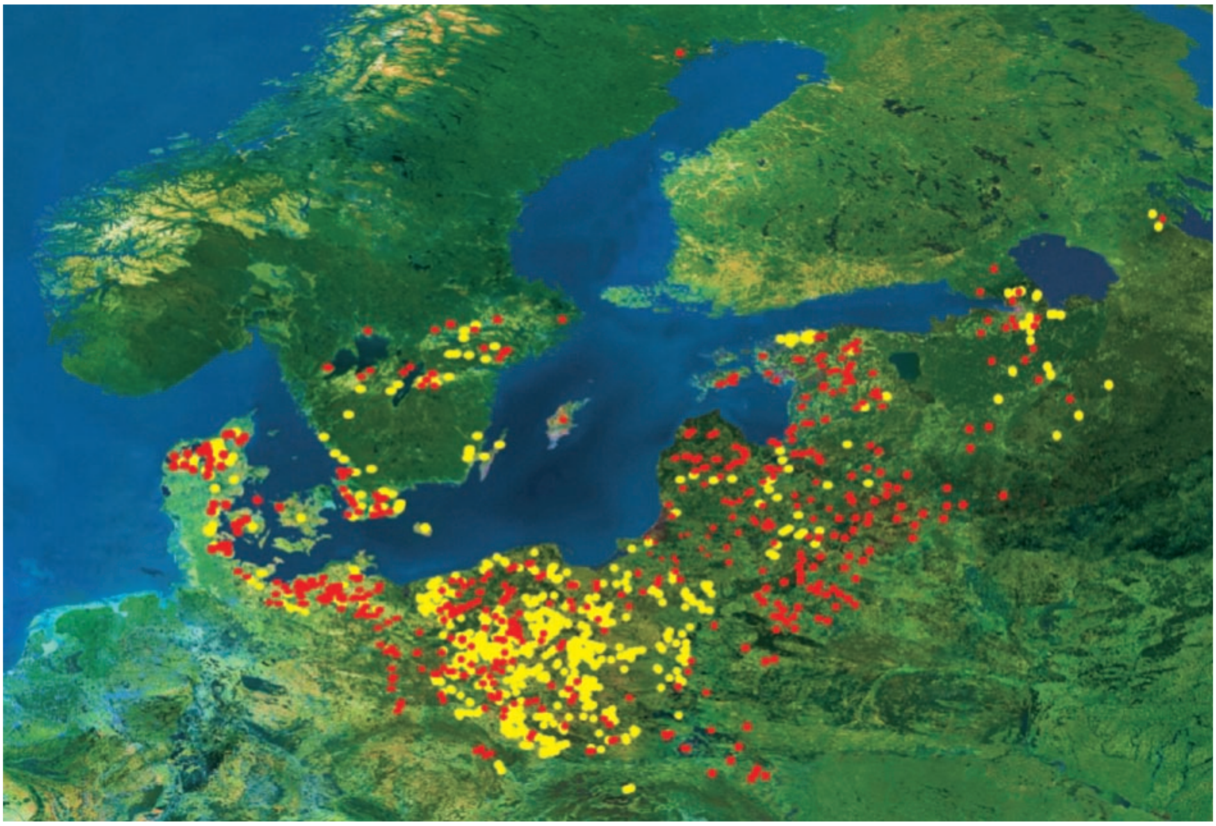

Fig. 12 Combined map of industrial pig (red dots) and poultry (yellow dots) farms in the Baltic Sea catchment area

Fig. 13 Distribution map of large-scale pig farms in Belarus (includes only installations located in the Baltic Sea catchment area)

Fig. 15 Distribution map of large-scale poultry farms in Czech Republic (includes only installations located in the Baltic Sea catchment area)

Fig. 14 Distribution map of large-scale pig farms in Czech Republic (includes only installations located in the Baltic Sea catchment area)

Fig. 16 Distribution map of large-scale pig farms in Denmark (includes only installations located in the Baltic Sea catchment area)

Fig. 17 Distribution map of large-scale poultry farms in Denmark (includes only installations located in the Baltic Sea catchment area)

Fig. 18 Distribution map of large-scale pig farms in Estonia

Fig. 19 Distribution map of large-scale poultry farms in Estonia

Fig. 20 Distribution map of large-scale pig farms in Germany (includes only installations located in the Baltic Sea catchment area)

Fig. 21 Distribution map of large-scale poultry farms in Germany (includes only installations located in the Baltic Sea catchment area)

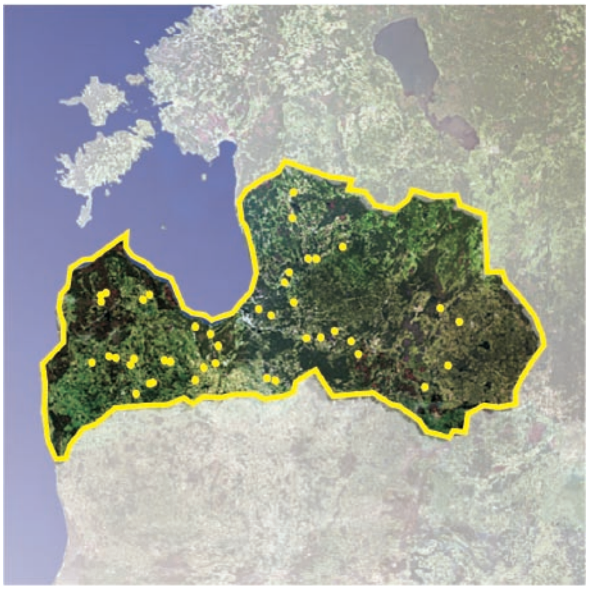

Fig. 22 Distribution map of large-scale pig farms in Latvia

Fig. 23 Distribution map of large-scale poultry farms in Latvia

Fig. 24 Distribution map of large-scale pig farms in Lithuania

Fig. 25 Distribution map of large-scale poultry farms in Lithuania

Fig. 26 Distribution map of large-scale pig farms in Poland (includes only installations located in the Baltic Sea catchment area)

Fig. 27 Distribution map of large-scale poultry farms in Poland (includes only installations located in the Baltic Sea catchment area)

Fig. 28 Distribution map of large-scale pig farms in Russia (includes only installations located in the Baltic Sea catchment area)

Fig. 29 Distribution map of large-scale poultry farms in Russia (includes only installations located in the Baltic Sea catchment area)

Fig. 30 Distribution map of large-scale poultry farms in Slovakia (includes only installations located in the Baltic Sea catchment area)

Fig. 31 Distribution map of large-scale pig farms in Ukraine (includes only installations located in the Baltic Sea catchment area)

Fig. 32 Distribution map of large-scale poultry farms in Sweden (includes only installations located in the Baltic Sea catchment area)

Fig. 33 Distribution map of large-scale pig farms in Sweden (includes only installations located in the Baltic Sea catchment area)

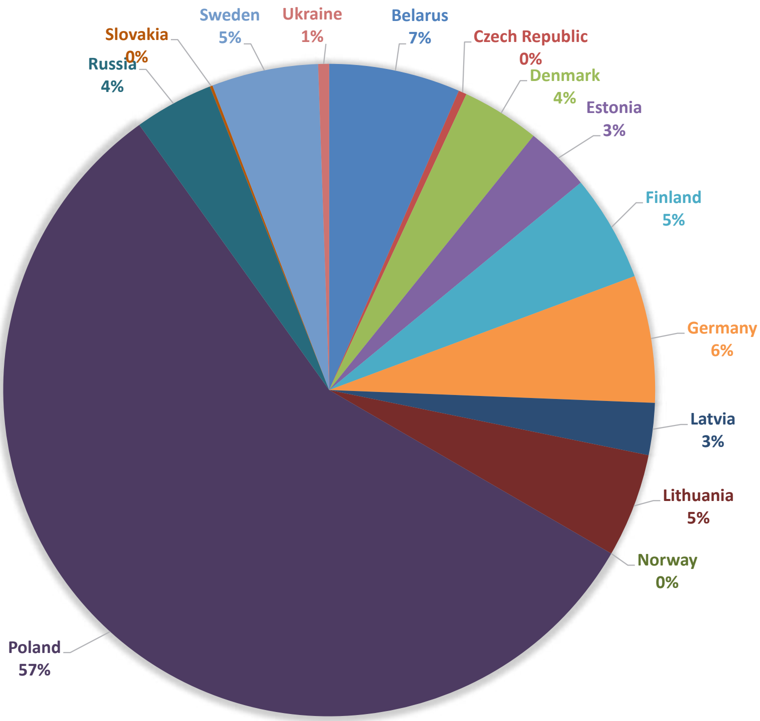

Fig. 34 Share (in %) of number of industrial farms in each country in the total pool of large-scale animal farms in the catchment area of the Baltic Sea (includes only country-territories belonging to the Baltic Sea catchment area)

Highest livestock density, expressed as livestock units (LSU) per utilised agricultural area (UAA, total area taken up by arable land, permanent pasture and meadow, land used for permanent crops and kitchen gardens), is characteristic for Denmark (1.72), Norway (1.22), Germany (1.06) and Poland (0.72) (Fig. 35).

In livestock production, and especially in large-scale farms focused on intensive livestock production, a small utilised agricultural area does not necessarily reflect the scale of production. Large-scale industrial farms of very high livestock production capacity typically have relatively small arable land area. Instead, the number of most profitable livestock holdings with over 500 000 euro SO (standard output of an agricultural product (crop or livestock) is the average monetary value of the agricultural output at farmgate price, in euro per hectare or per head of livestock) can be a more meaningful indication. In 2010, this type of agricultural holdings accounted for 27.3% of all agricultural holdings in Denmark, 17.4% – in Czech Republic, 7.4% – in Sweden, 6.8% – in Germany, 1.6% – in Slovakia, and 0.1% in Poland, while in Estonia, Finland, Lithuania and Latvia such livestock farms account for less than 0.1% (EuroStat 2010).

The actual share of industrial livestock farming in the agricultural landscape of different countries of the Baltic Sea catchment area can be estimated by calculating large-scale poultry and pig farms (IED farms)

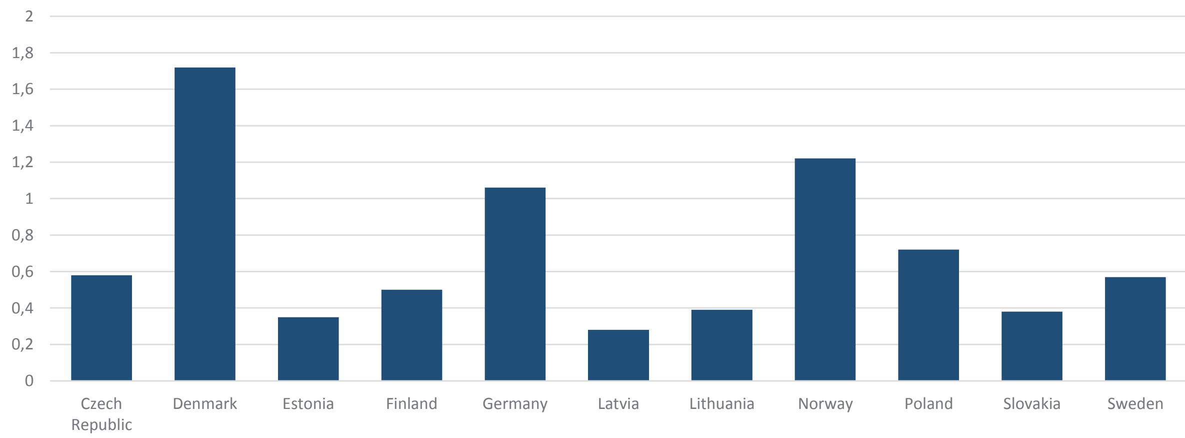

Fig. 35 Livestock density (LSU/UAA) in the EU Member States of the Baltic Sea catchment area and Norway (EuroStat 2012)

density, expressed as number of IED farms per utilised agricultural area (1 000 ha) for the whole territory of particular EU-country. This indicator reaches a value of 0.46 for Denmark, 0.11 for Slovakia, 0.10 for Czech Republic, 0.09 for Germany and Sweden, 0.06 for Poland, 0.05 for Estonia, 0.03 for Finland and Lithuania, and 0.02 for Latvia; the average for all EU-countries of the Baltic Sea Region is 0.09% (all indicators calculated for the whole country-territory) (Monteny et al. 2007, EuroStat 2010, E-PRTR 2011).

Similar indicator can be calculated for the total livestock population in the country, and expressed as number of IED farms per livestock units (1 000 LSU). It accounts for 0.30 for Slovakia, 0.23 for Denmark, 0.20 for Czech Republic, 0.16 for Estonia, 0.15 for Sweden, 0.08 for Germany, Latvia, Lithuania and Poland, and 0.07 for Finland; the average for all EU-countries of the Baltic Sea Region is 0.12% (all indicators calculated for the whole country-territory) (Monteny et al. 2007, EuroStat 2010, E-PRTR 2011).

In a similar way the possible scale of large-scale livestock farming impact on the local population can be estimated – by dividing number of farms in particular country by number of inhabitants (in thousands) of rural areas in the country. This indicator reaches the highest value for Denmark – 1.69, followed by Sweden – 0.19, Estonia – 0.12, and Finland – 0.10, while has the lowest value in the case of Germany and Lithuania (0.07), Latvia (0.05), Slovakia (0.04), Czech Republic (0.03), and Poland (0.02) (all indicators calculated for the whole country-territory). The average for all EU-countries of the Baltic Sea Region amounts to 0.06 (United Nations, Department of Economic and Social Affairs, Population Division 2011).

Interesting measure of both, industrial crop and livestock farming, is average fertiliser consumption per ha of agricultural land. For nitrogen-fertilisers, this indicator amounts to 115 kg/ha the case of Germany, 91 kg/ha for Denmark, 70 kg/ha for Czech Republic and Sweden, 83 kg/ha for Finland, 59 kg/ha for Poland, 38 kg/ha for Lithuania, 37 kg/ha for Slovakia, 31 kg/ha for Estonia, and 19 kg/ha for Latvia – all data for 2000 (FAOSTAT 2000, Alterra 2007, Velthof et al. 2007).

Taking into account the all mentioned indicators, as well as the share of the country-territory in the total area of the Baltic Sea catchment basin, Poland, Sweden, Denmark, Russia and Germany are countries of particularly high share of large-scale livestock production in the socio-economic landscape, and can be thus recognized as most critically influencing the natural environment of the sea, from the point of view of large-scale livestock farming (agricultural point-source Hot Spots).

2.2 Implementation of the Annex III to the Helsinki Convention

The Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area of 9 April 1992, referred to as the Helsinki Convention, was adopted to provide comprehensive protection of the Baltic Sea environment, both sea waters, inland waters, and the Baltic Sea catchment basin. It is an international agreement of fundamental importance for concerted and international protection of the Baltic Sea. The Helsinki Convention was signed by Denmark, Estonia, Finland, Lithuania, Latvia, Germany, Poland, Russia, Sweden and the EU. The Convention is executed by the Baltic Marine Environment Protection Commission (HELCOM) based in Helsinki.

The Land-based Pollution Group (HELCOM LAND) is responsible for pollution from agricultural sources, and the core principles and obligations concerning pollution from land-based sources are listed in Article 6 of the Convention. Under this Article, the Contracting Parties undertake to prevent and eliminate pollution of the Baltic Sea area from land-based sources by using, inter alia, Best Environmental Practice for all sources and Best Available Technology for point sources. The relevant measures shall be taken by each Contracting Party in the catchment area of the Baltic Sea, without prejudice to its sovereignty.

The Helsinki Convention lays down two important definitions – the Best Environmental Practice and the Best Available Technology. The term *Best Environmental Practice* is taken to mean the application of the most appropriate combination of measures:

- provision of information and education to the public and to users about the environmental consequences of choosing particular activities and products, their use and final disposal,
- the development and application of Codes of Good Environmental Practice covering all aspects of activity in the product's life,
- mandatory labels informing the public and users of environmental risks related to a product, its use and final disposal,
- availability of collection and disposal systems,
- saving of resources,
- recycling, recovery and re-use,
- avoiding the use of hazardous substances and products and the generation of hazardous waste,
- application of economic instruments,
- a system of licensing involving a range of restrictions or a ban.

In determining the appropriate combination of measures, particular consideration should be given to the precautionary principle, the ecological risk associated with the product/process, selection of the most environmentally friendly measures, scale of use, potential environmental benefit or penalty of substitute materials or activities, advances and changes in scientific knowledge and understanding, time limits for implementation, and social and economic implications.

The term *Best Available Technology* is taken to mean the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a par-

ticular measure for limiting discharges. In determining whether a technology constitutes the 'Best Available Technology', special consideration should be given to comparable processes, facilities or methods of operation which have recently been successfully tried out, technological advances and changes in scientific knowledge and understanding, the economic feasibility of such technology, time limits for application, the nature and volume of the emissions concerned, non-waste/low-waste technology, and the precautionary principle.

In terms of agricultural activities, the Contracting Parties shall implement procedures and measures listed in the Annex III, called 'Criteria and measures concerning the prevention of pollution from land-based sources'. To this end, the Contracting Parties shall cooperate in preparing, accepting and implementing special programmes, guidelines, standards and rules on emissions and discharges to water and air, quality of environment and products containing hazardous substances and materials. As a result, the detailed provisions of this Annex become the most significant. In the original version, the regulations were relatively general. Diffuse sources of pollution, including agriculture, were supposed to be eliminated by supporting and implementing the 'Best Environmental Practice'.

Later, the Annex III was amended in a procedure for adopting amendments laid down in the Convention. First, on 31 December 2000, according to the Helsinki Commission Recommendation No 21/1, the Annex was divided into two parts: 'Part 1: Prevention of Pollution from Industry and Municipalities', and 'Part 2: Prevention of Pollution from Agriculture', adding contents of Part 2. Next, on 15 November 2008, according to the Helsinki Commission Recommendation No 28E/4, Part 2, Annex III was recasted.

What is important in terms of natural fertilisers, the Contracting Parties agreed to integrate the following basic principles into national legislation or guidelines and accommodate them to the prevailing conditions within the country to reduce the adverse environmental impact of agriculture (Regulation 2). Also, specified requirements levels are considered to be the minimum basis for national legislation.

In terms of detailed regulations, the question of animal density was addressed in the first place. It was agreed 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 amount of animals on the farm and the amount of land available for spreading manure, expressed as animal density. The maximum amount of animals should be explicitly determined considering the amount of phosphorus and nitrogen in manure and the uptake of plant nutrients by crops.

The second detailed regulation addresses the question of location and design of livestock housings. It was agreed that livestock housing location and design should prevent contamination of soil and surface water.

In the present report implementation assessment of the various specified provisions of the Annex III was conducted.

2.2.1 Construction of manure storage

Manure storage is another issue tackled in a detailed manner. Manure storage must be of such a quality that prevents losses. The storage capacity shall be sufficiently large, to ensure that manure only will be spread when the plants can utilize nutrients. The minimum level to be required should be 6 months storage capacity. Technical requirements are also mentioned, such as water-proof floor and side walls.

