A Greener Agriculture for a Bluer Baltic Sea 2013

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Submitted ABSTRACTS
(in alphabetical order)

Profitability and repayment period of investment in slurry separation
Two calculation examples for the demonstration farm, Brændegård

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With input and calculations from specialist adviser, Erik Maegaard, Knowledge Centre for Agriculture, crop adviser Carsten Mouridsen, the agricultural advisory service of Bornholm, and Baltic Deal farmer, Karsten Westh, Brændegård.

For Danish farmers, fertilisation is subject to restrictive legislation setting an upper limit for the amount of nitrogen the farmer is allowed to apply per ha. In Denmark the calculated upper limit lies below the economical optimum for nitrogen application, so extra N would have a relatively large effect on the yield in Denmark.
In the total calculation of the maximum amount of nitrogen the farmers are allowed to apply, they have to utilise 75% of the nitrogen content of their pig slurry and calculate this into the fertiliser plan. In reality, the utilisation of nitrogen in pig manure is maybe only around 60% some years because of bad weather conditions like drought and wind. Other years the utilisation may be more than 75% because of rainfall and calm weather after application of the slurry.
The farmers are interested in utilising the slurry in the best possible way, as lost nutrients are bad both for the environment and for the farmer's economy.
At slurry separation, slurry is separated in slurry fibers and separated slurry (reject water). Separated slurry also has to be utilised by 75% in the statutory calculation. However, in practice the farmer often get a better effect from separated slurry because it penetrates faster into the soil, and there is less evaporation. Furthermore, the separated slurry contains a higher concentration of ammonium nitrogen.
In the profitability calculations you can see that the utilisation rate of raw slurry and separated slurry differs significantly. We lack knowledge about the actual utilisation rates in raw slurry and separated slurry under practical conditions at the farms and hopefully farmtest etc. will be able to bring us this knowledge in the future.
The two calculation examples presented are based on data from the demonstration farm "Brændegaard" by/ Karsten Westh. The repayment period is defined as the number of years it will be before the investment will breakeven, and at a difference of 30% in utilisation this makes 3.78 years. The repayment period is, with a difference of 15% in utilisation, 15.13 years.
Investments in slurry separation can be a good, but also a very bad decision at a farm, as shown in the examples. Therefore, calculation has to be made with the economic parameters from the actual farm in the actual country. It shows, that cost – benefit analyses, profitability and repayment period are important key factors in agro environmental decision making.

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Innovative manure handling technologies - Agro Technology ATLAS

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AgroTechnologyATLAS was established as a platform to facilitate exchange of science-based information about innovative agro-environmental technologies in the Baltic Sea Region. Legally, the role of the ATLAS is linked to especially EU's Industrial Emissions Directive (75/2010/EU) as well as other EU and national agro-environmental legislation. The ATLAS is a web-based platform, found at http://agro-technology-atlas.eu. It holds today information about 58 agro-environmental technologies, divided in 11 groups; it contains about 300 datasets of seven different types of organic material and biomasses, such as end-and byproducts from manure processing; five tools are available, such as a pre-feasibility calculation tool for biogas plants. About 300 users are registered at the ATLAS, and received around four times per year an electronic newsletter, a newsletter which also servers the function of being a Baltic Compact information channel; and a wealth of scientific reports and other information can be found at the ATLAS.
Agro-environmental technologies are on the ATLAS defined as those primarily having relation to agriculture and livestock production in EUs Nitrates Directive (91/676/EC), Water Framework Directive (2000/60/EC) and Industrial Emissions Directive (2010/75/EC). The technologies include as well some Best Available Techniques, as defined in the Reference Document on Intensive Rearing of Poultry and Pigs as found at http://eippcb.jrc.ec.europa.eu/reference/.
The ATLAS builds on the believe that access to trustworthy information is a fundamental enhancer for investments in the technologies, and that this likewise is prerequisite for the authorities' ability to appraise farms' environmental permit applications in a justified and professional manner. Such information is typically rather expensive to produce; a technology verification, such as a VERA Verification Statement, would typically cost more than € 50,000, and the information is in many cases transferable to neighbor countries with similar climate conditions, also because livestock production systems, and farming systems in general, are rather similar among countries in the macro-region, especially for the large farms with intensive production. There is therefore every good reason for sharing the already produced and existing information and the role of the ATLAS is simply to structure this information and make it easily accessible.
The information on the ATLAS is currently much based on the DG ENV financed project "Manure processing activities in Europe", as well as maintenance undertaken by Baltic COMPASS, Baltic Compact and Baltic Manure. The VERA secretariat, which builds on a cooperation between German, Dutch and Danish authorities, maintains the ATLAS with information about new VERA Verification Statements. The current challenge for the ATLAS is to expand and further share the recognition and use, and we are for this purpose looking for the possibility to establish a steering committee of users and information providers representing research and authorities.