Minimum capacity level for manure storage vary from 4 to 12 months-production (Tab. 1).

There are no minimum capacity limits for manure storage in Belarus and Ukraine. In both cases, the volume of manure storages depends on the number of animals on the farm and national law regulates technical conditions of manure storages – it is required to made it from water-resistant materials.

2.2.2 Application of organic manures

Another regulation concerns the application of organic manures. Organic manures (slurry, solid manure, urine, sewage sludge, composts, etc.) shall be spread in a way that maximizes their effective application. These fertilisers should be spread in a way that minimizes the risk for loss of

Tab. 1 Minimum capacity level for manure storage (months) in different countries of the Baltic Sea catchment area

	Contracting Party								
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden
Minimum storage capacity	7*-9	8	12	6	7	6-8**	4-6***	–	6-10****

* cattle
** for pigs and poultry
*** NVZs
**** depending on farm animal species and farm size

plant nutrients and should not be spread on soils that are frozen, water saturated or covered with snow. Organic manures should be incorporated as soon as possible after application on bare soils.

Each HELCOM country introduced measures to minimizes the risk for nutrient runoff. Fertilisation plans are legally required in Denmark (farms with 10 ha or more), Estonia (farms with more than 300 LSU), Finland (large-scale farms) Latvia (farms with more than 20 ha located in NVZs), Lithuania (farms with more than 50 ha), Poland (IED farms), Sweden (farms with more than 100 LSU) and Russia. Fertilisation plans are not obligatory required for farmers in Belarus, Germany and Ukraine.

There are different rules of agro-chemical analysis of soils and manures, in terms of developing the fertilisation plans. In Denmark, for example, the nitrogen and phosphorus content is based on two planning tools – Individual field planning and manure planning holding 3 principles of calculation: (1) for each field (crop) the optimal supply of nitrogen and phosphorus is calculated, (2) the proportion of nitrogen supply by means of organic manure, other organic fertilizers, or chemical fertilizer is accounted for, (3) the planned utilization of the nitrogen content in organic manure and other organic fertilizers is accounted for.

2.2.3 Application rates for nutrients and winter crop cover

Part 2, the Annex III also refers to the application rates for nutrients in fertilisers. It was agreed that the application rates for nutrients should not exceed the crops nutrient requirements, based on the equilibrium between the forecasted plant demand and the volumes of nutrients absorbed from soil and supplied with fertilisers to prevent eutrophication. National guidelines should be developed with fertilizing recommendations and they should take reference to:

- soil conditions, soil nutrient content, soil type and slope,
- climatic conditions and irrigation,
- land use and agricultural practices, including crop rotation systems,
- all external potential nutrient sources.

The upper limits for application of animal fertilisers correspond to 170 kg of nitrogen and 25 kg of phosphorus per hectare annually. The Convention also mentions winter crop cover to effectively reduce the loss of plant nutrients.

Characteristic is the absence of restrictions on the use of phosphorus in fertilizer dose, per ha per year, in most countries of the region. An interesting exception is Sweden, where legislation on upper limits for nutrient is based on phosphorus and not on nitrogen as in the Nitrate Directive (Tab. 2).

Winter crop cover is legally required only in Denmark (35%) and for NVZs in Estonia (30%) and Sweden (50-60%).

2.2.4 Water protection measures and nutrient reduction areas

From the point of view of protecting the natural environment of the Baltic Sea, regulations on water protection against pollution by nitrates from agricultural sources appear to be of paramount importance.

The Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC), or the Nitrates Directive, defines a series of actions for water protection against pollution from agricultural sources to be followed by the EU Member States. One of the key conditions for the implementation of the provisions of the Directive is to designate waters vulnerable to pollution from nitrogen compounds from agricultural sources where measures to limit nitrogen runoff from agricultural sources need to be employed (Nitrate Vulnerable Zones, NVZs), in respect of which action programmes shall be established and good agricultural practice promoted. The Directive also requires Member States to undertake actions aimed at limiting water pollution by nitrogen

Tab. 2 The upper limits for nutrient (from livestock manure) application (kg/year) in different countries of the Baltic Sea catchment area

Nutrient	Contracting Party								
	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden
Nitrogen	140-170	170 (100-140)	170	170-230***	170	170	170	200	–
Phosphorus	30*	25	–	9	–	–	–	–	22

* indirect limitation
** NVZs
*** grassland

compounds runoff from land used for agricultural purposes, including to monitor waters, support environmentally friendly and sustainable agriculture, to introduce suitable land management technique for crop and livestock production, thereby limiting nitrogen compounds runoff to water.

Vulnerable zones are identified by the presence of runoffs to surface freshwaters and/or groundwaters which contain or could contain more than 50 mg/l of nitrates and whose condition may worsen unless actions are taken, and runoffs to eutrophic or in the near future may become eutrophic, unless actions are taken.

Action programmes aimed at limiting nitrogen runoff from agricultural sources in the nitrogen vulnerable zones are intended to protect these areas from more pollution and to restore water quality standards put forward in the relevant laws. These action programmes determine the direction and scope of action, as well as remedial measures that farmers are committed to implement. The tasks of agricultural authorities and environmental protection bodies related to agriculture in general and to the mitigation of waste pollution from agricultural sources are also explicitly listed (including education and advisory services on developing fertilisation plans, assistance in the implementation of water protection investments by agricultural holdings, i.e. natural fertiliser collection and storage tanks and slabs, controlling contamination sources and related risks, inspections of obligation fulfilment by farmers, monitoring the quality of surface waters and groundwaters; organisational, financial and professional assistance for stakeholders engaged in the implementation of action programmes). The requirements for action programmes adopted for individual NVZs may differ, which is why agricultural holdings located within specific NVZs should make sure they become familiar with relevant action programme.

Even if implementation of the Nitrates Directive provisions is obligatory for all EU-member countries of the Baltic Sea catchment area, its implementation, mainly if it comes to the area of designated NVZs, still face many problems.

Poland, having the smallest NVZs-area from all EU Member States, is most serious example (Fig. 36-37).

The relevant regulations should have been into force since the date of Poland's accession to the EU on 1 May 2004, yet the Directive has not been transposed since. At the end of 2011, the European Commission demanded full transposition of the Nitrates Directive into the Polish legal system, predominantly by proper and adequate designation of Nitrate Vulnerable Zones (NVZs), and to adapt NVZ-specific action programmes to the requirements set out in the Directive.

The first NVZs in Poland were designated in 2007. There were 21 zones designated based on water monitoring data from the period 1990-2002, with the total surface of 6264.35 km^2, accounting for 2% of the total area of Poland. Individual action programmes have been drawn up for all Nitrate Vulnerable Zones and adopted by Regional Water Management Agencies (RZGW). These action plans were then published in the Journals of Laws of the relevant Provinces and entered into force as local laws.

In 2007, under Contract 2006/441164/MAR/B1 – Implementation of the Nitrates Directive (91/676/EEC) – Task 3, experts from the Wageningen University submitted an Assessment of the Designation of Nitrate Vulnerable Zones in Poland. The key conclusions were as follows:

- the current designation of NVZs in Poland seems incomplete and must be reconsidered,
- NVZs have been designated by relying on surface water pollution with nitrates from agricultural sources, without taking proper account of groundwater pollution (only two NVZs have been designated partly based on data on vulnerable ground waters),
- a large percentage of surface water and groundwater with nitrate concentrations near or exceeding 50 mg per litre are located outside the designated NVZs,
- a clear correlation between regional distribution of NVZs and regional distribution of crops, excess nitrate levels, regions of high livestock density, concentrations of nitrates in discharged water, and the calculated nitrate leaching losses is missing,
- in the context of the large number of farms with inappropriate manure storage facilities and runoff collection systems, the relatively uniform distribution of vulnerable groundwater and surface waters in the rural areas, the prevalence and vulnerability of light-textured sandy soils, relatively high share of livestock waste in nitrogen leaching, the prevalence of land amelioration (improvement) practices, high eutrophication of the Baltic Sea and the relatively large nutrient discharges from agricultural sources carried by Oder and Vistula to the Baltic Sea, one may argue to designate the whole Polish territory as NVZ (as is case in Denmark, Finland, Germany and Lithuania).

In response to the proposal to designate the whole Polish territory as NVZ, it is argued that the proposal is in general prescriptive and restrictive, and that it carries some serious consequences for farmers and can only discourage them from undertaking environmental protection measures. However, it needs to be pointed out that, as indicated in the Assessment, there are some serious shortcomings in designation of NVZs. Also, the Assessment of Pollution of Shallow Groundwater Directly Exposed to Nutrient Runoff, with a Focus on Agriculture, and the Potential Environmental Impact of Pollution from Agricultural Sources drafted in 2008 by the Institute of Soil Science Fertilisation and Plant Cultivation (IUNG) in Puławy conclude that the decisions to designate Nitrate Vulnerable Zones in

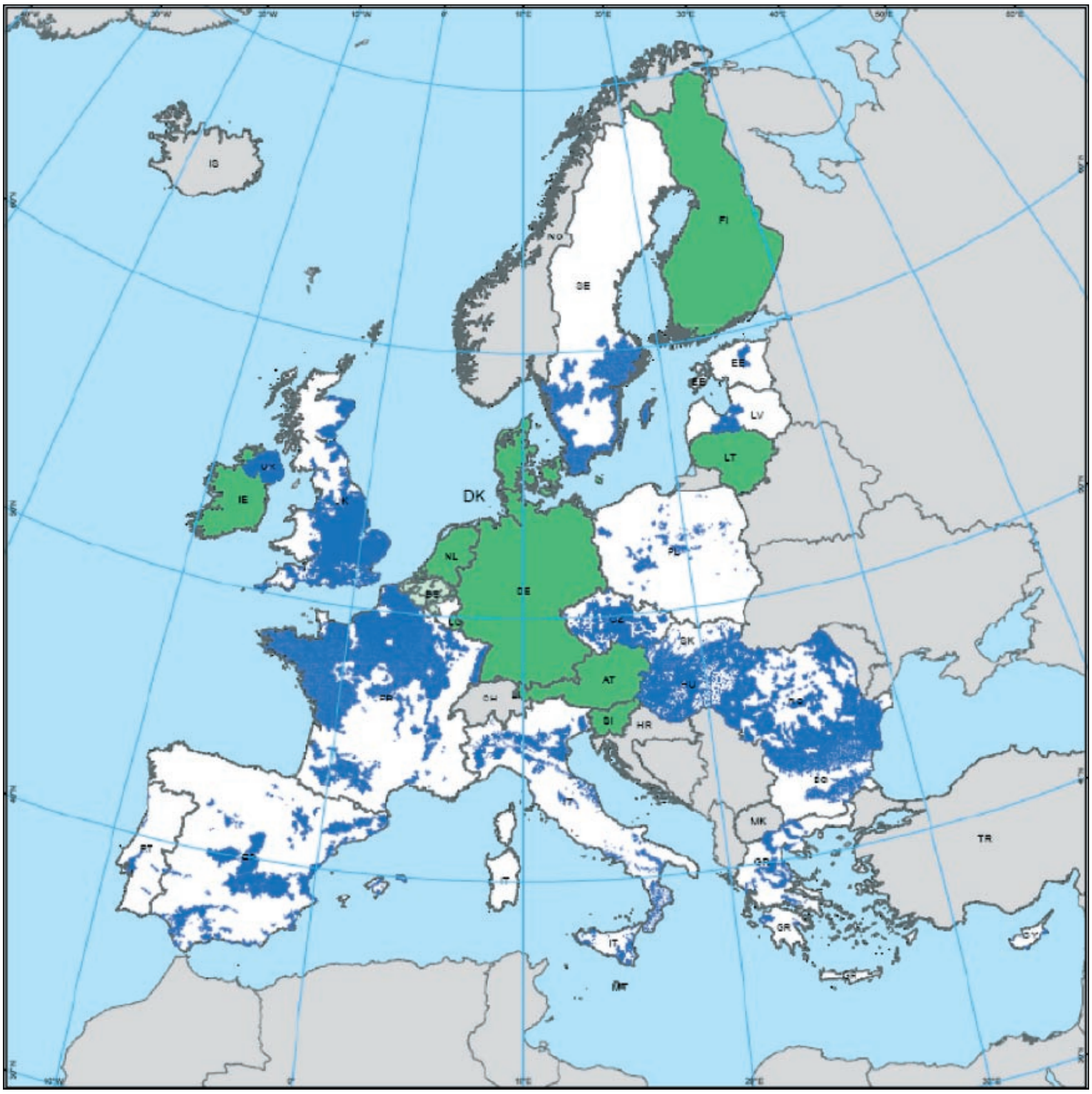

Fig. 37 Map of Nitrate Vulnerable Zones, marked by blue and green (if the whole territory is designated as NVZ) colour (photo: the EU Directorate-General for the Environment 2013)

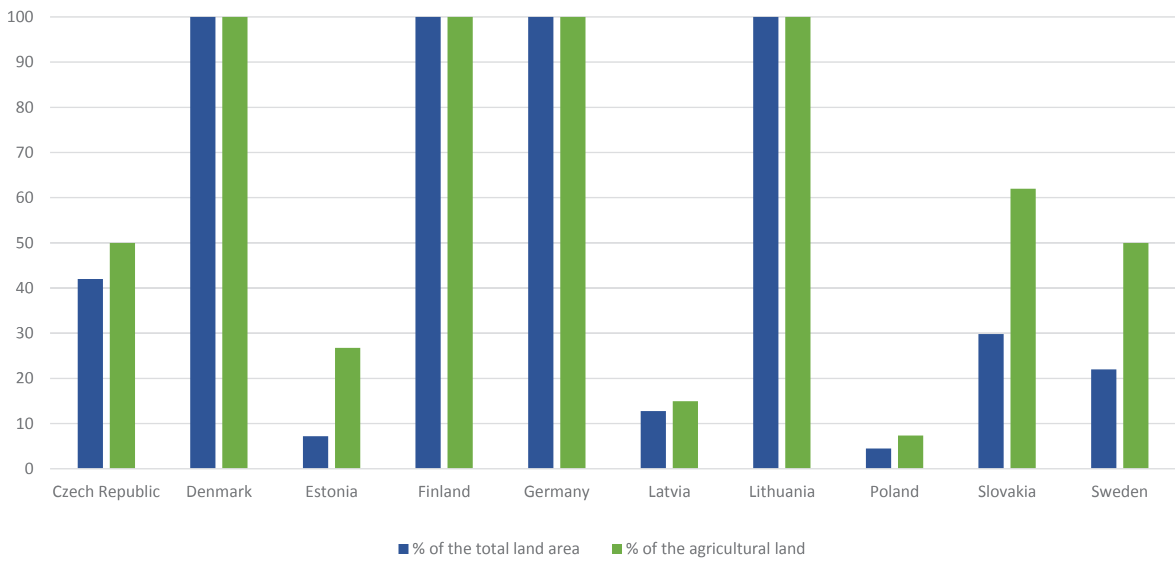

Fig. 36 Percentage of the country area covered by the NVZs (agricultural land excluding forests and inland waters)

2004 were based solely on hydrologic criteria, without taking into consideration the relevant agricultural indicators, and that until 2010, it would be necessary to develop a coherent methodology of designating NVZs based on hydrologic criteria and agricultural indicators, and that the boundaries of NVZs and those of administrative districts should overlap, but account should be taken of the existing catchment areas.

In 2008, the National Water Management Authority (KZGW) and the Ministry of Environment reviewed the boundaries of NVZs within individual Regional Water Management Authorities (RZGW). Action programmes were also developed to limit nitrogen runoff from agricultural sources for zones vulnerable to pollution from nitrates from agricultural sources (2008 – 2012). In consequence, the area of NVZs was reduced by over 26% against the year 2004. The number of NVZs was limited to 19. NVZs occupied the area of 4623.14 km^2, or 1.5 of the total area of Poland. 4 NVZs were excluded, the area of 13 NVZs was modified, and there were 2 new NVZs established. NVZs were now designated according to the river catchment areas based on geodesic zones instead of local administrative districts (as was the case in 2004), and their total area was reduced accordingly.

In 2009, the European Commission negatively evaluated the new Polish action programmes and assessments of the designated zones vulnerable to nitrates from agricultural sources (the European Commission's document featuring evaluation of new Polish action programmes and assessments of the designated zones vulnerable to nitrates from agricultural sources, enclosed to the letter of the European Commission, Directorate General for the Environment, Directorate B for Environmental Protection BI/AR/cvi/D(09)Ares 155620 of 3 July 2009 sent to the National Water Management Authority, Water Planning and Water Resources Department, No. DPZWpgw-987/09/AR, of 15 July 2009). One year later, the European Commission, acting through the General Secretariat in Brussels, sent a formal letter 2010/2063 K(2010)6549a to Poland, arguing that the designation of waters contaminated and exposed to contamination was insufficient, and that the area of water polluted by nitrates and exposed to eutrophication was too small. In addition, Poland failed to establish action programmes for all NVZs which would be binding and applicable to all farmers, satisfying the obligations set out in Annex II and Annex III to the Nitrates Directive. The last time the European Commission wrote a formal letter to Poland was in November 2011, in which it demanded that the irregularities in designating Nitrate Vulnerable Zones be removed and that Poland fulfils the obligations imposed by the Nitrates Directive. The European Commission also distanced itself from the opinion of Poland's authorities claiming that the status of the designated nitrate vulnerable waters and zones is satisfactory, arguing that:

- the precautionary principle has not been taken into consideration,
- the 50 mg N-NO3/l threshold value would be exceeded in a significant fraction of waters outside NVZs, unless protective measures were taken,
- waters exposed to mixed sources of pollution from nitrates (municipal, household/tourist-recreation, agricultural) should be excluded from the designation process of NVZs (the Commission argues that whenever elevated nitrogen concentrations in local waters originate from agricultural sources, risk zones should be designated and appropriate action programmes developed).

Assessment and designation of NVZs for the period 2012-2015 was conducted in 2012. It was mainly based on the expert report commissioned by IUNG: 'Assessment of Agricultural Pressure on the Status of Surface Water and Groundwater and Designation of Zones Particularly Vulnerable to Nitrates from Agricultural Sources'. In the result, 48 NVZs were established. They cover 4.46% of the country territory, which corresponds to 7.36% of Poland's agricultural land. Even though, in January 2013, the European Commission referred Poland to the EU Court of Justice for failing to guarantee that water pollution by nitrates is addressed effectively, arguing that Poland still has not designated a sufficient number of zones that are vulnerable to nitrates pollution, and measures to effectively combat nitrates pollution in these zones have not been adopted.

Problems with NVZs are also reported in Estonia and Germany. In the first case, the most fertile soils in the country are located in the Nitrate Vulnerable Zones, resulting in 50% more intensive agricultural land use in these areas, in comparison with the average of Estonia. The same applies to livestock farming – 35% of cattle, 30% of pigs and 12,5% of poultry are raised in Nitrate Vulnerable Zones.