A Greener Agriculture in Finland – possibilities now and in the future

Toni Haapakoski, Agrologist, Saarijärvi, middle Finland

Questions and facts to be discussed:

- How we can transfer environmental knowledge inside the farm management?
- A greener farming needs investments – payback time is long.
- Invests of environmentally friendly farming can be economical.
- Small steps in farm level => big affects in the water systems.
- The most important thing to better future => Own activity in finding solutions

Opinions of agriculture must be changed. Groupwork ⇔ Discussions!

The perfect match – P fertiliser demand and P fertiliser rates

Silvia Haneklaus, Judith Schick and Ewald Schnug, Institute for Crop and Soil Science, Federal Research Institute for Cultivated Plants, silvia.haneklaus@jki.bund.de

Global P reserves are limited while utilisation of farmyard manure based on nutrient demand is regularly critical on big livestock units. The fertiliser rate is usually calculated as the difference between natural supply by soils and environment and the nutrient demand of the crop plus inevitable losses to the environment.
Sustainability can be achieved only if nutrient losses are minimised whilst crop productivity and economic profits are maximised. Then resources will be saved, environmental burdens reduced and a positive contribution to the income of the farmer be made. Local Knowledge enables farmers to operate a site-specific nutrient management on all scales. The farmer himself becomes the biological interface between his fields and machinery. This procedure is certainly limited to an upper farm size. Then Precision Agriculture technologies need to be implemented.
In this presentation requirements for site-specific nutrient management with a special view to P will be defined, algorithms for variable rate fertilisation introduced and standards for commercial and recycled fertiliser products specified.

Controlled drainage and other SCIEN drainage technologies - results from Hofmansgave pilot project

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SCIEN drainage stands for technologies, which make drainage sustainable, controlled, intelligent, and environmentally friendly, and which can also mitigate the loss of nutrients. Research and demonstration activities have been initiated in Denmark in order to investigate controlled drainage as a measure to reduce the outlet of nitrogen to the aquatic environment.
In 2012 four research and demonstrations sites were set up. One of them was at the Hofmansgave Estate. Different soil types and drainage systems are represented. Controlled drainage has not previously been tested in Denmark. According to literature the effects of controlled drainage in combination with spring sown crops are quite well known. Controlled drainage will in this project be tested in a winter wheat cropping system.
Controlled drainage is considered to be an alternative measure to catch crops and/or reduced nitrogen quotas in order to meet the goals of the Water Framework Directive. Before controlled drainage can be implemented in Danish agriculture as a recognized nitrogen measure several questions have to be answered, including effects on crop production, root growth, greenhouse gas emissions, drainage system and losses of nitrogen and phosphorous under Danish crop growing conditions.
Controlled drainage can also be used in combination with riparian buffer zones and constructed wetlands in order to level out the outflow of drainage water and thereby increasing the effect on nitrogen reduction.

Systems perspectives in nutrient management

Mats Johansson, Systems ecologist, Senior Partner, Ecoloop

Improving the management of the flows of nutrients is important to help protecting the environment, climate and human health, and it is also strongly linked to food and energy security. The nutrient management in the Baltic Sea Region as a whole can and should be seen in a wider systems perspective.
General recommendations for improving nutrient management on farm level or in a agricultural system: I) avoid excess input of nutrients and increase reuse of nutrients from other flows in the society, II) reuse nutrients on the farm / within the agricultural system, III) reduce the emissions from the farm to water and air.
These recommendations are unfortunately not applied on catchment or municipal level and very little used when governing nutrient flows on national or transnational scales. To move towards a sustainable nutrient management we need to develop a mix of policy instruments and activities.
To get this in place national and even trans-national policy measures of nutrient flows need to be developed including to:

I) create a platform on national level for actors to discuss and develop policy for sustainable nutrient management,
II) develop models to describe nutrient flows and the nutrient economy
III) identify efficient policy activities and instruments on municipal, national and transnational level.

Can agro-ecological food production systems deliver food security?