In the case of Germany, the Commission has voiced that it expects a stricter fertilisation law (Ger. *Düngeverordnung*), but no legal action has been taken so far. There is a formal exemption for Germany (2009/753/EG), allowing higher manure applications than demanded by the Nitrates Directive. under certain conditions until 31 December 2013 (up to 230 kg N/ha). Germany has indicated that it wishes a prolongation of this exemption, however, it is uncertain if this will be agreed on by the Commission, especially without simultaneous substantial improvements in the German legal settings, mainly the *Düngeverordnung*, which still does not explicitly mention NVZs.

In addition to Nitrate Vulnerable Zones, being a completion of the EU directive requirements, there are other regulations address natural fertiliser application in special zones of the limited agricultural use – this also applies to the countries of the Baltic Sea catchment basin that are non-EU members. These

are buffer zones along water courses and water reservoirs, where no fertilisation is allowed.

In Czech Republic such zones width varies from 3 m for any surface water in NVZs and for farmers under the agri-environmental programme to 25 m for liquid manure used along surface water with land slope >7° in NVZs and for farmers under the agri-environmental programme. In Denmark – 10 m for streams and lakes with surface area >100 m² and 20 m for streams and lakes with surface area >100 m² if slope >6°. In Estonia – 1 m for drainage systems with catchment area <10 km², 10 m for other lakes, rivers, streams, springs and channels and 20 m in the case of the Baltic Sea, lake Peipsi and lake Võrtsjärv. In Finland it is 5 m for all water courses and 10 m if slope >2%). In Germany it is 3 m for all water courses and 1 m in the case of exact application techniques and slope <10%. In Latvia buffer zones width starts from 10 m for all rivers with length >10 km and lakes with surface area >10 ha, but can reach even 500 m, depending upon the importance of the surface water. In Norway 2 m is mandatory and additionally 8-10 m buffer zones are subsidized. In Poland – 5 m (10 for slurry) for lakes and reservoirs <50 ha, water courses, ditches < 5 m width and channels, 20 m for lakes and reservoirs >50 ha, water intake protection zones and the Baltic Sea. Both cases are connected with direct support schemes for farmers. There is also a subsidiary system for 2-5 m buffer zones along streams. In Sweden 2 m buffer zones are obligatory for brooks, streams, rivers, canals or small dam weirs within a NVZs, and in any other location for cross compliance. In Ukraine – 25 m for small rivers, creeks and streams (up to 50 km) and ponds of less than 3 ha, 50 m for medium rivers (length from 50 to 100 km), reservoirs and ponds of the area of more than 3 ha, and 100 m for large rivers (100 km), reservoirs and lakes on them. If slopes are more than 3°, the minimum width of the coastal protection zone is doubled.

In Belarus there are 422 specially water protected areas (covering almost 1.6 million ha), for which legal restrictions are imposed by water protection policy. It is forbidden to establish livestock farms and complexes, sewage pounds, fields irrigated with untreated sewage and burial ground of cattle within the water protection are. According to the law of the Republic of Belarus *On specially protected natural areas* (20.10.1994 № 3335 – XII) citizens and public organizations have the right to make proposals and to assist state agencies in the implementation of activities for the organization, operation, protection and use of specially protected areas. Public bodies should recognize the suggestions of citizens and public organizations when making decisions about the claiming, transformation and ceasing operation of specially protected natural territories and establishing a regime for their protection and usage. Citizens and public organizations have also the right to request and obtain from the relevant government authorities complete information concerning the issues of protected areas.

In Russia sanitary-protected zones with a width of 100 up to 1000 m are designated, depending on the threat and the importance of the water body.

2.2.5 Ammonia emissions

Programmes including strategies and measures for reducing ammonia volatilisation from animal husbandry are developed only by Latvia and Lithuania. In other countries, like in Poland, it is often included in the Code of Good Agricultural Practice, and thus is not legally binding and does not constitute any direct legal obligations.

Requirement of urine and slurry stores covered or handled by a method that efficiently reduces ammonia emissions is implemented in case of Denmark, Estonia, Latvia, Lithuania, Sweden, Russia.

Other legal obligations aiming to reduce ammonia emission from animal farming, being in force in the contracting parties, include: BAT (Denmark), Germany (monitoring and manure application obligations), Lithuania (Nitrates Directive Action Programme), Sweden.

Interesting example of ammonia emission problem comes from the Leningrad Oblast (Russia), with the most developed industrial animal farming characterized by the largest ammonia emissions in the North-western Russia. However, there are still no governmental programs, including measures to reduce ammonia emissions from evaporation as well as no other legal obligations aimed at its reduction.

2.2.6 Environmental permits

Regulation 4 on environmental permits is also important in the context of natural fertilisers. Farms with livestock production above certain size should require approval with regard to environmental aspects and impacts of the farms. Environmental permits are obligatory for farms with livestock density of over 40 000 places for poultry, 2 000 places for production pigs (over 30 kg), 750 places for sows or 400 animal units cattle. Amended Annex III also specifies that contracting parties shall put in practice general rules or a system corresponding to a simplified permit system for installations with more than 100 animal units (HELCOM RECOMMENDATION 13/7), to ensure the implementation of the requirements in this Annex.

This obligation has been fully implemented only by Denmark, Finland and Sweden.

2.2.7 National implementation of the Baltic Sea Action Plan – agricultural (eutrophication) sector

One of the man goals of the HELCOM Baltic Sea Action Plan is to have Baltic Sea unaffected by eutrophication, and is specifically defined by five ecological objectives: concentrations of nutrients close to natural levels, clear water, natural level of algal blooms, natu-

ral distribution and occurrence of plants and animals, natural oxygen levels.

Following actions were set up to reach listed objectives, in terms of agricultural activity (implementation deadlines indicated in parentheses):

- national programmes on nutrient reduction (2010),
- actions to reduce nutrient load undertaken (2016),
- inclusion of the Baltic Sea Action Plan targets in national programmes (2009),
- designation of zones vulnerable to nitrogen (2021),
- permit systems for animal farms (2012),
- list of agricultural hot spots (2009).

According to the WWF findings, described in the report *Baltic Sea Action Plan - is it on track? WWF Baltic Ecoregion Programme* (2013), only national programmes on nutrient reduction were introduced as planned in all contracting parties. Inclusion of the Baltic Sea Action Plan targets in national programmes has been completed by Estonia, Finland, Germany, Latvia and Sweden; permit systems for animal farms – by Denmark, Estonia, Finland, Germany, Poland and Sweden; list of agricultural hot spots – only by Denmark, Finland, Germany and Latvia.

2.3 Risks from large-scale livestock production identified in the Baltic Sea catchment area

Large-scale livestock production negatively affects the directly adjacent areas and the whole regions. In both cases, the environmental impact is not necessarily related to the type or scale of production, but is the result of careless and irresponsible livestock production where economic outcomes take precedence over environmental protection and living standard of local residents. The risk of environmental damage is inherent to large-scale livestock production. Otherwise the integrated permit (which is obligatory for animal rearing installations which meet the criteria adopted with the Industrial Emissions Directive) would not define means to prevent accidents and to minimise the consequences for the environment. Requirements for prevention of industrial accidents are also explicitly articulated in decisions on environmental conditions for investment permits.

If accidents at large-scale livestock farms are deemed possible, then the permanent (regular), intensified and adverse environmental impact should be perhaps considered as a breach of commitments imposed by national, EU and international laws, the Code of Good Agricultural Practice, Best Environmental Practice (BEP), and Best Available Techniques (BAT), including commitments imposed by the integrated permits or decisions on environmental conditions for investment permits (or any decision resulting from the Environmental Impact Assessment).

Due to the nature of the environmental burden and the impact area, risks related to large-scale livestock production, identified in the countries of the Baltic Sea region, can be divided into environmental, socio-economic, and legal. The various aspects of the negative impact of large-scale livestock production on the natural environment of the Baltic Sea will be discussed, considering both direct and indirect impact.

Where the environmental correlations between the negative impact of contamination and adverse production practices at large-scale livestock farms and the Baltic Sea ecosystem is negligible or difficult to validate, these issues are not addressed (impact on farm animals – lower animal welfare and reduced resistance to stress, intoxication by toxic elements or compounds from incorrectly prepared, stored and administered feed, zoohygienic risks; impact on agro-ecosystem biocenoses surrounding the farms – transmission of pathogens to the natural environment and epizootics, local biodiversity losses, noise and exhaust gas emissions; impact on human health – deterioration of mental health of residents of areas surrounding the farms, health status of farm workers, reduced competitiveness of small and medium livestock farms, ethical questions, loss of balance between resources produced and consumed, etc.).

Also, this analysis does not address environmental risks from large-scale crop production (contamination with mineral fertilisers, soil erosion, loss of biodiversity) correlated with the growing demand for feed from intensified and industrialised livestock production.

2.3.1 Environmental impact of intensive livestock industry

The risks discussed in this analysis are closely and directly related to the loss of ecosystem homeostasis (ecological imbalance), reduced self-purifying (regeneration) capacity of the environment, landscape transformation and loss of biodiversity.

2.3.1.1 Fertiliser overload or lack of fertiliser application options

Livestock faeces is a precious natural fertiliser for small livestock farms, and a troublesome by-product for intensive livestock production installations. The scale of the problem can be illustrated by the natural fertiliser production volume – a non-litter system farm with 2 000 cows produces 50 000 m^3 of slurry annually, a shallow bedding system farm with 5 000 grower-finishers produces 12 500 tons of solid manure and 11 000 m^3 of fermented urine.

Large volumes of manure must be removed from livestock buildings, stored and disposed, which poses a serious logistical challenge, especially for large-scale livestock farms. Fertiliser disposal requires continuous technical supervision, high flow capacity of the draining system, and regular collection and removal of manure (in litter systems). Animal fertilisers must

be disposed into leak-proof tanks or slabs, which can occupy large space or area. According to the Helsinki Convention, the minimum storage capacity level required should be 6 months storage (manure can be used in pre-summer and pre-winter ploughing).

There is also the issue of livestock waste utilisation. In Poland, for example, large-scale livestock farms are under the duty to spread at least 70% of the slurry they produce on agricultural land they own or lease (according to the Act of 10 July 2007 on fertilisers and fertilisation, Polish Journal of Laws 2007.147.1033). With the reduced maximum nitrogen dose of 170 kg/ha/year (maximum phosphorus dose is 25 kg/ha/year), a cattle farm with 2 000 LSU would need at least 823.5 ha of arable land, and a grower-finisher farm of 5 000 LSU – would need at least 123.5 ha (without including fermented urine). Natural fertiliser overproduction it has to be disposed (for use by other farmers) under a written fertiliser disposal contract. If livestock waste is used as a fertiliser, it must be borne in mind that the majority of plants more easily adapt to nitrogen deficiency than nitrogen excess.

Over-fertilisation or fertilisation carried out at incorrect time and under improper conditions has been quite common since many large-scale livestock farms are unable to make use of the volumes of natural fertiliser they produce. This can be explained by unauthorised increase in livestock size beyond the limits defined in the relevant permit or decision, or providing false data on the agricultural land owned or rented in requests for integrated permit/environmental impact reports, or unauthorised modifications of animal rearing conditions. In the broader context, this can be explained by the fact that, as is frequently the case, livestock manure is not accounted for in the agricultural production cycle and food supplies, and in the cost-accounting of livestock farming.

Overfertilisation of fields belonging to intensive livestock farms is often reported problem in Belarus, Estonia, Germany, Lithuania, Poland, Russia and Ukraine.

2.3.1.2 Water contamination with nitrogen and phosphorus compounds

Contamination of soil, surface water and groundwater with biogenic compounds (nutrients, macroelements), most notably nitrogen and phosphorus, is the major environmental threat posed by large-scale livestock farming. Concentrated livestock production and increasing productivity of industrial farms are major sources of pollution from agriculture. The circulation of matter in agro-ecosystems can be seriously compromised, especially when livestock waste (organic fertilisers) are not included in the agricultural production, which can be considered the distinctive feature between conventional agricultural holdings and large-scale farm enterprises. In crop production, only around 30% of nitrogen is released to the environment, as opposed to 75% nitrogen losses in livestock production.

This can be explained by the fact that some farms are focused exclusively on livestock production, and tend to be located at a large spatial and technological distance from farms which cultivate land. The increasing gap between industrial livestock production and crop production means that large livestock farms produce excess livestock waste which is no longer a fertiliser (high-value by-product) but a troublesome waste product.

In Poland, for example, 90% of crop production is consumed by livestock, and the share of solid-manure in total fertiliser consumption is only 15%, while around 38% of all fertilisers used are artificial fertilisers (GUS, 2009). This illustrates the real scale of imbalance in the circulation of biogenic compounds in agro-ecosystems. For comparison, Estimated overproduction of biogenic compounds in agricultural holdings is as follows: N – 56 kg/ha/year, P – 20 kg/ha/year, K – 22 kg/ha/year.

It is assumed that the volume of biogenic compounds excreted by cattle is the same as the volume produced by 16.4 humans, 1.9 pigs, 0.3 minks, and 0.14 of poultry. If a cow produces 74.2 kg N and 14.4 kg P per year, then the daily production is around 203 g of nitrogen and around 40 g of phosphorus. For daily waste production of 150 L per cow, the mean concentrations of nitrogen and phosphorus compounds are around 1350 mg/L and 263 mg/L, respectively. These values exceed the maximum permitted concentrations of nitrogen and phosphorus in municipal waste by dozen or hundred times (a mean of 20-85 mg/L of total nitrogen and 6-20 mg/L of total phosphorus). What follows, the maximum cattle livestock which would guarantee full utilization of natural fertilisers (produced from livestock waste) is 1-2 animals per 1 ha.

On average, around 50% of nitrogen, 80% of phosphorus and around 95% of potassium contained in feed is excreted. 55% of nitrogen and 99% of phosphorus is excreted with faeces. As much as 80% of potassium is excreted with urine. There values are to a large extent influenced by the animal rearing system, for example, in intensive livestock production, nitrogen content in urine exceeds 70% of total nitrogen compounds excreted.

The highest quantities of biogenic compounds from livestock waste (equivalent to emissions to the natural environment) are lost in livestock farming, fertiliser storage and landspreading. Around 10-25% of nitrogen is lost in non-litter livestock buildings, and around 30-80% in straw-bedded livestock buildings, around 25% in swine housings, and around 70% in deep litter poultry housings. 20-50% of nitrogen is lost from manure slabs. 10% (manure) to 65% (slurry) is lost from landspreading; around 50-70% is leached from soil. Medium uptake of nutrients in Polish agricultural

holdings is around 20-30% for N, around 25-40% for P and slightly above 10-30% for K.

Over-fertilisation and nutrient runoff from fields to groundwater are the sources of surface water pollution, and the resulting pollution of the Baltic Sea. It is estimated that around 75% of all nitrogen compounds and over 95% of phosphorus compounds which pollute the Baltic Sea are carried with water. Total nitrogen and phosphorus runoff to the Baltic Sea amounts to around 638 000 and 28 400 tons, respectively (HELCOM, 2010). Poland (24% N; 36% P), Sweden (19% N; 13% P) and Russia (17% N and 14% P) are the major contributors (HELCOM, 2010). Per capita nitrogen and phosphorus runoff in Estonia – around 22 kg and 1.2 kg, respectively, is the highest (in Poland, per capita nitrogen and phosphorus runoff is around 3.5 kg and 0.2 kg). Agriculture in general is the biggest source of highest nitrogen and phosphorus supply to the Baltic Sea.

There are diffuse sources and point sources (such as large-scale livestock production) of agricultural pollution distinguished. Point sources are specific discharge sites (factories, municipal waste collectors), as opposed to diffuse sources which include surface runoff from large areas, related mainly to crop production as well as small and medium livestock farms. It is estimated that 60% of nitrogen and 40% of phosphorus (from agriculture) is discharged to the Baltic Sea from large-scale livestock farming. Therefore, large-scale livestock farms should be classified as point sources of pollution due to the nature of nutrient runoff (clearly defined and restricted to a small area, as is the case with industrial facilities), and the discharge volume.

Poor technical condition or even absence of fertiliser storage installations increases nitrogen and phosphorus runoff to soil and water. In a study conducted in 2004, in Miedwie Lake catchment area in Zachodniopomorskie Province, Poland, only nearly 53% of livestock farms had proper livestock housing facilities. Moreover, enclosed natural fertiliser tanks were present in only slightly more than 26% of these holdings. It is estimated that only 35-45% of all agricultural holdings in Poland are equipped with proper manure storage slabs, and only 20-30% of all agricultural holdings in Poland have suitable tanks for fermented urine. Similar cases are reported in Belarus, Estonia, Latvia, Lithuania, Russia and Ukraine.

Water pollution, water eutrophication, soil degradation, and increased content of nutrients in crops are the most serious consequences of nutrient overload. Another consequence, which is often underestimated, is the accumulation of nitrates, which are toxic to animals (decomposition of vitamin A and beta-carotene, growth and development inhibition, haemoglobin conversion into methaemoglobin), and of potassium, which is antagonistic to many macro- and microelements (including phosphorus, magnesium, sodium, copper, cobalt) in some crops (oat, barley, corn, lucerne, sugar beets, fodder beet) and weeds (milk thistle, common nettle, goosefoot, common amaranth). High nitrate levels can create conditions favourable to the development of toxic and carcinogenic nitrosamines. Contamination of plants can result in toxin transfer to livestock feed, human food, and wild animals.

Water contamination with nitrogen and phosphorus compounds seems to be the most frequently reported problem, connected with the intensive livestock production, in Belarus, Estonia, Poland, Russia and Ukraine. Also in Denmark, Germany and Sweden, water and soil contamination caused by activities of the large-scale livestock farms is often indicated as the cause of loss of the agro-ecosystems biodiversity and disruption of ecological corridors continuity and connectivity.

2.3.1.3 Eutrophication

Eutrophication (hypertrophication) is defined as water enrichment with nutrients, particularly with nitrogen or phosphorus compounds, which causes accelerated growth of algae and higher plants, compromises the balance of the aquatic environment and deteriorates the water quality.

In addressing the problem of eutrophication, its causes must be clearly separated from its consequences. The causes of eutrophication are excessive nutrient levels in water reservoirs and water courses. The causes of excessive influx of biogenic compounds can be either natural or anthropogenic (excessive anthropogenic fertilisation is also referred to as hypertrophication). Agriculture is the main anthropogenic cause of eutrophication. Natural fertilisers, if applied in excess, carry the same loads of biogenic compounds as artificial fertilisers. Nitrogen and phosphorus – the key chemical elements in the process of eutrophication – are washed from fields to surface water (surface runoff and precipitation), and the nutrient overload interferes with the natural distribution of macroelements.