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The presentation will review recent scientific studies into the problem of increasing dependency and rapidly rising costs of non-renewable/limited resources (energy, water, mineral fertilisers) used as inputs and decreasing resource use efficiency in European and global agricultural production.
It will also highlight links between increasing mineral N and P input use and negative environmental impacts including
(a) nitrate and phosphorus pollution of aquatic ecosystems and
(b) greenhouse gas emissions from agriculture.
Agri-ecological approaches (e.g. organic matter/waste recycling, utilization of biological N-fixation and breeding for resource use efficiency) that can address these food security challenges will be discussed.

Biogas – energy and nutrient solutions

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Biogas production has usually been seen as a means of renewable energy production. According to the estimations made in the project Baltic Manure, nearly 190 million tons of manure is annually produced in the BSR.
The manure holds a theoretical energy potential of 38 – 74 TWh/a as biogas, while leaving out small farms converts it into a techno-economical potential of 17 - 35 TWh/a. The potential is significant and could be easily increased with co-digestion of manure and other suitable biomasses.
Recently, also other important effects of manure based biogas, such as nutrient recycling and emission mitigation have been gaining more due attention. However, to do all this in the most efficient and environmentally friendly way requires knowhow in all steps of the manure management chain, not just in the biogas plant. As importantly, to harness the positive effects targeted incentives are essential.
In this presentation, the potential of manure based biogas will be elaborated for the BSR and some important recommendations given for farmers, companies and policy / decision makers.

Safety aspects of recycled fertilizer products

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Nutrient recycling is needed to save limited phosphorus resources and energy required to produce nitrogen fertilizers. Nutrient's sources for recycling are often waste based materials like biowastes, industrial by-products, sewage sludge or animal manure. These may contain different impurities which may be in conflict with the use of these materials as nutrient sources. Impurities of concern are, for example, pathogenic microbes, hazardous organic chemicals and heavy metals. Some of these impurities can be removed or inactivated in waste treatment processes, but some of them may still remain in the end product to be used for fertilization. Biogas technology has proven to be a competitive and sustainable process for waste treatment and renewable energy production allowing also nutrient recycling. In order to promote utilization of digestates from biogas plants as fertilizers, additional information on their quality and environmental impacts is needed.

The presentation will summarize the results of two projects where digestates from biogas plants have been studied with a view to their phytotoxicity, content of hazardous organic chemicals, and survival of pathogens. The results deliver relevant information about the characteristics and applicability of digestates for producers and users.

Digestates did not unfold significant phytotoxic effects when rates were applied to satisfy the nutrient demand of the crop. Pathogenic microbes were regularly found in original waste products used for fermentation, but removed efficiently during processing so that legal requirements were met. Various hazardous organic chemicals originating from households, industry and municipal sewage treatment plants were present in digestates. In hazard assessment, however, they did not indicate an immediate hazard to the safety of foodstuffs. However, efforts should be made to reduce the amount of harmful chemicals and pharmaceuticals in wastewater and organic wastes so that environmental chemical loading is reduced.

Based on the results of our case studies, properly treated biogas plant digestates may be considered safe fertilizers.

Balancing global needs, intensive agriculture and the environment

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The world is facing a great challenge when it comes to feeding its growing population. At the same time, increasing economic wealth gives rise to a growing demand for meat products, which puts further pressure on future food security. A growing political focus on a healthy environment is emerging, resulting in restrictions on the output of nutrients and an increasing use of sustainable production practices.

In Denmark, we have come a long way towards implementing sustainable production. However restrictions on the use of fertilizer are very expensive due to lowered quantity and quality of products. Therefore, new ways to ensure a healthy ecosystem must be explored. We believe that the answer is sustainable intensive production, targeted measures and the use of a holistic approach. Intensive production will increase the yield without increasing the production area and at the same time provide food security. In order to minimize loss of production, it is important to take action first at the recipient water body, next at the edge of the arable land and finally – if necessary – at the arable land.

Targeted measures are important in order to avoid expensive over-implementation and unnecessary costly restrictions. Furthermore, the cost-effectiveness of measures must be evaluated in the planning phase. Areas with of a low output of nutrients or robust recipients should have no or fewer restrictions in order to optimize production.

A holistic approach is crucial because it takes all the ecosystem stressors into account. For example, factors such as fishing, mussel dredging, mining and sewage overflow can have a devastating impact on the marine environment and must therefore also be considered along with agriculture.