Optimum N:P proportions for proper growth of cyanobacteria, alga (phytoplankton) and water plants is 16:1. If this balance is lost, phytoplankton will bloom or die. If the N:P weight ratio is more than 7, it indicates phosphorus deficiency, if the N:P weight ratio is less than 7, nitrogen deficiency is likely. It is the deficiency of phosphorus which most commonly inhibits algal blooms. There are several reasons: phosphorus is a biogenic compound which is naturally present at the lowest concentrations, its percentage share in the produced organic mass is the lowest, and is the only nutrient which is not gaseous. Because of the quantitative C:N:P proportions in phytoplankton cells, the primary productivity of an ecosystem depends on the presence of even the smallest quantities of phosphorus. If 1 kg of phosphorus is introduced to a water reservoir, as much as 1-2 mg of fresh algae mass can grow under favourable conditions; if 1 kg of nitrogen

is introduced, the biomass will increase by around 16 kg, which, and when it decays, it will elevate the overall chemical oxygen demand (COD) burden (commonly used to indirectly measure the levels of organic compounds in water) by over 20 kg O_2.

Under natural conditions, the growth of phytoplankton biomass in the Baltic Sea follows a specific pattern, conditional on the fluctuations in nutrient levels. Intensive, but short-term diatom spring blooms are typical. The diatom bloom reduces the concentrations of nutrients, which increase again in the autumn during water exchange and nutrient runoff. After the diatom spring bloom, other algae start and continue to bloom from mid-summer until autumn. In winter, in conditions of limited access to light and low temperatures, phytoplankton vegetation is inhibited. The ecosystem regenerates itself, nutrients levels are restored (decaying microalgae from the autumn bloom; supply of nutrients released from the sea bottom by microbiological decay of dead diatom from the spring bloom). Within an annual cycle, natural water enrichment of the Baltic ecosystem comes in two cycles (natural eutrophication).

Water bloom is when water changes its colour. According to various sources, water bloom becomes visible at cyanobacteria and algae levels of 1 000 -30 000/mL. During algal bloom, there can be as many as 10 million unicellular organisms in 1 ml of water. ≥20-50 mg of chlorophyll per 1 m^3 of water is the threshold value of water bloom. Another water bloom criterion is the total mass of alga and cyanobacteria: 3-10 g/m^3 in eutrophicated water, and 100-500 g/m^3 in water which is critically contaminated with biogenic compounds.

Algae blooms caused by natural eutrophication are time- and space-limited and carry beneficial ecological consequences; anthropogenic eutrophication involves dynamic over-fertilisation of inland waters and sea water (which cannot be mitigated by the natural rebalancing mechanisms) and the increase of phytoplankton and zooplankton biomass (hypertrophication).

Algal bloom is the direct consequence of eutrophication. Interference with the natural ecosystem, reduced oxygen levels (oxygen is consumed when organic matter sinks to the bottom and decays, which is particularly evident in oxygen-poor deep water, lead-

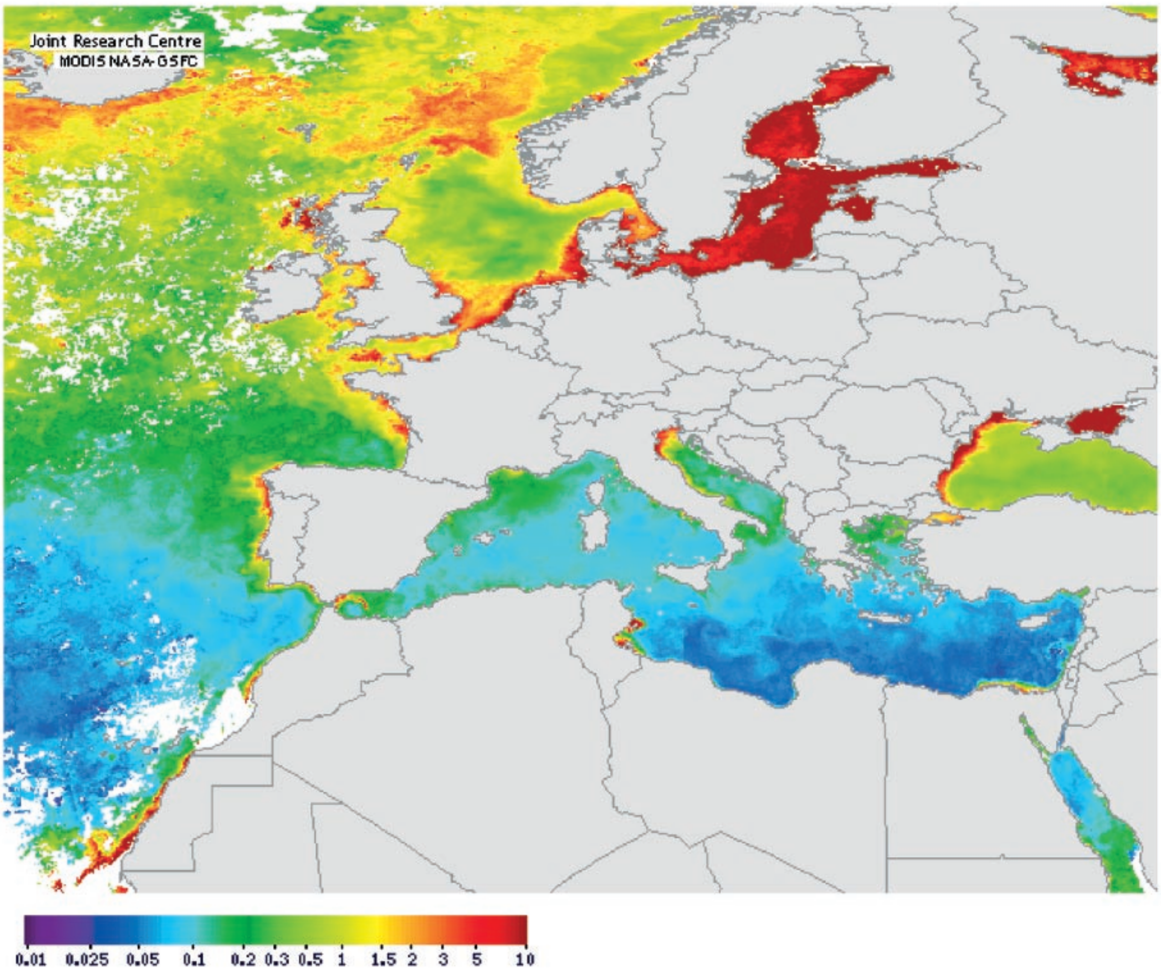

Fig. 38 Concentration of chlorophyll a [mg*m^-3] in the European seas, July 2007 (photo: JRC, emis.jrc.ec.europa.eu)

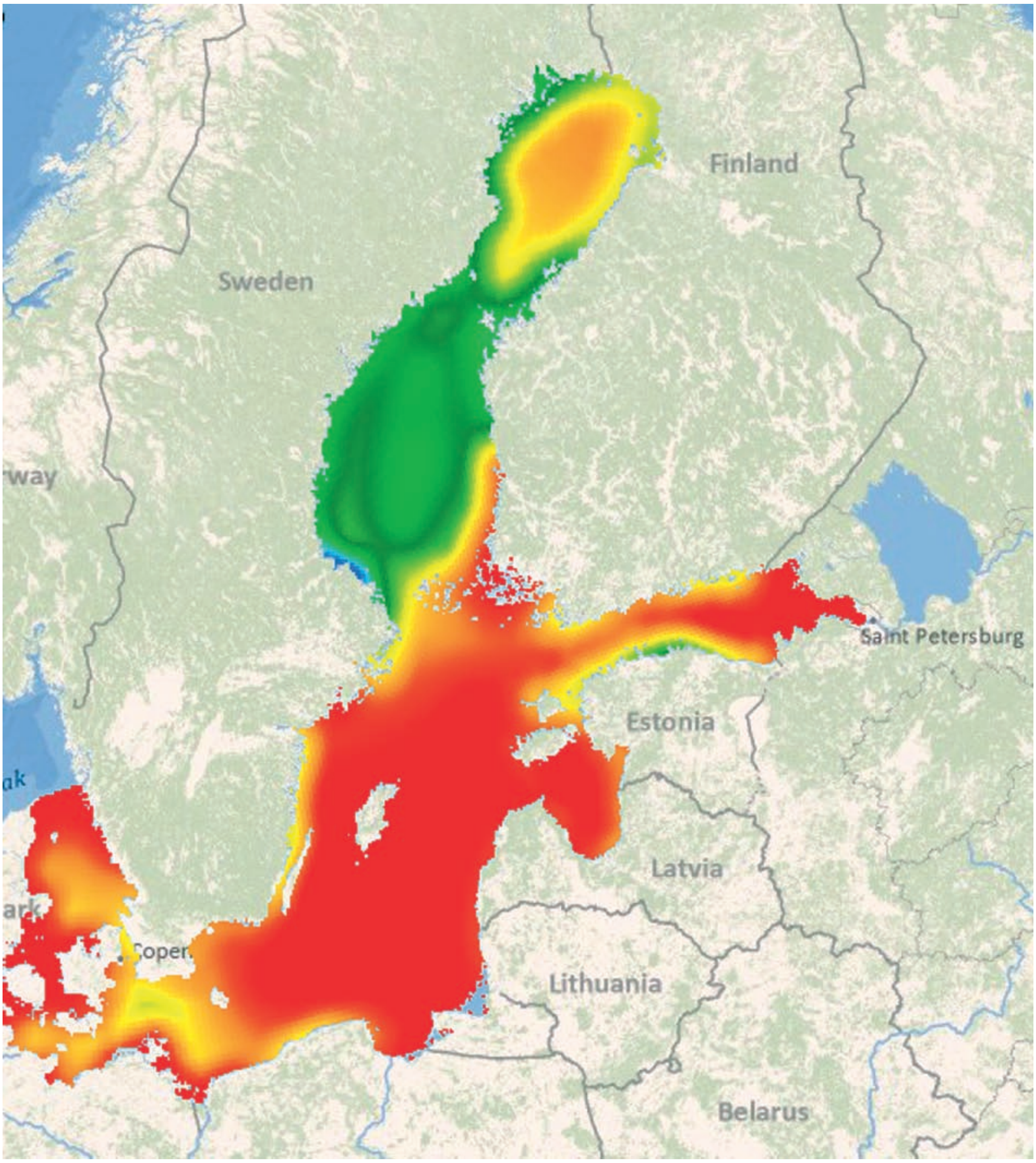

Fig. 39 Biodiversity status of different regions of the Baltic Sea based on HELCOM Biodiversity Assessment Tool (BEAT) – blue to green areas represent an acceptable biodiversity status; yellow, orange and red areas indicate poor biodiversity (photo: HELCOM Map and Data Service 2011)

ing to large hypoxic areas of oxygen deficits, or oxygen deserts, which cover up to 100 000 km^2 of the Baltic Sea deep water), loss of fauna living in deep water, reduced light penetration in deep water which limits the growth of macroalgae and embryophytes (including fucus species/*Fucus vesiculosus* and *Fucus serratus,* and seagrass /*Zostera marina*) are the indirect consequences.

Primary production of the Baltic Sea ecosystem has increased by around 30-70% in the 21st century, zooplankton growth increased by around 25%, zoobenthos production doubled, and organic carbon sedimentation increased by 70-190%. What is also important, biomass increase caused by eutrophication, which can be indirectly measured by the chlorophyll a concentration, is accompanied by general loss of biodiversity (Fig. 38-39).

As mentioned before, nutrient runoff from agricultural production is one of the major anthropogenic factors that contribute to eutrophication (hypertroph-

ication). In fact, as much as 50-80% of nitrogen influx comes from agricultural areas (land cultivation, fertilisation, slurry storage, industrial livestock production). Although municipal waste is the main source of phosphorus influx, agriculture is the main donor of phosphorus in the Scandinavia, where biological waste water purification is commonly applied. Large nutrient influx per unit of area (kg N or P/ha/year) is typical for densely populated regions with a large share of agricultural land. Within the last 40 years, nitrogen and phosphorus influx from households and industry has been considerably reduced; nutrient influx from agricultural sources has been maintained at a constant level.

Sea eutrophication is the final stage of the process of increased nutrient runoff from a number of inland ecosystems. Surface water are particularly exposed since the consequences of eutrophication can be proportionally more severe.

Land ecosystems eutrophication is another environmental phenomenon which deserves more attention. Eutrophication of land ecosystems can affect forests and grasslands where excess phosphorus stimulates the growth of plants, which prefer phosphorus-rich environments and compete with species of low tolerance to high phosphorus levels. Loss of plant species is accompanied by the loss of animals, which used to feed on these plants. This has a negative impact on the food chain in general, which further reduces the biodiversity of eutrophicated ecosystems.

2.3.1.4 Sanitary risk

Sanitary risk associated with large-scale livestock production involves microbiological contamination of air and water.

Litter (bedding), livestock excreta, feed, animals and farm workers are sources of microbiological contamination of air in livestock buildings. The composition of air microflora depends on the livestock housing design, type of livestock, livestock size, air ventilation type, air temperature and humidity, and the lighting system. Microbiological air contamination can reach the level of 10^5 CFU (colony forming units)/m^3 of bacteria and 10^4 CFU/m^3 of fungi in swine buildings. 1 LSU of pigs (sows) produces around 1.57 CFU/h.

There are multiple infectious, toxic and allergenic microorganisms present in contaminated air, which pose a serious threat for exposed individuals. Microorganisms suspended in indoor air are emitted to the open air. For example, a poultry battery facility of 50 000 laying hens releases 52.5-90.7 billion bacteria and around 0.3-5.5 billion fungi to the open air, many of which are pathogenic (such as *Erysipelothrix rhusiopathiae, Mycobacterium tuberculosis*, streptococcus and staphylococcus bacteria, foot-and-mouth disease virus, parasite eggs, *Cladosporium* sp., *Alternaria* sp., *Penicillium* sp. and *Fusarium* sp. fungi). They can cause serious infectious diseases in animals and humans as they can be carried by the wind over large distances.

Absence of natural biothermal purification processes in liquid-manure significantly prolongs the survival period of microorganisms: up to 457 days for *Mycobacterium tuberculosis*, up to 157 days for *Erysipelothrix rhusiopathiae*, up to 158 days for paratyphoid fever bacteria, up to 174 days for *Brucellosis* sp. bacteria, and up to 192 days for foot-and-mouth disease virus. Apart from these pathogens, slurry was found to contain faecal streptococci, *Escherichia coli*, pathogenic streptococci bacteria, *Staphylococcus* sp., fungi and parasite eggs (such as cestoda). Slurry can contain as many as 150 pathogens which can be dangerous for human. *Salmonella* sp., *Listeria* sp., *Giardia* sp. and *E. coli* bacteria are responsible for 90% of food poisonings and waterborne bacterial infections. Pathogens in contaminated surface water can be dangerous for people who bathe in sea water or eat sea food.

Sanitary risks from large-scale farms are of particular importance in Belarus, Estonia, Lithuania and Ukraine.

2.3.1.5 Greenhouse gas emissions

In consideration of nature and scale of intensive livestock production, this type of agricultural activity produces large quantities of greenhouse gases (contributing to global warming, i.e. increase in globally averaged temperatures), including carbon dioxide, methane and nitrogen oxides. Greenhouse gas emissions from livestock production accounts for around 18% of total anthropogenic greenhouse gas emissions worldwide (more than the transportation). In 2007, agricultural contribution to greenhouse gas emissions in the EU was 9.2% (excluding emissions from energy consumption and transportation in agriculture, and emissions from the international trade in agricultural products and inputs). For example, it is estimated that one pig (sow) produces 0.089 kg CO_2/h and 0.238 kg NH_3/h.

Methane is much more dangerous than CO_2, as its global warming potential is 21-times higher. Agriculture accounts for over 50% of total methane emission (40% is contributed by livestock production). Digestion by ruminants (cattle, sheep, goats) is the main source of methane emissions in agriculture (around 74-90% of emissions from agricultural sources). The remaining share is attributed to methane losses from natural fertilisers. Farm animals produce around 75 million Mg CH_4 annually (80% comes from cattle and buffalo). 30% of global methane production has its source in agriculture, its contribution to the global warming effect is estimated at 18%. A single cow can produce around 65 kg (80 m^3) of methane annually. Methane emissions from agriculture is estimated at 587 000 Mg/year, including 438 000 Mg from colonic

fermentation, and 148 000 Mg from livestock waste (GUS, 2009).

Nitrous oxide is mainly released from fertilised soil (around 83% of agricultural emissions) and is lost during fertiliser storage and transportation. According to many sources, agriculture is the main source of nitrous oxide, whose contribution to the global warming is estimated at 68%. Just in Poland, N_2O emissions in 2009 amounted to 75 000 Mg (GUS).

2.3.1.6 Acid rains

Acid rains date back to the 19th century Industrial Revolution, which brought with it powerful increase in coal combustion and sulphur emissions. In the atmosphere, sulphur compounds are oxidised to SO_3 and react with water to produce sulphuric acid (VI), producing acid rains (pH<4.5). Today, although the levels of sulphur compounds in the air are much lower, acid rains continue. Large volumes of acidifying gases, ammonia and nitrogen oxides are believed to be the cause. These compounds are released when animal fertilisers are used in quantities exceeding plant uptake, and under specific animal rearing conditions (emissions from livestock buildings).

In terms of emission volumes, ammonia is one of the major contributors to rain acidification. It forms ammonium salt aerosols, including NH_4NO_3 and $(NH_4)_2SO_4$, which have a significant rain acidification effect. Ammonia has the same rain acidification potential as SO_2 and twice as high as NO_2.

Ammonia produced from agriculture is believed to be responsible for around 30% of total rain acidification. Ammonia is produced in the decomposition process of protein compounds (ammonification) and is very toxic for humans and animals, as well as plants and soil and aquatic ecosystems. Livestock production has the highest share in overall ammonia emissions – 65-70% (agriculture in total – 80-90%). Ammonia is released from livestock buildings, natural fertilisers storage installations, and during landspreading. Ammonia emissions to a large extent depends on the animal rearing system – the highest ammonia emissions are generated by non-litter systems (slurry producing systems), and are lower in systems with deep litter.

Enzymatic and anaerobic decomposition of excreta, urine and feed is the main source of ammonia released from livestock buildings. In the case of animals which excrete urea (cattle, sheep, goats, swine, fur-bearing animals), total enzymatic decomposition of ammonia takes place, with gaseous ammonia released to the atmosphere and transformed into nitrates. Animal excreta contain organic nitrogen compounds which are progressively mineralized by anaerobic bacteria. Nitrogen contained in poultry litter is solid (uric acid) and is bacteria-enzymatic decomposed. It is estimated that dairy cattle releases 27.8 kg NH_3/year, swine – 5,1 kg NH_3/year, sheep or goat – 1.9 kg NH_3/year, poultry – 0.26 kg NH_3/year, horse – 12.5 kg NH_3/year. In 2009, ammonia release from agriculture totalled 268 000 tons. Ammonia input to the Baltic Sea due to atmospheric deposition amounted to around 92 000 Mg in 2005 (44% of total nitrogen input from atmospheric deposition). Poland, Germany and Denmark are the biggest contributors of ammonia input to the Baltic Sea.

Ammonia concentration in livestock buildings is 5-10 ppm (parts per million), and can reach 100 ppm in poultry housings and during livestock waste removal from cattle and swine buildings. In general, ammonia concentrations depend on temperature, animal rearing system, livestock size, ventilation system, type of feed, and feeding methods.

Ammonia released to the atmosphere is washed down with precipitation, causing surface water pollution (eutrophication), soil acidification, and contributes to the dissolution and leaching of nutrients from soil.

Due to toxicological (health-related) and ecological (environmental) risks, restrictions on ammonia production have been imposed under national and international laws (maximum concentration of NH3 in the natural environment, workplaces, livestock housing, and residential housing; the Helsinki Conventions established an obligation to reduce ammonia emissions from livestock housings and livestock waste deposition sites).

2.3.1.7 Contribution to ozone depletion

Greenhouse gases released from large-scale livestock production contribute to the depletion of the ozone layer (ozonosphere). These are mainly methane and nitrous oxide, which are produced by livestock and released from natural fertilisers.

Methane has the highest ozone (O_3) depletion capacity. Although methane bonds with chloride to create hydrochloric acid at lower levels of the atmosphere and, under specific conditions (polar night), this form of chloride can be released back to the atmosphere and deplete the ozonosphere.

Nitrous oxide (N_2O) is another compound which can deplete the ozone layer. It is formed during microbiological processes (mainly nitrification) in soil (65-70% of global N_2O emissions). It is commonly believed that the main source of nitrous oxide emissions to the atmosphere are wet soils, over-fertilised with nitrate-nitrogen.

Although methane contributes to ozone depletion in the stratosphere (ozonosphere), it also protects ozone in lower atmosphere levels (troposphere). However, ozone protects the biosphere from ultraviolet radiation if it is contained in the upper atmosphere, and is harmful for living organisms if it is present in tropospheric air.

2.3.1.8 Particulate pollutants

Livestock buildings, especially poultry and swine housings, are a serious source of particulate mass and

dust emissions (organic and inorganic fine particles suspended in the air). Particulate mass at livestock farms come from animal fur and skin, straw bedding and feed.

Dust and particulate mass content in the air inside livestock buildings depends on the animal rearing system, air ventilation and heating systems, as well as the season. Swine farms are estimated to produce the average of around 0.15 g/h/LSU; poultry farms are believed to generate from ca. 0.71 g/ha/LSU (battery cages) to around 3.65 g/ha/LSU (laying hens in a litter system). A farm of 1 000 sows (350 LSU) will generate around 1.26 kg of particulate mass every 24 h.

Particulate mass contains particles of epidermis, fur, excreta, feed and insects. It can carry fungal spores and pathogenic bacteria (*Pseudomonas* sp., *Bacillus* sp., *Pasterella* sp., *Vibrio* sp., *Enterobacter* sp., *Salmonella* sp., *Leptospira* sp., *Brucella* sp., *Yersinia enterocolitica*), protozoa (*Cryptosporidium parvum*), dust mite (*Acarus siro*, *Lepidoglyphys destructor*, *Gopcyphagus domesticus*), natural toxins (mitotoxins/fungal toxins, bacterial endotoxins), glucans, odorants, and toxic chemical agents (NH_3, H_2S, nitrates).

Dust generated by fur-bearing animal farms can cause a number of health conditions in humans and animals in areas surrounding the livestock facilities. On contact with skin and mucosa, these factors can cause irritation, itching, inflammatory conditions and allergies; and - following inhalation – irritation of nasal mucosa, nasal congestion and bronchitis, pneumoconiosis, and the organic toxic dust syndrome related to the immune response to long-term exposal to particulate mass.

2.3.2 Socioeconomic problems

Many large-scale high-dense livestock operations have led to the deterioration of the quality of life of local residents. Although the risks analysed below refer specifically to social and economic issues, they also indirectly affect the local biocenoses.

2.3.2.1 Odours

Odorant emissions (aroma compounds, bad-smelling gases) causing unpleasant and burdensome odours (olfactory sensations, malodors) at livestock farms and in the adjacent area can become a significant inconvenience for the residents of areas close to large-scale high-dense livestock operations. Odours are equally harmful for the agro-ecosystems. The sources of odours are: farm animals (livestock buildings), secondary emissions from natural fertiliser storage sites, and landspreading.

Odours produced by intensive livestock production can include as many as 100-200 volatile odorants, of which at least 30 compounds are particularly burdensome and harmful for health, such as hydrogen sulphide, ammonia, methane, thiols, indole, skatole, phenol, aliphatic amines and sulphides, volatile fatty acids, mercaptans, organic sulphides, a variety of organic acids (including acetic acid, propionic acid, butyric acid, isobutyric acid), carbonyl compounds (aldehydes and ketones), diacetyl, heterocyclic organic nitrogen and sulphur compounds, aliphatic alcohols, esters, and aromatic hydrocarbons (toluene, xylene).

Air pollution with bad smelling gases can be carried over large distances. Volatile odorants are easily carried in the air by wind, and are poorly miscible with the air, which means they can be carried in highly concentrated streams. For example, a cattle farm of 140 000 animals emits 25.7 tons of nitrogen compounds per day. 90% of these volumes evaporate within a week to the atmosphere in the form of pure ammonia. A swine farm of 25 000 animals generates 240 kg of ammonia within 24 hours, which increases air ammonia levels within the area of around 600 km^2. In the summer period, a swine farm of 100 000 animals produces around 7.6 kg of hydrogen sulphide per 1 hour.

These compounds have been shown to cause a number of dangerous diseases, including migraines, cough, rhinorrhea, nasal congestion, chest pain, and other conditions of the respiratory system, inflammatory and allergic reactions, allergies, lacrimation, haemoglobin transformation to hematin, resulting in hypoxia, and emotional reactions (insomnia, stress, apathy and depression, irritation and unrestlessness).

Intensity and nuisance of odours can be difficult to quantify. Odorants level at a broiler farm of 25 000 birds are around 2 420 OU/m^3 (OU – odour unit, corresponding amount of odorant(s) in one cubic metre of neutral gas and detected by 50% of a group representative for the population), and odorants emission amounts to 20 000 OU/s, i.e. 0.8 OU/animal/s. Odour can be smelled within the radius of 250 m from the farm. Similar odorant concentrations in the air are observed at mink farms, i.e. 1 000-2 500 OU/m^3, directly at cages. Estimated odorant release from a breeding pavilion with 2 000 animals is 300 OU/s, i.e. 0.2 OU/s per animal. At a farm with 12 000 minks, the odour radius can extend over a distance of 200-300 m from the farm.

Despite the gravity of the problem, many countries of the Baltic Sea catchment area currently have no legal regulations concerning a possibility of odour emission limitation and no objective criteria to determine odour emissions. This concerns the following countries: Belarus, Estonia, Poland, Russia and Ukraine. Even in countries where anti-odour law exist many examples of problems with its implementation and enforcement are reported, e.g. in Germany, Latvia and Lithuania, where responsible authorities do not react quickly enough for requests for investigation if the air does not match the quality standards and even if the violations are recorded, strict measures are not being taken.

Anti-odour law can be based on the European Committee for Standardization, European Standard EN 13725:2003 (including amendment AC:2006) Air quality – Determination of odour concentration by dynamic olfactometry.

2.3.2.2 Soil degradation

Intensive livestock production and the resulting overuse or misuse of natural fertilisers, mainly slurry, contributes to chemical and biological degradation, erosion and reduced fertility of arable land.

It is particularly dangerous to spread liquid-manure directly on soils of small air capacity during the period of plant vegetation. Soil salinity and elevated nitrate levels, acute oxygen deficiency in the rhizosphere caused by intensification of biochemical reactions, increased humidity and oxygen consumption by plant roots are the likely consequences. Oxygen depletion in soil inhibits the growth of plant roots, which are able to absorb limited amounts of nutrients and water. Another consequence of oxygen deficit is the increased proliferation of anaerobic microorganisms and facultative aerobic microorganisms which consume oxygen from chemical compounds. As a result, the released iron and manganese can react with other elements to create compounds which are toxic to land plants.

Slurry is a source of excessive volumes of chemical compounds which decompose easily, leaving excess energy and higher demand for inorganic ions among soil microorganisms, which can exceed the mineralization capacity of soil. Excess ions are metabolized and immobilized in soil, which significantly restricts access to nutrients which can be easily absorbed by crops.

In case of soil slurry application there is a risk of parasites and pathogens contamination, and if the fertilisation is particularly intensive, humus levels in the soil may be unintentionally decreased.

2.3.2.3 High costs of potable water purification and increased water consumption

Contamination of surface water, precipitation water and groundwater increase the costs of potable water processing. From the point of view of water purification process, water contamination with phosphorus and nitrogen compounds and water eutrophication are the most serious problems.

With elevated levels of nitrogen pollution, ammonia nitrogen and nitrate nitrogen need to be removed from surface and groundwater. As for ammonia nitrogen, there are no effective and relatively simple methods of its removal from water.

Nitrate compounds can be only eliminated with the use of complicated and relatively burdensome means. Additionally, nitrate nitrogen is highly soluble in water and cannot be extracted by coagulation or chemical precipitation, which makes it necessary to use expensive methods involving high operating requirements (electrodialysis, reverse osmosis, ion exchange, denitrification). As a result, it is much more difficult to remove excess nitrate ions from tap water than from waste water.

Water eutrophication is primarily caused by increased phosphorus intake, which makes it necessary

Fig. 40 Algae on the surface of eutrophicated water reservoir (photo: F. Lamiot)

to purify water by filtering phytoplankton (the levels of algae and cyanobacteria can be as high as 10^9 microorganisms/m^3 during water bloom). The most difficult to eliminate are cyanobacteria (most notably *Microcystis* sp., *Aphanizomenon* sp., *Anabaena* sp., *Nostocales* sp., *Oscillatoria* sp., *Trichodesmium* sp., *Gomphospheria* sp.), which – when in bloom – have the appearance of blue-green paint or scum, characteristic taste and smell; contaminated water has higher water turbidity and contains chemically stable toxins dangerous for human and animals, able to survive under adverse conditions (toxins are also released by dinoflagellates, diatoms, or chrysophytes, although to a lesser extent).

Cyanobacterial toxins include neurotoxins (they attack the nervous system), hepatotoxins (they are toxic for the liver and are particularly dangerous for humans), cytotoxins (which are toxic to all types of cells), dermatoxins (which cause irritation of the skin and the mucosa) and irritants (which cause inflammatory conditions of the skin or the respiratory system). Contamination with livestock waste is, for example, a problem for the Miedwie Lake, where tap water intakes for the Szczecin (Poland) agglomeration are located. The Miedwie Lake catchment area is heavily exploited by the agriculture (livestock production).

Increase in phytoplankton populations is correlated with increased water levels of organic matter, heavy metals, radionuclides, pesticides, chlorinated organic compounds and polycyclic aromatic hydrocarbons adsorbed by algae and cyanobacteria (Fig. 40).

Unconventional means are employed to remove phytoplankton from water (since conventional methods proved ineffective), such as coagulation, sedimentation, micromesh filtration and membrane filtration; however, they offer limited effectiveness and do not eliminate algal and cyanobacterial metabolites, and well soluble cyanobacterial toxins.

Apart from the costs of potable water treatment, excessive levels of microorganisms in water leads to contamination of water intakes, treatment facilities and distribution installations. Algae blooms can result in lower performance, clogging and serious failures (microbiological corrosion) of this type of systems, which can be very costly to repair.

On the other hand, large-scale livestock production generates increased water demand and consumption. A grower-finisher farm of 80 000 animals is estimated to consume over 757 m^3 of water on a daily basis. Over 100 000 and 35 000 L of water is consumed to produce 1 kg of beef (cattle fed with crop fodder) and 1 kg of poultry meat, respectively. For comparison, to produce 1 kg of potatoes, 1 kg of wheat, 1 kg of rise, and 1 kg of soya 500 L, 900 L, 1 900 L and 2 000 L of water is needed, respectively.

The problem of increased water consumption is particularly apparent in large-scale non-litter swine production where large quantities of slurry are produced. For example, 500 cows and 36 500 grower-finishers produce over 34 m^3 and 350 m^3 of slurry, respectively, on a daily basis. In practice, there volumes can vary considerably and can reach the level of 800 m^3 slurry per day for grower-finishers.

Large volumes of liquid-manure can involve some serious transportation, storage and utilization problems, and significantly increase water consumption. Apart from water given to animals and used for production processes and sanitation activities, additional water volumes are used for slurry dilution which contains more than 8% of dry mass. Depending on weather conditions, fertilisation period, and plant sensitivity, slurry can be diluted with water at 1:1 – 1:6 proportions. If slurry is diluted with water at 1:3 proportions at a grower-finisher farm, then water consumption will increase by 383 000 m^3/year.

2.3.2.4 Loss of recreation sites

Illegal storage, transportation and use of animal fertilisers (mainly liquid manure) can contaminate surface water in regions of high recreational value. For example, slurry produced by farms located near the Gołdapia Health Resort (Poland) caused fish die-off in the nearby lakes in 2006.

Rural areas where agricultural activities are highly diversified and targeted at the development of agrotourism are worst affected. The problem also exists in the coastal region with seaside resorts, significantly limiting the recreation qualities of the Baltic Sea. Just on the Polish coast 6 bathing sites were closed in 2009, for reasons of microbiological contamination. The problem is also reported for Lithuanian coast.

2.3.3 Legislation and legal problems

Large-scale livestock production involves a number of legislation and legal problems, which directly and indirectly influence the environment of the Baltic Sea. These problems include non-compliance with the relevant legislation, ineffective law enforcement, and absence of legal regulations.

2.3.3.1 Non-implementation of the Helsinki Convention

In Poland, there is a mismatch between the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (HELCOM) signed on 9 April 1992 and ratified on 24 June 1999 and the current legislation. Although the Helsinki Convention entered into force on 5 February 2000, Poland's laws and regulations on the storage and use of animal fertilisers have not been fully accommodated to the requirements ensuing from Annex III to the Helsinki Convention. The volume of slurry storage containers can be an example – according to the Polish laws, only farms located in Nitrate Vulnerable Zones are required to have 6 months storage capacity, whereas according

to the Helsinki Convention, this obligation is imposed on all agricultural holdings.

Annex III to the Helsinki Convention shall not be binding until it is promulgated in the Official Journal of Laws of the Republic of Poland. As a result, Poland has two equivalent (within the meaning of international law) and dissimilar legal acts governing issues related to natural fertilisers.

Due to these discrepancies, it could be difficult to officially recognise the criteria for inclusion/removal of Agricultural Hot Spots proposed by HELCOM in Poland. The Statement of the Ministry of Agriculture and Rural Development concerning HELCOM 30/2009 2.17/Rev.1/Add.2 on criteria for inclusion/removal of agricultural *Hot Spots* of March 2009 advocates for consultations on this issue and for delaying the entry into force of these criteria in Poland. It argues that the criteria cannot be accepted 'in the reality of the currently binding national laws and economic circumstances in the food production and agricultural sector'. This is even more surprising since, when the Baltic Sea Action Plan was signed in November 2007, the Polish Ministry of Agriculture and Rural Development and the Ministry of Environment were well aware of the current legal Framework in Poland.

This opinion is in contradiction to Article 32 of the Helsinki Convention concerning amendments to the Annexes and the adoption of Annexes, according to which the amended Annex III validly entered into force in Poland. Also, Minister of Agriculture and Rural Development claims that 'Poland's current laws fully guarantee that natural fertilisers are managed without any negative environmental impact', as opposed to the conclusions of the Supreme Audit Office (Pol. NIK) which inspected large-scale swine farms in 2006 and 2007, and — on revealing multiple irregularities and shortcomings — negatively evaluated the activities of Poland's governmental bodies concerning development and implementation of State's policy on large-scale swine production, and the supervision system of governmental bodies over large-scale livestock production. The authors of the Statement of the Ministry of Agriculture and Rural Development concerning HELCOM 30/2009 2.17/Rev.1/Add.2 on criteria for inclusion/removal of agricultural *Hot Spots* were apparently familiar with these conclusions since the Statement reads: 'Poland has consistently held that the problem of water pollution cannot be solved by regulation of the storage capacity of containers or slabs, but by the determination and monitoring of the method of storage and landspreading'.

Poland should promulgate the amended Helsinki Convention in the Official Journal of Laws in the first place in order to make room for its full implementation and transposition into Polish law, and to eliminate discrepancies between the state legislation and the international laws. As a result, Poland will have no arguments to justify its refusal to adopt the criteria for inclusion/removal of agricultural 'Hot Spots', or to block works on establishing general criteria for the whole Baltic Sea catchment area. Poland is currently bound by the obligations listed in Annex III in external relations (in relations with signatories to the Convention and HELCOM itself), but not internally (since the obligations have not been officially notified to the stakeholders).

Secondly, financial means are needed to implement the requirements listed in the amended Helsinki Convention, under EU grants for farmers (Axis 1 to Rural Development Plans, to improve environmental protection standards in agricultural holdings, including manure storage).

2.3.3.2 Lack of public access to fertilisation plans

The obligatory fertilisation plans drawn up under the Good Agricultural Practice and Regulation (EC) No. 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption, and the opinions of agrochemical offices issued for fertilisation plans have not been classified as public information on environment and environmental protection (environmental information), nor public information disclosed by agrochemical offices.

This is in contradiction to the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters of 25 June 1998 (Aarhus Convention). In Poland, for example, according to the Act of 5 September 2001 on access to public information, a public document is 'the content of any declaration of will or knowledge made and signed in any form by a public officer within the meaning of the Criminal Code, within his or her professional competence, addressed to another person or body or put on file'. Fertilisation plans submitted by agricultural holdings satisfy the conditions of this definition, i.e. they contain the knowledge of the owner of an agricultural holding about the land and the planned fertilisation methods; they are signed by a public officer of regional agrochemical station and put on file.

Requests for opinion on fertilisation plans together with enclosed fertilisation plans fulfil all criteria of environmental information. Under the Environmental Protection Law Act of 27 April 2001, environmental information subject to obligatory disclosure is any *plan, program and financial analysis* regarding issues relevant for environmental protection. Fertilisation plans are also qualified as programmes intended to limit the environmental impact of nitrogen from agricultural sources. These plans concern issues relevant for the environment. Fertilisation plans are obligatory, and there are no arguments in favour of keeping them confidential under the Environmental Protection Law.

2.3.3.3 Ineffective supervision of large-scale livestock farms by state authorities

Well-documented example of Ineffective supervision of large-scale livestock farms by state authorities comes from Poland. Under the Supreme Audit Office inspection carried out in 2007 and 2011, the supervision of livestock production operations by state authorities was demonstrated to be insufficient and ineffective.

The first inspection examined and evaluated state authorities' supervision of the development and implementation of large-scale swine production policy, large-scale swine production operations, compliance with health, veterinary and environmental protection regulations, and the use of public funding allocated to animal rearing and breeding operations.