How to retrieve nutrients from organic wastes

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Nutrient recovery from organic waste materials is technologically highly demanding and with view to the limited global rock phosphate reserves and increasing prices of mineral fertilisers, the use of P from secondary raw materials is of special interest. Thus, recycled fertiliser products, for instance on basis of farmyard manure, sewage sludge ashes or slaughter wastes will play a major role in closing the P cycle on farms. However, since these materials do not only contain valuable nutrients but also organic and inorganic pollutants it has to be ensured that the final recycling product is free from xenobiotics and human-toxicologically relevant pathogens. In addition, the heavy metal content must not lead to an accumulation in soils.
The presentation introduces several approaches how to recover nutrients from different secondary raw materials such as sewage sludge, sewage sludge ashes and manure and highlights the value of the recycling products in terms of their agronomic efficiency with special focus on P and safety concerning the content of organic and inorganic pollutants.

The P-resource, status and opportunities for agriculture

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The presentation introduces the essential role of P for all life and the potential risk for a "peak P" scenario to develop, in which scarcity will limit availability of the P-resource.
Key global as well as regional drivers for increased P demand and the current knowledge about reserves, extraction rates and new mine developments are presented and an assessment of possible time-frames for peak P is given. I will outline why a radical change in our societal P management is needed irrespective of whether peak P is looming or not, from unidirectional to circular. Potential pathways and opportunities for this to happen will be illustrated, including both agricultural, industrial and public sectors.
Main messages will be to use less P and more efficiently, to increase recycling of P from main waste streams, and to cooperate between agricultural, industrial and urban sectors to achieve this.

Recommendations to improve manure handling in the Baltic Sea Region
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The Baltic Sea is polluted by excess nutrients, leading to algae blooms and 'dead' sea bottom. Some nutrients derive from agriculture, via air and water runoff. The loss of nutrients is often related to intensive animal husbandry, where many nutrients are at stake. One of the ways to a cleaner Baltic Sea is through better manure handling from animal husbandry to reduce emissions to air and leaching to water bodies. Manure handling is part of the whole agricultural system and meat production is a basic human economic and cultural activity in the BSR. Therefore, the solutions should be environmentally sound, socially acceptable and economically attractive. The project Baltic Manure has coined out the following key recommendations for what can/should be done and we give the reasoning behind each recommendation.
Basically, we recommend that the animal husbandry improves the use and recirculation of nutrient within the agricultural system. This can be stimulated by regulations (e.g. manure data, manure norms or quality criteria) and incentives at international and national levels. Also, the farmers themselves and the advisory system can support and deploy the best solutions in practical farming life.
The agreed preliminary recommendations from the different workpackages in Baltic Manure will be presented. Each farm and animal type have different needs, but the solutions to optimize manure handling should be seen in the recirculation concept as part of the agricultural food production system to meet societal needs for clean environment, food, energy and economic development. With these recommendations, Baltic Manure contributes to a Greener Agriculture and a Bluer Baltic Sea.

Environmentally preferable 2-stage channels: results from the Ritobäcken Brook

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Two-stage channels consisting of a main channel and a vegetated floodplain are recommended by the authorities as an environmentally preferable alternative to conventional drainage channels. Experimental data on the flow, erosion, deposition, and transport processes of e.g. fine sediment and nutrients in two-stage channels are scarce, and our research is intended to aid in designing and managing environmental channels. The results of the presentation are based on a three-year experimental program conducted in the Ritobäcken Brook (in Finland) where a two-stage profile was constructed in February 2010.

The properties of the floodplain vegetation were a key factor controlling the processes in the two-stage channel. For instance, 0.5 m high vegetation produced up to 3 times higher flow resistance and one third lower mean flow velocity than 0.1 m high vegetation. The effect of the vegetation on the flow could be predicted with simple vegetation properties, such as the cross-sectional coverage.

The properties of the vegetation, e.g. the height and inundated mass, were related to the magnitude of sediment erosion and deposition, with denser and taller vegetation producing more deposition. Approximately 4% of the annual suspended sediment load deposited on the 200 m long floodplain reach, with most of the deposited matter consisting of flocculated clay and silt. The concentration of the total phosphorus was directly proportional to the suspended sediment concentration, suggesting that also some phosphorus was trapped on the floodplain.

In conclusion, our investigations revealed the potential for managing channel vegetation according to different objectives, such as controlling the flow velocity, preventing erosion, or enhancing the trapping of sediment and phosphorus.

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