The state authorities' supervision of the development and implementation of large-scale swine production policy has been negatively evaluated. There were no suitable organisational and legal conditions created for ongoing collection of reliable information on the number of large-scale swine production holdings established, or the scale of livestock production; surveillance over these holdings proved to be equally ineffective. Inspections performed by the Veterinary Inspection, Environmental Protection Inspection, and the State Sanitary Inspection have been assessed negatively; it was revealed that such inspection procedures failed to cover all large-scale swine production holdings, and did not comprehensively examined whether the standards for natural fertilisers were properly followed. Cooperation and coordination of actions between these institutions were also demonstrated to be insufficient.

There were numerous cases of violations of environmental protection regulations by large-scale swine production operations, which should be of great concern. And in particular, many large-scale swine production holdings failed to acquire integrated permits on time, or to drawn up slurry management plans. It was also revealed that many large-scale swine production holdings violated construction law regulations (construction or adaptation of livestock buildings without having the required permits, introducing unauthorised material changes in the envisaged use of buildings).

In an inspection of supervision of fur-bearing animals farms by state authorities carried out 4 years later, the state surveillance over the operations of fur farms was negatively assessed mainly because of proved ineffectiveness of such inspections.

Ineffective supervision of large-scale livestock farms by state authorities is also well documented for Belarus, Estonia, Russia and Ukraine.

2.3.3.4 Low quality of environmental impact reports and Environmental Impact Assessment

Industrial livestock production holdings have permanent or potential impact on the environment, which means it is obligatory for them to draw up environmental impact reports and to obtain decisions on environmental conditions for investment permits (undergo a procedure of Environmental Impact Assessment). However, it is often the case that the reports submitted by investors, and the Environmental Impact Assessment procedures are of low quality.

The most common defaults in the Environmental Impact Assessment procedures are as follows:

- discrepancies between information provided in environmental impact reports and requests for integrated permits with the actual state of the environment, caused by insufficient qualifications of the individuals who draft these documents, use of incorrect methods, or intentional defaults,
- the *in or out* pattern of defining investment variants, taking into account only two possible outcomes - implementation of investment or non-implementation of investment, without reviewing other investment variants, i.e. different locations, changes in livestock size, or technological conditions of animal rearing,
- insufficient or badly planned mitigating measures (compensatory measures),
- irregularities in or absence of public consultations,
- limited access of local communities to administrative procedures involving the investment process,
- lack of clarity and uniformity in the operations of institutions responsible for Environmental Impact Assessments,
- environmental protection measures other than NATURA 2000 are marginalised,
- lack of vision for sustainable development in the context of the investment process,
- incompetence of public officers (especially at local level),
- routine approach to different cases (investments) by public officers,
- unwillingness on the part of public officers and investors to cooperate with non-governmental organizations.

2.3.3.5 Restrictions in public participation in the decision-making process related to location and setup of large-scale livestock farms

In terms of active involvement of the society in the decision-making processes related to the location and setup of large-scale livestock farms, in many cases, authorities simply fail to create conditions which would favour and encourage public involvement, whereas public information on active involvement and public participation options has not been properly disseminated.

Legislation in most countries of the Baltic Sea Region explicitly describes the conditions for public participation in the administrative decision-making process; however, due to the lack of transparency, re-

stricted access to information, very limited time, and unwelcoming approach of many public officers, the role of the society is typically limited to passive acceptance and acknowledgement of decisions which directly affect local communities, made by public authorities at central level.

The basic problem are obscure public disclosure practices concerning the proposed investments. With information displayed on information boards or published online on the official institutions' websites, which clearly lacks transparency, many stakeholders, including local communities and NGOs, remain underinformed.

Another problem is the approach of public officers who are in charge of the decision-making process. They frequently disregard complaints and appeals of local communities, even if they are formally submitted, by claiming that the information in question cannot be disclosed or by making access to such information difficult. As a result, the voice of local communities is often disregarded in issuing decisions on environmental conditions for investment permits, construction permits, building use permits, and decisions defining the scope of use of the environment (integrated permit, permit required under the Water Act, decision on approval of dust or gas emissions, waste management decisions, decisions on permitted noise emission, etc.).

On the other hand, it is the local community which needs to show the initiate, even in conditions favourable for active involvement in the decision-making process or a community-friendly environment. Activisation is the core feature of a civic society. Lack of information on the possibilities and options of active public involvement in the administrative decision making is another problem. The role of NGOs cannot be underestimated since they can act in an orchestrated manner as intermediaries between decision-makers and local communities directly affected by the decisions taken. However, public authorities still fail to interact with NGOs on equal terms, or to accept the fact that their activity has been mandated by the society.

Described problems with public participation in the decision-making process related to location and set-up of large-scale livestock farms are reported mainly in Belarus, Germany, Lithuania, Poland, Russia and Ukraine.

2.3.3.6 No effective links between public subsidies and compliance with environmental protection regulations

In many cases, especially in new EU member states, large-scale livestock farms have been receiving public funds in spite of confirmed cases of non-compliance with environmental protection regulations. Public funds include subsidies in exchange for biological progress in livestock production, grants for research, or subsidies for the purchase of fuel granted by local governments. However, the major share of public assistance is granted under the Common Agricultural Policy (CAP) and the subsidies for farmers granted under CAP – direct payments for agricultural area (production of specific crops and animals) and financial support for farmers in Less Favoured Areas (LFA).

The Common Agricultural Policy covers all agriculture-related operations taking place within the European Community with the aim to:

- improve agricultural productivity by promoting rational and optimum use of modern means of production in agriculture and new technologies, with a focus on workforce,
- ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture,
- secure supply of agricultural products to the community, allowing consumers to buy agricultural products at reasonable prices, and general stability of the agricultural and food sector.

CAP is also focused on increasing competitiveness of the EU agriculture on international market, at the same time safeguarding individual earnings of persons engaged in agriculture and the safety of the natural environment.

Expenditure on CAP of over Euro 40 billion annually account for over 40% of the Total EU budget. 90% of these funds are earmarked for financing the first pillar of CAP – providing agricultural market and income support (intervention purchases or subsidized exports, direct payments for producers) for market stability, better productivity, and stable earnings. Only 10% of the CAP budget is spent on the second pillar (with 4-5% spent on agri-environmental operations). The second pillar is directly related to the EU structural policy and is intended to level off the development conditions at regional level, secure appropriate living standards for rural communities, support environmental protection, protect local cultural resources, ensure production diversification within agricultural holdings, and enforce conformity with high food production standards.

Apart from the absence of stable and effective interdependence between the enforcement of environmental protection regulations and grating financial assistance under CAP, and the huge fund-sharing disproportion between CAP pillars, the major concern is also the fact that around 80% of direct payments are awarded to only around 20% of beneficiaries.

It would be advisable, at least in the case of large-scale livestock farms, to link direct payments with the livestock size for more preferential treatment of farmers who adapt the amount of animals to the amount of arable land available.

On the other hand, a serious problem is lack of or insufficient financial support from public funds (eg through subsidised loan, investments co-financing, free training courses, incentive system, etc.) for pro-environmental investments on large-scale livestock

farms. An example can be Russia, where the state does not provide economic incentives for agricultural enterprises in the proper use of natural fertilisers, environmental protection and adoption of environmental friendly technologies in industrial livestock production. Current legislation does not provide any incentives for organic fertilizer consumers, while the government encourages farmers to use inorganic fertilizers granting subsidies for their purchase.

3. PREVENTING NEGATIVE CONSEQUENCES OF INTENSIVE LIVESTOCK PRODUCTION

3.1 Sustainable agriculture

It is widely believed that large-scale animal production has no chance of being environmentally friendly, which seems to be confirmed in practice. This statement can be hardly argued with, which is also true for the apparent environmental-unfriendliness of industrial companies, mines, or large transhipment ports. Such operations are environmentally unfriendly not only by definition. They simply do not operate in line with sustainable development principles by putting excessive burden on the self-regulating and regenerating mechanisms of ecosystems and by exploiting the ecosystem resources.

Note that the intensive livestock industry is an element of production-focused (intensive) farming whose aim is to provide large volumes of cheap food for the growing population of an industrial society. This model of agriculture fits the assumptions of the capitalist economic system, which favours the fulfilment of economic goals as its top priority. With the development of intensive agriculture, the conflict between agricultural activities and the natural environment has deepened, which is clearly visible in the scale of the competition between economic and environmental goals.

This fundamental problem can be addressed by sustainable agriculture. It can be implemented by subjecting the existing installations to environmental protection discipline (also in terms of law enforcement and compliance monitoring), and by adapting them to environmentally friendly production requirements (causing as little harm to the environment as possible). With respect to the planned undertakings, sustainable approach to the investment process can be expressed by incorporating specific limitations and restrictions into spatial development plans so as to prevent the establishment of large-scale livestock farms within areas of precious environmental qualities, or unfit for intensive livestock industry for social (risk of social conflicts, close proximity to residential areas, etc.) and strategic reasons (tourist and recreation qualities as the area of interest of local administration).

The idea behind sustainable agriculture directly draws from the idea of sustainable development, i.e. the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1986). Sustainable development is considered equivalent to eco-development, which is defined as creating development without destroying the natural resources (definition by prof. Stanisław Kozłowski).

Sustainable agriculture is subordinate to the fulfilment of basic sustainable development goals, and consists in the use of environmentally friendly methods which allow to limit negative impact of agriculture on the environment by introducing integrated plant protection and fertilisation plans based on nitrogen balance (Council Regulation (CE) 1257/1999).

Sustainable agriculture is one of the agri-environmental programme packages of the Rural Development Programme for 2007-2013. The goal of Variant 1.1 Sustainable Farming System, Package I Sustainable Agriculture is to encourage farmers to adopt a sustainable farming system, i.e. rational use of natural resources and limiting negative impact of agriculture on the environment. For example, crop rotation (cultivating specific types of crops in sequential seasons) limits the growth of agrophages and weeds and reduces nitrogen losses. This variant involves the following do's and don'ts:

- variant to be implemented in the entire agricultural holding, and payments can be only obtained from the arable land available,
- annual fertilisation plans based on nitrogen balance and the latest chemical analysis of soil, determining the levels of P, K, Mg and the demand for liming,
- use of sewage sludge is not permitted,
- maximum nitrogen dose from natural fertilisers, composts and mineral fertilisers of 150 kg N/ha of arable land, and 120 kg N/ha on grasslands,
- obligatory haymaking or grazing on grasslands.

Ecological farming is a specific type of sustainable agriculture which balances plant and livestock production and uses natural agents only, without any agents which have been produced or processed industrially. The basic assumption of ecological farming is to imitate the processes of natural ecosystems, to keep high humus levels for soil fertility, to preserve biological balance in the agricultural environment, to obtain as closed matter cycle as possible in the agricultural holding by balancing plant and livestock production, to limit the use of chemical plant protection products and artificial fertilisers, antibiotics, food additives, processing aids and artificial means of production, as well as to exclude the use of genetically modified organisms (GMO).

The conflict of objectives of conventional and ecological farming is quite apparent. Conventional agriculture strives for profits at the cost of the environment. In ecological farming, reduced negative environmen-

tal impact is achieved at the cost of reduced profits from agricultural activities.

Ecological farming has proved to offer multiple benefits for the natural environment. First of all, it helps preserve biodiversity. Bird populations in agricultural areas are estimated to decrease by nearly 9% with every additional 1 ton of crops produced. In areas surrounding eco-farms, bird populations and breeding success are estimated to increase by 25-44% (laying season), the number of plant species is estimated to increase by 60%, and the populations of invertebrate species are twice higher than in conventional agricultural holdings. Popularisation and diffusion of ecological farming is estimated to reduce nitrogen and phosphorus overload in agricultural holdings down to 38 kg N/ha and 2 kg/ha, respectively. Nitrogen volume corresponds to the minimum levels required for keeping the soil fertile, and phosphorus deficiencies can be easily supplemented (introduction of a dose 100 kg P/50 years is sufficient).

In comparing the conventional farming, sustainable agriculture and ecological farming, it would be advisable to refer to the objectives of the agricultural activities in each of these farming models. Conventional farming strives for economic and social balance without paying much attention to ecological balance. Sustainable agriculture balances social, economic and ecological issues. Ecological farming strives to keep an ecological balance, which is superior to social issues and economic relations. As mentioned before, these three farming models have different environmental consequences. In intensive farming, the environment is polluted, the ecological balance and cultural qualities of rural areas are lost, and soil is degraded. In sustainable agriculture, these negative consequences are counterbalanced by limiting pollution and environmental degradation and by protecting the current environmental and cultural status. In ecological farming, the natural environment of the agro-ecosystems and the directly related ecosystems are a matter of priority with the aim to preserve their biodiversity for the future generations. The role of the society is different as well, and the relations between the dominant agriculture model and the environment are shaped differently.

All in all, the prevailing agricultural model depends mainly on the attitude of the society. In practice, especially in highly developed countries, this attitude is manifested by the approach of consumers who, by choosing specific products, influence the supply and demand, and make specific agricultural production models profitable or unprofitable in conditions of free market economy. Health and welfare of the society is the decisive factor in consumer choices. The development of the society in different parts of the world has clearly shown that improvements in wealth have been always accompanied by increased ecological awareness of consumers, and the growing tendency (and possibility) to spend more on healthier products (mainly food) which are of better quality and are produced in a more environmentally friendly manner.

3.2 Intensive livestock industry and Corporate Social Responsibility

The definition of intensive livestock production provided in Chapter 1 explicitly mentions that intensive livestock farms operate as agricultural conglomerates (agro-conglomerates), i.e. multi-agent capital groups, especially in the highly developed countries of Western Europe and the US. Internationalization of agro-conglomerates can be seen as an inevitable consequence of progressive globalization, as evidenced in the operations of the US-based Smithfield Foods (Animex Sp. z o.o., Agri Plus Sp. z o.o., Prima Farms Sp. z o.o.) and the Denmark-based AXZON Group (Poldanor SA) in Poland.

Large-scale intensive livestock production involves not only logistic problems, but also significantly increases the risks for the natural environment and rural communities. This can be proved by numerous irregularities in the operations of large-scale livestock farms belonging to multinational companies, revealed during inspections by the Polish Supreme Chamber of Control (NIK) and the Polish Chief Environmental Protection Inspectorate (absence of fertilisation plans approved by chemical-agricultural stations, default in the payment of emissions charges, irregularities in obtaining integrated permits, overdue payments of environmental fees, absence of waste disposal agreements, incorrect storage of animal carcasses, incorrect veterinary records, absence of building permits and unauthorized adaptations of buildings, defaults in the application and storage of natural fertilisers, including slurry disposal directly to drainage ditches). Environmental nuisance frequently affects local communities residing in close vicinity to large-scale livestock farms, giving rise to controversies and protests. The scale of the problem can be seen from the number of social initiatives, including *Zakończ chów wielkoprzemysłowy [Stop Intensive Livestock Production]* (The Viva Foundation), *Kwik rozpaczy* [The Squeak of Despair] (The Viva Foundation), *Food from Farms not Factories* (Tracy Worcester), and press articles: *Te amerykańskie świnie* [Those American pigs] (NIE Weekly, 4/2008), *Świnia trojańska* [The Trojan Pig] (NIE Weekly, 10/2000), *"Świński interes" zagraża polskiemu rolnictwu* [The pig business vs. Polish agriculture] (INTERIA.PL, 09.02.2011), *Wielkoprzemysłowe farmy ekologiczną bombą* [Large-scale livestock farms – a ticking ecological bomb] (Zielone Brygady, 2003), *Wolna amerykanka świńskich gigantów* [Anything goes for pig conglomerates] (Nasz Dziennik, 7/2008), *Kto zatrzyma Smithfielda?* [Who stops Smithfield?] (Zielone Brygady, 2003).

In order to improve their corporate image, large-scale livestock farms may refer to *Corporate Social Re-*

sponsibility (CSR) strategies as a means to protect social interests, the environment and relations with various stakeholders. With respect to agriculture, the term *Socially Responsible Agriculture* (SRA) is often used.

Corporate Social Responsibility is a management strategy which makes room for social dialogue at local levels; it helps increase global competitiveness of enterprises and creates conditions for sustainable social and economic development. By employing corporate social responsibility methods, enterprises manage their relations with various stakeholders, which can be considered an investment rather than expense, as is the case with quality management. Corporate social responsibility involves strategic, long-term and voluntary commitments to invest in human resources, environmental protection and relationship with the surrounding environment.

Commissioning of agricultural biogas plants by large-scale livestock farms in Belarus, Lithuania and Poland can be mentioned as an example of CSR measures. In Belarus, for example, there are 6 farms that use manure for biogas production. One of them is *Zapadnyi* factory pig farm, with app. 92 800 pigs (Brest region, West Bug river basin). The biogas production unit was constructed in 2007, and started its operation in 2008. The planned capacity of the unit is 520 kW, which allows treatment of app. 43 tons of liquid and 43 tones of solid manure daily and the final product is used as a fertilizer.

Under social corporate responsibility related to the idea of *Cleaner Production* (CP), large-scale production farms undertake to fulfil *Voluntary Ecological Commitments* (VEC) and the *International Declaration on Cleaner Production under the United Nations Environment Programme (UNEP)*.

Cleaner Production is an environmental protection strategy which consists in continuous, integrated, preventive activities targeted at processes, products and services, intended to increase production and service effectiveness and to reduce risk for humans and the natural environment. The idea of *Cleaner Production* is in opposition to the approach based on mitigating consequences of environmental impact of production. Recovery in the context of *Cleaner Production* is the final measure taken if all other measures offered by CP fail. Waste-free production and respecting the environmental discharge/emissions limits are the basic assumptions. CP is the process of production and service management and control for preventing and limiting waste of resources, labour, raw materials, materials and energy.

The *International Declaration of Cleaner Production* is a voluntary and public statement of commitment to implement and promote the environmental management strategy based on the *Cleaner Production* philosophy to broaden the environmental awareness, understanding of the concepts of pollution prevention, and to boost demand for cleaner production. The Declaration was formulated in 1999 at the UNEP Governing Council meeting in Nairobi.

Voluntary Ecological Commitments (VEC) were introduced in 1996 by the Polish Cleaner Production Society to supplement the existing environmental protection regulations, or more specifically, emission limits and environmental fees imposed according to the *polluter pays* principle. This strategy covers ecological, social and ethical aspects of business activities followed in contacts with the stakeholders (employees, clients, local community, shareholders, suppliers, local governments). This is tantamount to prioritising measures to prevent waste of resources, limiting pollution and balancing effectiveness and profitability vs. social interest in business activities. VEC is therefore an important and quantifiable (although declarative) contribution to the fulfilment of the idea of sustainable development (sustainable production and consumption).

Voluntary environmental protection initiatives are one of many UNEP initiatives intended to help enterprises select individual ways and methods to pursue the goals of the state environmental policy. The degree and scope to which VEC are formalised can vary, but the basic idea behind VEC is to continuously reduce environmental impact according to internal individual corporate strategies reflecting the underlying environmental policy of the State.

VEC also covers social commitments, listed in the *Global Compact* published by the United Nations Secretary-General. This UN initiative encourages businesses to support, accept and use, in all spheres of their activity, 9 fundamental principles of human rights, labour standards, and environment. These nine principles are as follows: in terms of human rights, businesses should support and respect the protection of internationally proclaimed human rights (1), to make sure that they are not complicit in human rights abuses (2), in terms of labour standards, businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining (3), the elimination of all forms of forced and compulsory labour (4), the effective abolition of child labour (5), the elimination of discrimination in employment and occupation (6), in terms of the environment, businesses should support a precautionary approach to environmental challenges (7), undertake initiatives to promote environmental responsibility (8), and encourage the development and diffusion of environmentally friendly technologies (9).

To implement the *Voluntary Ecological Commitments* for *Cleaner Production*, a business should submit an application featuring a voluntary statement on the implementation of the *Cleaner Production Strategy* to its management system, an environmental protection policy, list of ecological accomplishments and pro-environmental investments, and the action plan for the years to come.

After submitting the application and successful completion of the application procedure at the national Cleaner Production Centre, the applying business receives a Cleaner Production Certificate and, following 2 years, it is entered in the national Register of Cleaner Production and Responsible Entrepreneurship. The Cleaner Production Certificate means that the company has been operating an environmental management system according to the *Cleaner Production Strategy*, and that CP logo can be placed on its products. Following entry in the CP Register, the company is committed to submit annual ecological reports on environmental management.

Applications for registration can be submitted by businesses which implemented and operate according to the *Cleaner Production Strategy*, demonstrated to have been systematically reducing environmental impact, operated according to the environmental protection laws, submitted the ecological reports on time, and signed the UNEP International Declaration of Cleaner Production. The Environment Management Strategy (EMS) based on the Cleaner Production Strategy can become the basis for implementing the ISO 14001 standard (international environmental management standard).

Corporate Community Involvement/Investment (CCI) has a more restricted meaning as compared to the *Corporate Social Responsibility*, and means addressing social issues and active involvement in solving social problems. CCI includes financial assistance (supporting education of children and adolescents in rural areas, like the Animex Foundation, supporting bottom-up social initiatives *Działajmy razem* [Let's Act Together] by POLDANOR), in-kind assistance, or voluntary work.

Other good example comes from Latvia, where industrial pig farm *Ulbroka* received the *Farmer of the Year award* in 2010. This fattening pig complex is located in *Stopiņu* region and grown 16 000 pigs. The company uses innovative and effective methods for grading pig farm pollution reduction, like special air filters that attracts methane and ammonia.

Corporate Social Involvement can be beneficial for both, local communities and businesses, specifically by building a positive public image of the corporation and consolidating business credibility.

3.3 Soft-law of environmental protection in agriculture and protection of the Baltic Sea ecosystem

Apart from binding domestic and international laws, there are several acts (guidelines, recommendations, reference documents) which do not create any legal obligations or whose legally binding force is weaker than the binding force of traditional law.

There are two main exceptions:

- for installations for the intensive rearing of poultry or pigs with more than 40 000 places for poultry, 2 000 places for production pigs (over 30 kg), or 750 places for sows – Best Available Techniques Reference Document (BREF) for Intensive Rearing of Poultry and Pigs (ILF) is the basis for determining the maximum emissions from installation laid down in integrated permits,
- agricultural holdings (including large-scale livestock farms) in EU, which implement an agri-environmental programme, afforestation, receiving financial support for aid scheme to farmers in Less Favoured Areas (LFA), and applying for direct payments – they are committed to follow the cross compliance principle (with which the *good agricultural practice* was substituted) and the *Good Agricultural and Environmental Condition* (GAEC), whereas farmers who implement an agri-environmental programme are also committed to comply with the minimum requirements for the use of fertilisers and plant protection products.

These are *soft-law* documents and can be implemented voluntarily. The voluntary nature of these documents shall mean that the decision on whether to commit oneself to the requirements ensuing from the EU *Rural Development Programme* or to operate a large-scale livestock farm is taken at sole discretion of, or is an autonomous choice of the farmer interested in environmental protection issues. The first case concerns the instruments of the EU *Common Agricultural Policy* under which the *Rural Development Programme for 2007-2013* has been developed, with the *Agri-Environmental Programme* as its integral part (minimum requirements for the use of fertilisers and plant protection products, cross-compliance). In the second case, the recommendations listed in the *Code of Good Agricultural Practice* are involved.

Moreover, there are strategies and programmes which rely on the Baltic Sea Region countries' international commitments, or more specifically, the *Baltic Sea Action Plan*, the *European Union Strategy for the Baltic Sea Region*, and the *Agenda 21 for the Baltic Sea Region*.

3.3.1 The Code of Good Agricultural Practice

In order to implement the goals of the *Common Agricultural Policy* and the requirements of the Nitrates Directive, the Code of Good Agricultural Practice has been drawn up, which is a compilation of rules and recommendations for environmental protection, and advise on how to limit negative environmental impact of agriculture. The Code raises environmental awareness of farmers and helps them implement concrete environmentally friendly solutions.

The *Code of Good Agricultural Practice* also features guidelines for reducing emissions of odorants and other pollutants from agricultural sources.

3.3.2 Cross compliance

The EU *Cross compliance* principle was adopted as a result of the *Common Agricultural Policy* reform in 2003.

It links direct payments to a number of environmental requirements rather than production structure and size.

Cross compliance applies to all large-scale farms which apply for the following forms of assistance: direct payments, LFA payments, afforestation, agri-environment payments.

Maintaining the land in good agricultural and environmental condition, fulfilling minimum requirements for the use of fertilisers and plant protection agents, and a number of detailed guidelines divided into 3 themes are the main requirements defined for the cross compliance instrument. Section important for preventing eutrophication covers groundwater protection against pollution from nitrates from agricultural sources.

3.3.3 Minimum requirements for the use of fertilisers

Large-scale livestock farms which implement the agri-environmental programme under the Rural Development Programme for 2007-2013 are committed to comply with the following minimal requirements for the use of fertilisers:

- it is not permitted to use non-authorised fertilisers,
- it is not permitted to use more than 170 N per 1 hectare of arable land per year,
- slurry and fermented urine must be stored in containers offering at least 4 months storage capacity, and in Nitrate Vulnerable Zones (NVZs) – in containers offering at least 6 months storage capacity; such containers must be leak-proof closed,
- natural fertilisers other than slurry and fermented urine must be stored on leak-proof slabs protected against leakage to soil,
- natural and organic solid and liquid fertilisers can be applied only from 1 March until 30 November, except for areas under shelter, i.e. greenhouses, permanent frames, and film tunnels,
- natural fertilisers should be covered or mixed with soil on the next day after application at the latest, except for fertilisers used on grasslands,
- fertilisers cannot be applied over water saturated areas, covered with snow or frozen to the depth of 30 cm and during rain,
- it is prohibited to apply liquid and nitrogen fertilisers on vegetation-free soils covering slopes with more than 10% gradient,
- it is prohibited to apply liquid fertilisers during vegetation of plants for human consumption,
- natural fertilisers should be applied at at least 20 m distance from the protection zone of springs, water intakes and water courses, and bathing sites over surface waters and in the coastal area.

3.3.4 Best Available Techniques Reference Document (BREF) for intensive rearing of poultry and pigs (Industrial Emissions Directive)

The Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs (BREF) is an executive summary of regularly validated and updated practices for the operation of installations obliged to obtain an integrated permit, allowing for integrated pollution prevention and control, taken into account in defining conditions for integrated permits by the issuing authorities. BREF reference documents are the basis for the compilation of requests for integrated permits.

BREF has been drawn up from information exchange between Member States and enterprises committed to the Best Available Techniques, BAT. The information exchange has been coordinated by the European IPPC Bureau in Seville, which collects and prepares reference documents on BAT. It was published by the European Commission to follow-up Article 3 and Article 16(2) of Directive 96/61/EC of the Council of 24 September 1996 on integrated pollution prevention and control (IPPC Directive), to help owners of IPPC installations undertake all available measures to prevent pollution, and in particular by applying the Best Available Techniques for improving the condition of the environment.

According to Article 2(11) of the IPPC Directive, the *best available techniques* shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole. And in particular:

- *techniques* include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned,
- *available* techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator,
- *best* shall mean most effective in achieving a high general level of protection of the environment as a whole.

The purpose of BAT is to provide indications regarding maximum emission values that reflect correct proportions between costs and benefits. These limits must take into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. In addition, the emission limit values are determined for pollutants which are likely to be emitted from the installation concerned in significant quantities, and in particular, those listed in Annex III, IPPC Directive.

Aimed at improving general environmental performance of intensive poultry and pig farms, the best available techniques (BAT) are intended to:

- identify and implement education and training programmes for farm staff,
- keep records of water and energy usage, amounts of livestock feed, waste arising and field applications of inorganic fertiliser and manure,
- have an emergency procedure to deal with unplanned emissions and incidents,
- implement a repair and maintenance programme to ensure that structures and equipment are in good working order and that facilities are kept clean,
- plan activities at the site properly, such as the delivery of materials and the removal of products and waste,
- plan the application of manure to land properly.

The BREF reference document consists of 5 chapters:

- Chapter 1 provides general information at a European level on the sectors of poultry and pigs rearing. This includes economic data, consumption and production levels of eggs, poultry and pork as well as information on some legislative requirements,
- In Chapter 2 the production systems and techniques are described that are commonly applied in Europe,
- Chapter 3 provides data and information on current emission and consumption levels, as well as factors that account for the variation of consumption and emissions levels,
- Chapter 4 describes the techniques that are considered to be most relevant for determining BAT and BAT-based permit conditions,
- Chapter 5 provides general indications for the Best Available Techniques, however, the determination of appropriate permit conditions will involve taking into account local, site-specific factors (technical characteristics of the installation concerned, its geographical location and the local environmental conditions).

In terms of protection of the Baltic ecosystem, BREF lists the following Best Available Techniques:

- nutritional management by applying techniques for reducing the excretion of nutrients (N, P) in swine manure and poultry litter,
- techniques for reduction of water use on farms by cleaning animal housing and equipment with high-pressure cleaners at the end of each production cycle or batch of livestock,
- for a stack of pig manure that is always situated on the same place, either on the installation or in the field, BAT is to apply a concrete floor, with a collection system and a tank for runoff liquid, and locate any new to build manure storage areas where they are least likely to cause annoyance to sensitive receptors for odour, taking into account the distance to receptors and the prevailing wind direction.
- BAT on the storage of pig slurry in a concrete or steel tank comprises all of the following criteria: a stable tank able to withstand likely mechanical, thermal and chemical influences; the base and walls of the tank are impermeable and protected against corrosion; the store is emptied regularly for inspection and maintenance, preferably every year; double valves are used on any valved outlet from the store; the slurry is stirred only just before emptying the tank for, e.g., application on land,
- it is BAT to cover slurry tanks using one of the following options: a rigid lid, roof or tent structure, or a floating cover, such as chopped straw, natural crust, canvas, foil, peat, light expanded clay aggregate (LECA) or expanded polystyrene (EPS),

it is BAT to cover lagoons where slurry is stored using one of the following options a plastic cover, or a floating cover, such as chopped straw, LECA or natural crust,

- manure treatment prior to or instead of land spreading may be performed for the following reasons: to recover the residual energy (biogas) in the manure, to reduce odour emissions during storage and/or land spreading, to decrease the nitrogen content of the manure, with the aim of preventing possible ground and surface water pollution as a result of land spreading and to reduce odour, to allow easy and safe transportation of the manure to distant regions or when it has to be applied in other processes,
- applying nutritional measures; balancing the manure that is going to be spread with the available land and crop requirements and – if applied – with other fertilisers; managing the landspreading of manure,
- BAT is to take into account the characteristics of the land concerned when applying manure; in particular soil conditions, soil type and slope, climatic conditions, rainfall and irrigation, land use and agricultural practices, including crop rotation systems,
- BAT is to reduce pollution of water by doing in particular all of the following: not applying manure to land when the field is water saturated, flooded, frozen, snow covered; not applying manure to steeply sloping fields; not applying manure adjacent to any watercourse (leaving an untreated strip of land), and spreading the manure as close as possible before maximum crop growth and nutrient uptake occur,
- BAT is managing the landspreading of manure to reduce odour nuisance where neighbours are likely to be affected, by doing in particular all of the following: spreading during the day when people are less likely to be at home and avoiding weekends and public holidays, and paying attention to wind direction in related to neighbouring houses,
- the emissions of ammonia to air caused by the landspreading can be reduced through the selection of the right equipment – landspreading with septic tanker truck, followed by fast incorporation.

Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (IED Directive) entered into force on 6 January 2011, substituting the IPPC Directive. The IE Directive establishes new conditions for obtaining integrated permits, which had to be transposed into national law until 7 January 2013. The new regulations referring to existing installations shall be implemented until 7 January 2014, and until 7 July 2015 for installations which have not been so far required to obtain the integrated permit. The directive shall be transposed in full until 1 January 2016.

One of the most important changes introduced with the IE Directive is the modified legitimacy of BREF reference documents, which are now legally binding, which means environmental protection requirements will be much more demanding. Also, there is an obligation introduced to compile a report on soil and groundwater pollution, and to monitor soil and groundwater pollution. Much tighter emission limit values for nitrogen oxides and dust have been introduced.

3.3.5 The European Union Strategy for the Baltic Sea Region

The European Union Strategy for the Baltic Sea Region, EUSBR was adopted in the Council of the European Union Conclusions of 29/30 October 2009 and incorporates 15 priority areas (including reducing nutrient inputs to the sea to acceptable levels) broken down into 4 pillars:

- Making the Baltic Sea a safe and secure region,
- Making the Baltic Sea a prosperous region,
- Making the Baltic Sea an accessible and attractive region, and
- Making the Baltic Sea an environmentally sustainable region.

It also lists 27 strategic actions and 78 flagship projects (including the analysis of the results of pilot actions funded under the European Regional Development Fund, LIFE and Baltic 21 on prevention of eutrophication, and the Baltic Deal – Putting best agricultural practices to work to limit nutrient loads from agricultural sources entering the Baltic Sea, and cooperation with Russia and Belarus in assessing regional nutrient pollution load).

The Chief Inspectorate for Environmental Protection of Poland, in cooperation with the Minister of the Environment in Finland, coordinates the priority tasks for limiting nutrient pollution load under the 1st Pillar. Under this Pillar, the following actions are implemented:

- *Implement actions to reduce nutrients.* In addition to the full implementation of the key directives relating to eutrophication, these actions are in the *Baltic Sea Action Plan* (BSAP) of HELCOM,
- *Promote measures and practices which reduce nutrient losses from farming and address eutrophication.* The aim is to ensure high environmental standards with particular focus on reducing nutrient leakage. To achieve this, in addition to the full implementation of the Nitrates and Water Framework Directives, and the new Common Agricultural Policy Cross-Compliance requirement to establish buffer strips along water courses no later than 1 January 2012, additional rural development measures could be used, for example, to maximise fertiliser efficiency or achieve nutrient recycling. To support this process, it is important to identify all the intensively used agricultural land of the whole catchment area and to focus on these areas first. Should this prove insufficient, consideration could be given to what further measures might be needed through environmental or agricultural policies.
- *Full implementation of the Water Framework Directive in order to maximize the environmental benefits for the Baltic Sea.* Member States shall take measures to obtain good ecological status in all water bodies, including coastal waters, by 2015. A full implementation (including reporting) of the Water Framework Directive, together with the Nitrate Directive and the Urban Waste Water Treatment Directive, will also improve the environment in the open sea, in line with the objectives of the Marine Strategy Framework Directive for 2020.
- *Establish and restore more wetlands* to recycle the nutrients (to stop the nutrients leaking into the sea) and to mitigate floods (to stop the runoff of fertilisers during floods). The wetlands should be established where long-term effects can be expected, considering the different climatic conditions, the sensitivity for eutrophication, etc.
- *Set up the BONUS 185 (formerly 169) scheme* in order to have a sustainable research framework.
- *Facilitate cross-sectoral, policy-oriented dialogue* on integration of agricultural, environmental and rural development issues by supporting the implementation of projects which build capacity based on an integrated approach to mitigation of nutrient losses and policy level adaptation.

This Strategy unites the Baltic Sea macroregion (Sweden, Denmark, Finland, Germany, Latvia, Lithuania and Poland, with contribution from Norway, Belarus and Russia) and is one of two EU macroregional strategies. Its purpose is to take advantage of the full potential of the Baltic Sea region after EU enlargement in 2004, and to take concerted efforts to solve the problems of the region in other to address urgent environmental challenges of the Baltic Sea.

The Strategy should provide an integrated framework that allows the European Union and Member States to identify needs and match them to the available resources through co-ordination of appropriate policies. This will enable the Baltic Sea Region to enjoy a sustainable environment and optimal economic and social development.

The European Union Strategy for the Baltic Sea Region is criticized for its non-transparent structure, unclear goals, lack of additional sources of financing, and the unclear methods of management, as well as insufficient dissemination of information about the Strategy.

3.3.6 The HELCOM Baltic Sea Action Plan

The HELCOM Baltic Sea Action Plan, BSAP proposed by the Helsinki Commission was adopted by all 9 Baltic states (8 signatories and Russia) and the European Community at the ministerial meeting in 2007 in Kraków. Its vision is to achieve a healthy marine ecosystem and sustainable regional development, and the priority goal is to restore the good ecological status of the Baltic marine environment by 2021. A number of actions will be undertaken to accomplish this goal, divided into four segments: eutrophication, hazardous substances, environmental protection and biodiversity, and maritime transportation (the goals are planned to be made more specific until 2013).

The purpose of the eutrophication segment is as follows: *'Baltic Sea unaffected by eutrophication'*. Ecological goals to address the issue of eutrophication:

- concentrations of nutrients close to natural levels (1),
- clear water (2),
- natural level of algal blooms (3),
- natural distribution and occurrence of plants and animals (4),
- natural oxygen levels (5).

In order to accomplish these goals, the following actions are planned, mainly with respect to agriculture:

- country-wise reduction in nutrient discharged from inland waters and as atmospheric deposition;
- full implementation of amended Annex III *Criteria and Measures concerning the Prevention of Pollution from Land-based Sources*, Part II: *Prevention of pollution from Agriculture* of the Helsinki Convention;
- implementation of the Best Environmental Practice (BEP) and the Best Available Technology (BAT);
- establishing a list of Hot Spots (i.e. areas of high emissions for the Baltic Sea) identifying existing installations for the intensive rearing of cattle, poultry and pigs not fulfilling the requirements in the revised Annex III of the Helsinki Convention (this task was planned to be accomplished by 2009; however, it was removed from the agenda due to problems with implementing Annex III; non-implementation means that virtually, just in Poland, all intensive rearing installations would have to be classified as HELCOM Hot Spots);
- designation of Nitrate Vulnerable Zones, NVZs;
- determining measures for ecological objectives for eutrophication in the agricultural sector;
- drawing attention to the referencing eutrophication-related goals and actions to particular forms of agricultural activities of significant impact on marine eutrophication, such as aquaculture, fur farming.

It has been decided that the ecological objectives for eutrophication will be measured by, inter alia, winter surface concentrations of nutrients reflecting the ecological objective 'Concentrations of nutrients close to natural levels'. For objective no. 2 – Summer Secchi depth reflecting the ecological objective 'Clear water', No. 4 – Chlorophyll a concentrations reflecting the ecological objective 'Natural level of algal blooms', No. 5 – Area and length of seasonal oxygen depletion reflecting the ecological objective 'Natural oxygen levels'.

The Plan lists specific good practices for accomplishing the goals defined in agricultural practice. The practices were divided into 5 groups:

1. Soil management:

- plant cover in winter will reduce nitrogen and phosphorus leaching and soil erosion.

2. Fertiliser and manure management:

- preparing nutrient balances for holding/farm (nutrient balances provide information on the efficiency of nutrient utilisation and help to identify the cropping phases in which nutrients are lost),
- conversion from conventional to organic production,
- reduced fertilisation,
- promoting injection techniques and mulching,
- integration of fertiliser and manure nutrient supply,
- liming (preventing soil acidification which reduces effective phosphorus uptake and stimulate its runoff),
- avoiding the application of fertilisers and manure to high-risk areas (for example, areas with flushes draining to a nearby watercourse, cracked soils over field drains or fields with high phosphorus values),
- avoiding the spreading of fertilisers and manure during high-risk periods (for example, when there is a high risk of surface flow, rapid movement to field drains from wet soils or when there is little or no crop uptake),
- increasing the capacity of manure storage: manure containers and slabs (enough storage capacity for manure at times when there is a risk of nitrate leaching and phosphorus being transported to watercourses in surface runoff),
- transporting manure to neighbouring farm,
- slurry separation (the liquid part with lower nutrient concentration can be utilised at the production site),
- composting solid manure (composting uses aerobic microbial metabolism to increase temperatures to inactivate pathogens and to reduce the readily available nitrate content of manures),

- biogas production (biogas production reduces greenhouse gas emissions),
- pelletisation (for easier transportation),
- incineration (poultry litter is used as a fuel for power plants, the resulting ash can be sold as a phosphate and potassium fertiliser).

3. Animal feeding:
- adopting phase feeding of livestock to different growth stages or stages of the reproductive cycle (some stock will receive higher levels of nitrogen and phosphorus than they can utilise efficiently and will excrete the surplus),
- reducing dietary nitrogen and phosphorus intakes (avoiding excess nitrogen and phosphorus in the diet composition of livestock diets can reduce the amount of nitrogen and phosphorus excreted either directly to fields or via manure),
- phytase supplementation (phytase increases the availability of phosphorus in the feed),
- wet feed and fermentation (wetting fed some time before feeding activates phytase, and eliminates the need for mineral phosphorus supplementation).

4. Farm infrastructure:
- establishment of wetlands (wetlands act by intercepting pollutant delivery, providing a buffer zone and can potentially clean up polluted water).

5. Other:
- effective purification of runoff waters,
- systematic on-farm individual advice.

Member States draw up national implementation plans of the HELCOM Baltic Sea Action Plan. The majority of actions listed in the HELCOM Baltic Sea Action Plan are in line with EU Member State obligations as the Community members, international agreements, and membership in international organizations operating in the Baltic Sea region, and therefore the National Implementation Programmes for the HELCOM Baltic Sea Action Plan plans to take advantage of the complementarity and synergy effects of instruments and processes used in river basin areas and the sea. These instruments include the Water Framework Directive, the Nitrates Directive, the Industrial Emissions Directive, Common Agricultural Policy, and the Geneva Convention on long-range transboundary air pollution concerning the control of emissions of nitrogen oxides or their transboundary fluxes of 13 November 1979.

3.3.7 Agenda 21 for the Baltic Sea Region

The Agenda 21 fwas adopted in 1992 at the United Nations Conference on Environmental Development, UNCED, and ratified by 179 countries. The Agenda 21 is a Global Action Plan determining goals and directions for solving worldwide environmental protection problems at the turn of the 21 century, based on the sustainable development principle (eco-development). The idea behind Agenda 21 is to achieve long-term economic development while preserving and protecting the natural resources. Agenda 21 provides a number of recommendations for shaping and protecting the human environment, taking into consideration social, economic and environmental conditions, in order to achieve lasting and sustainable development.

Under Agenda 21, the Agenda 21 for the Baltic Sea Region was adopted by the Council of the Baltic Sea States, CBSS, in 1998. The Baltic Sea region became the first macroregion worldwide to adopt common goals and undertake actions for sustainable development. The Agenda has been implemented through the involvement of Denmark, Estonia, Finland, Island, Lithuania, Latvia, Germany, Norway, Poland, Russia (North-East part of Russia), Sweden and the European Commission.

The Baltic 21 Action Plan is a crucial part of the Agenda, divided into 7 sectors – agriculture, power engineering, fisheries, forestry, industry, tourism, and transportation. Poland is the leading country in the agricultural sector. The Programme for Sustainable Agricultural Sector Development in the Baltic Sea Region was drafted to support implementation of the Agenda in the agricultural sector, and the sustainable agriculture was defined as the production of high quality food and other agricultural products/services in the long run with consideration taken to economy and social structure, in such a way that the resource base of non-renewable and renewable resources is maintained. Important sub-goals are:

- the farmers income should be sufficient to provide a fair standard of living in the agricultural community,
- the farmers should practise environmentally friendly production methods,
- non-renewable resources have to gradually be replaced by renewable resources and that recirculation of non-renewable resources is maximised,
- sustainable agriculture will meet societies needs of food and recreation and preserve the landscape, cultural values and the historical heritage of rural areas and contribute to create stable well developed and secure rural communities,
- the ethical aspects of agricultural production are secured.

The Programme also identifies 9 key assumptions for the agricultural sector:

- reducing dietary nitrogen and phosphorus intake to the Baltic Sea,
- excess ammonia emissions,
- relying on non-renewable natural resources,
- improper use of plant protection products,
- deteriorating fertility of soil,
- reduced welfare of farmed animals,
- greenhouse emissions,
- occupational diseases of farmers, risk associated with genetically modified organisms (GMO),
- deterioration of economic and social conditions in rural areas.

The Programme for Sustainable Agricultural Sector Development in the Baltic Sea Region features 9 action plans which, apart from education for farmers and residents of rural areas and incorporation of the Programme to the State policy on agriculture and environmental protection, are the basic means for implementing Agenda 21 for the Baltic Sea Region. These actions include:

- reduction of nutrient losses from agriculture (most notably by balancing total plant nutrients cycle),
- limiting risk related to the use of plant protection products,
- protection of surface water and groundwater intakes for consumption in rural areas (providing sufficient volumes of tap water for residents of rural areas),
- preserving productivity of agriculture in producing high quality food and feed,
- protection of biodiversity in agricultural ecosystems and the agricultural landscape,
- limiting the use of antibiotics and growth regulators in livestock production, improving animal health,
- development of rural infrastructure and improving quality of life and economic conditions of sustainable production in rural areas,
- development of alternative production on arable land,
- other issues, including recycling, recovery and re-use in agriculture, high food quality, limiting greenhouse gas emissions, transport logistics, etc.

4. RECOMMENDATIONS FOR REDUCTION AND CONTROL OF NUTRIENT RUN-OFF FROM INDUSTRIAL ANIMAL FARMS IN THE BALTIC SEA CATCHMENT AREA

There are methods to prevent negative consequences of industrial livestock production to make it, if not environmentally friendly, neutral to the natural environment. By applying these methods, the intensive livestock industry can come closer to the sustainable agriculture model. The best way to avoid installations with adverse environmental impact, is of course to introduce the sustainable production and practices approach at the planning stage (investment planning and permit process).

4.1 Preventing water and soil pollution

- Full compliance with national and international legal agro-technical requirements for storage and use of natural fertilisers (legally binding Helsinki Convention – Annex III Prevention of pollution from agriculture, EU Industrial Emission Directive – IED) , with a focus on periods when the use of fertilisers is prohibited, field conditions, doses and methods of land spreading, use of fertilisers close to watercourses and water protection zones, volume/area and non-permeability of manure fertiliser storage tanks (minimum storage capacity for no less than 6 months), fertilisation plans including application of nutrient-balanced fertilization.
- Determining application of fertilisers based on nutrient balance (both nitrogen and phosphorus), taking into account nutrient supply to the crops from the soil and nitrogen supply from nitrogen oxides deposition from the air.
- Introduce mandatory requirements to calculate nutrient surplus (for both N and P) per hectare at farm level (preferably as soil/field balance or farm-gate balance), giving possibility to account for balanced fertilization. Develop tolerable national nutrient surplus levels, to be kept as low as possible and never exceed 50 kg N/ha and 2 kg P/ha, as soil/field balance. Do never allow P-fertilization on P-saturated soils.
- Guarantee higher N and P input efficiency of livestock manure via legal standards, to reach full utilization of nutrient content of manure (via analyses) in fertilization practices to avoid over-fertilization.
- Manure shall be spread in a way that minimizes the risk of loss of plant nutrients and shall not be spread on soils that are frozen, water saturated or covered with snow. Manure shall be incorporated as soon as possible after application on bare soils.
- Periods shall be defined on national level when no application is accepted.
- Manure shall only be spread when the plants can utilize nutrients. Manure spreading on bare soils in autumn shall not be allowed, and spreading on growing crops in autumn period should be restricted(when the highest nutrient losses are observed).
- Introduce mandatory national requirements for buffer strips close to watercourses where fertilizers will be spread, for minimum 5-10 meters.
- Executing regular, independent soil monitoring in terms of nitrate contamination for farmland with high load of manure.
- Limiting livestock size (animal density) down to levels that balance available farmland that can be used for spreading manure, to guarantee sustainable-optimal use of produced manure and nutrient-balanced fertilization.
- Classifying large-scale livestock farms, that don't fulfil the requirements of the Annex III to the Helsinki Convention, as point sources of agricultural pollution HELCOM's Hot Spots, to make room for formal recovery programmes to eliminate conditions which were the basis for such classification.
- Promoting methods to limit nutrient runoff to groundwater and surface water (water recirculation – using river/pond nutrient-rich waters for irrigation; nitrogen and phosphorus reduction in biological (bacteria-algae) treatment ponds, re-

moval of soil suspended solid particles in traps/ponds, macrophyte/plant filters, buffer zones along watercourses, filtration ditches, phosphorus removal from surface water using biological coagulation methods.
- Providing effective education system for present-day (professional agricultural advisory services) and future (training teachers and updating curricula in agricultural schools) farmers on environmental impact of agricultural production, including intensive rearing of animals.
- Promoting the conversion from conventional to organic livestock production.
- Increase financial support for low nutrient-surplus agriculture and nutrient-balanced fertilization practices. No CAP-subsidies to intensive farming and industrial animal farming, not fulfilling the requirements of the Annex III to the Helsinki Convention.
- Reduce the import of cheap food for livestock, e.g. soya-proteins, from outside Europe, which create nutrient surplus on European farmland.
- Combine crop production and animal husbandry, thus allowing for nutrients recycling at farm/regional level.

4.2 Preventing air pollution

- Urine and slurry stores shall be covered or handled by a method that efficiently reduces ammonia emissions.
- Biotechnological slurry processing (biological disinfection and sanitisation, mineralisation of organic matter, biological treatment installations, controlled fermentation, use of 'effective microorganisms').
- Use of balanced livestock diet which is easier to digest, adapting feed portions to the actual demand for nutrients (in terms of species, age, production type), adding phytase to prevent over-excretion of nitrogen and phosphorus.
- Promoting production and conversion of agricultural biogas into thermal, electric or mechanical energy (in Poland, for example, with the current production levels of livestock waste, as much as 3.3 Gm3 biogas with average calorific value of 23 MJ/m^3 could be produced).
- Limiting ammonia emissions by ultraviolet radiation, negative air ionisation, mechanical ventilation with recirculation, floor (surface) heating, maintaining optimum litter humidity, as well as microbiological and mineral-organic additive to animal excrements (bentonite, zeolites, humic raw materials – peat and brown coal, microbiological agents based on Lactobacillus and Bacillus strains, saponins) in livestock housings.
- Limiting microbiological contamination of air in livestock buildings (regular disinfection and disinsectisation of livestock housings, ventilation and recirculation filters with disinfecting agents, livestock hygiene).
- Isolation and protection zones (green belts made of selected species of tall and medium trees, and shrubs).
- Use of alternative natural fertilisers processing methods (ashing, thermal gasification of fermentation residues).
- In order to reduce ammonia emissions from animal husbandry, a surplus of nitrogen in the manure should be avoided by adjusting the composition of the diet to the requirements of the individual animal. In poultry production, emissions should be brought down by reducing the moisture content of the manure or by removal of manure to storage outside the housing system as soon as possible.
- Programmes including strategies and measures for reducing ammonia volatilisation from animal husbandry should be developed.
- Urine and slurry stores should be covered or handled by a method that efficiently reduces ammonia emissions.

4.3 Preventing odour pollution

- Use of modern deodoration methods for exhaust gases from intensive livestock farms (biological methods – biofilters and bio-scrubbers, neutralisation).
- Location of new livestock farms far from residential areas, preferably always more than 1 km.
- Implementation of odour air quality standard of European Committee of Standardization (CEN) BS EN 13725:2003 Air quality – Determination of odour concentration by dynamic olfactometry.

4.4 Preventing legislative and legal problems

- Active encouragement of Belarus and Ukraine to ratify the Helsinki Convention.
- Enforce full implementation of the Annex III Criteria and Measures concerning the Prevention of Pollution from Land-based Sources, Part II: Prevention of pollution from Agriculture of the Helsinki Convention and its transposition to the national laws of the contracting parties, especially for nutrient balanced fertilization with Industrial animal farms.
- Implement the upper limit for application of animal fertilisers correspond to 25 kg of phosphorus per hectare annually, as well as a system corresponding to a simplified permit system for farms with more than 100 animal units, in accordance with the Annex III to the Helsinki Convention.
- Effective supervision of intensive livestock industry by public authorities and municipal bodies, including establishment of an effective penalty system.
- Adoption and enforcement well-designed and effective laws and regulations on air quality standards, establishing standards and methods of air quality assessment.

- Facilitating public involvement in the decision-making on location and commissioning of new large-scale livestock farms and introducing changes in operating permits awarded to existing farms (i.e. by unification of the official authorities' webpages, in terms of social consultations, facilitating access to public information and environmental information and its protection, changing the attitudes of public officers to the participation of local communities and NGOs in decision-making, proper implementation of the requirements of the Aarhus Convention).
- Review of Nitrogen Vulnerable Zones (particularly exposed to nitrogen pollution from agricultural sources) by adapting their location and size to the actual vulnerability of waters, based on environmental, hydrological and agricultural criteria.
- Unification of the definition of large-scale livestock farms, by expanding it to include rearing installations designed for all livestock species (cattle, horses, sheep, goats, fallow deer, and fur-bearing animals, apart from poultry and pigs) with livestock size determined by means of unified criteria expressed in LSU. This applies primarily to require an integrated permit for industrial cattle farms, according to the EU Industrial Emissions Directive system.
- Consolidating the legitimacy of the Best Available Techniques (BAT) for intensive livestock production, and making them legally binding while determining the conditions for granting integrated permits and decisions on environmental conditions for investment permits in the EU.
- Popularisation of the idea of Corporate Social Responsibility and the Voluntary Ecological Commitments among the large-scale livestock farm owners and consumers.
- More effective enforcement of voluntary commitments made by large-scale livestock farms under the Rural Development Programme, and making subsidies/preferential loans/public assistance granted by the EU (e.g. European Bank for Reconstruction and Development, EBRD) dependent on meeting the EU environmental protection standards.
- Fertilisation plans shall be publicly available for public monitoring of compliance with fertilisation regulations.
- Training of public officers who deal with environmental assessment procedures; optimisation of environmental assessment procedures and timetables.
- Introduction of environmental permits, to be renewed on regular basis, which will also consider measures, taken to reduce nitrogen and phosphorous content in final discharges in countries which are not members of the European Union and are not a party to the Helsinki Convention.
- Statistical and operational management of large cattle farms according to HELCOM Recommendation 13/7 must finally be performed, e.g. through inclusion in the European Pollutant Release and Transfer Register (E-PRTR) reporting.
- Developing systems of financial support and financial incentives for large-scale livestock farms implementing agro-technical requirements for storage and use of natural fertilisers, especially on voluntary basis.
- Regular updating every year, of the European Pollutant Release and Transfer Register (E-PRTR) reporting for installations on Intensive rearing of animals.
- Recognition of all Industrial animal farms (also those not included in the IE Directive) as Pollution Hot Spots and produce national maps and basic information on such installations to complement the E-PRTR register.
- Not allow for Industrial animal farms in NATURA 2000 areas and remove existing Industrial animal farms from such areas.
- Mandatory permit for installations more than 100 Animal Units (AU), including fulfilment of the requirements from the Annex III to the Helsinki Convention.

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The Baltic Sea catchment basin is a highly urbanized, heavily populated and economically exploited area (14 cities with the population of over 500 thousand). It is a home to over 85 million people (UNEP, 1996), and the population density varies from 19 to 150 people/km^2. The land use structure (UNEP, 1996) is dominated by forests (48% of the total area) and agricultural areas (20%).

The catchment basin (a land area where surface and ground water flow into a single sea) of the Baltic Sea covers the area of 1.720.270 km^2 in 14 countries – Finland, Sweden, Norway, Denmark, Germany, Poland, Lithuania, Latvia, Estonia, Russia, Belarus, Ukraine, Czech Republic, and Slovakia. The catchment area is made up of 14 catchment basins of large rivers flowing across different countries.

The distinctive characteristics of the Baltic Sea (shallow, semi-enclosed, brackish water, coastline diversity, cold climate, heavy traffic, ecological vulnerability, intensive fishery, high recreation value, undiscovered risk from chemical weapons dumped into the Baltic Sea during World War II, low biodiversity, oxygen stratification, limited water exchange with the World Ocean) make it a maritime ecosystem which is unique worldwide, but make the natural water self-purification processes much less effective as compared to open sea and ocean waters. In consideration of the high population density, high industrialisation and intensive agricultural activities in the Baltic Sea catchment area, the Baltic is considered one of the most heavily polluted seas in the world.

In consideration of the foregoing, the International Maritime Organization (IMO) and the United Nations agenda named the Baltic Sea a Particularly Sensitive Sea Area (PSSA). A Particularly Sensitive Sea Area (PSSA) is an area that needs special protection because of its significance for recognized ecological, cultural, socio-economic or scientific reasons and which may be vulnerable to damage by international maritime activities (the volume of maritime traffic in the Baltic Sea is one of the highest in the world). The Baltic Sea is counted among the most precious and most environmentally vulnerable sea ecosystems in the world, among the Galapagos Islands, the Great Barrier Reef, and the Canary Islands.

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