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Policy Brief

Baltic Sea Centre | Stockholm University

Nutrient recycling in agriculture – for a cleaner Baltic Sea

Agriculture is a large source of nutrients to the Baltic Sea. Only about half of the nutrients in fertiliser and manure are converted to harvested crops. Nutrient use efficiency must improve.

Human inputs of nitrogen and phosphorus to the Baltic Sea are responsible for the eutrophication that is apparent in algal blooms, reduced water clarity, changes in species composition, and reduced oxygen concentrations in bottom waters. Together, these environmental stressors limit opportunities for people to enjoy the sea. The Baltic Sea is particularly sensitive to eutrophication because of limited exchange of water with the North Sea.

Agriculture is the single largest source of new nutrients to the Baltic Sea, contributing about half of total waterborne nitrogen and phosphorus inputs. A major portion of mineral fertiliser and livestock feed that is imported to the catchment is transformed into manure; however, the nutrients in manure are often not used efficiently in crop production. This inefficiency can result in the accumulation of nutrients in agricultural soils and increase the risk of losses to lakes, streams, and the Baltic Sea.

There is potential to reduce these nutrient losses by improving manure management and replacing imported mineral fertilisers with manure. Reducing the import of livestock feed and the number of animals in regions with high densities can also reduce agricultural nutrient surpluses.

This policy brief presents research regarding agricultural nutrient flows for the whole Baltic Sea catchment in the context of eutrophication.

Increased nutrient recycling and reduced inputs of new nutrients, for example fertilisers and feed, contributes to reducing nutrient losses from agriculture.

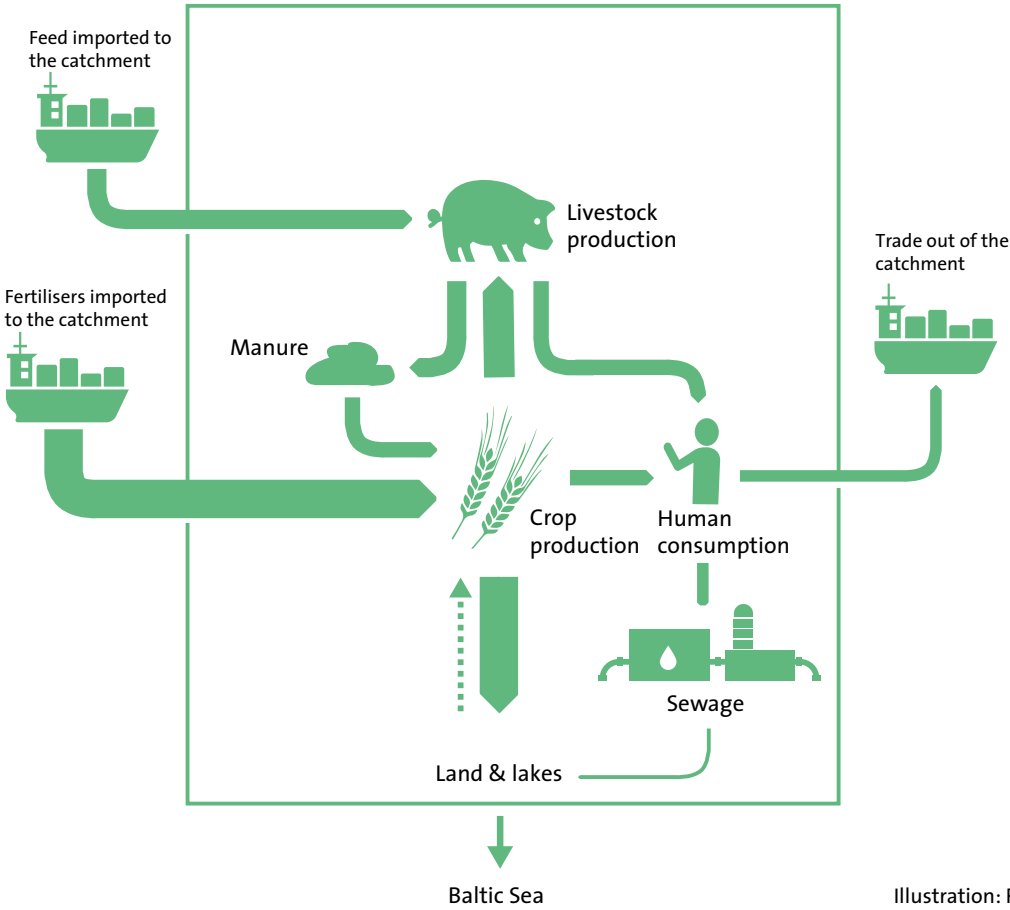


Illustration: Robert Kautsky/Azote

Within the agricultural system, nitrogen and phosphorus from imported fertilisers and feed are transformed to manure, feed, and food products. A large portion of nutrients moves through the livestock sector. Only about half of the nutrients in fertiliser and manure are converted to harvested crops. Excess nutrients can be stored in soils or leak to lakes, streams, and the Baltic Sea. The relative magnitude of nutrient flows is shown by the arrow widths. Sources: Baltic Eye compilation of data from Eurostat, the Russian Federation Federal State Statistical Service, and Belarusinfo.

The state of the Baltic Sea

Progress has been made in reducing nutrient inputs to the Baltic Sea. Since 1995, nitrogen inputs have decreased by 17 % and phosphorus by 20 % according to Helcom. After nutrient inputs are reduced, it will take time before there are noticeable improvements. Although the eutrophication status of most parts of the Baltic Sea is still poor, improvement is nowadays seen in some large areas, such as the Eastern Gulf of Finland, Kattegat, and Danish Straits. It took decades for the sea to become eutrophic and it will take decades for it to recover. However, reducing nutrient leakage on land will not only benefit the sea, but also lakes, rivers, and groundwater.

Nutrient flows in agriculture

Nitrogen and phosphorus are essential nutrients for crop production. Fertilisers boost crop growth and replace nutrients that are removed from soils by crop harvest. Some nutrients are lost from agricultural soils by surface runoff or by water moving through the soil and transported to surface waters, eventually reaching the Baltic Sea.

In an efficient agricultural system, nutrients circulate in the system and losses are small. Unfortunately, agricultural systems are often far from efficient because of dependence on imported nutrients in livestock feed and mineral fertilisers and because of losses of nutrients that degrade the aquatic environment. This is far from a sustainable system.

Mineral fertilisers and feed imports represent most of the new nutrients brought into the Baltic Sea region through trade. Nutrient flows in the livestock sector are especially large. About 70% of crop production is fed to animals, while only 30% of crop productions are consumed directly by people. The 23 million pigs, 16 million cows, and 244 million chickens in the region produce manure containing 2 million tons of nitrogen and 0,4 million tons of phosphorus per year – about three times the amounts in human sewage. Most of the manure is used in agriculture, but it can be used more efficiently.

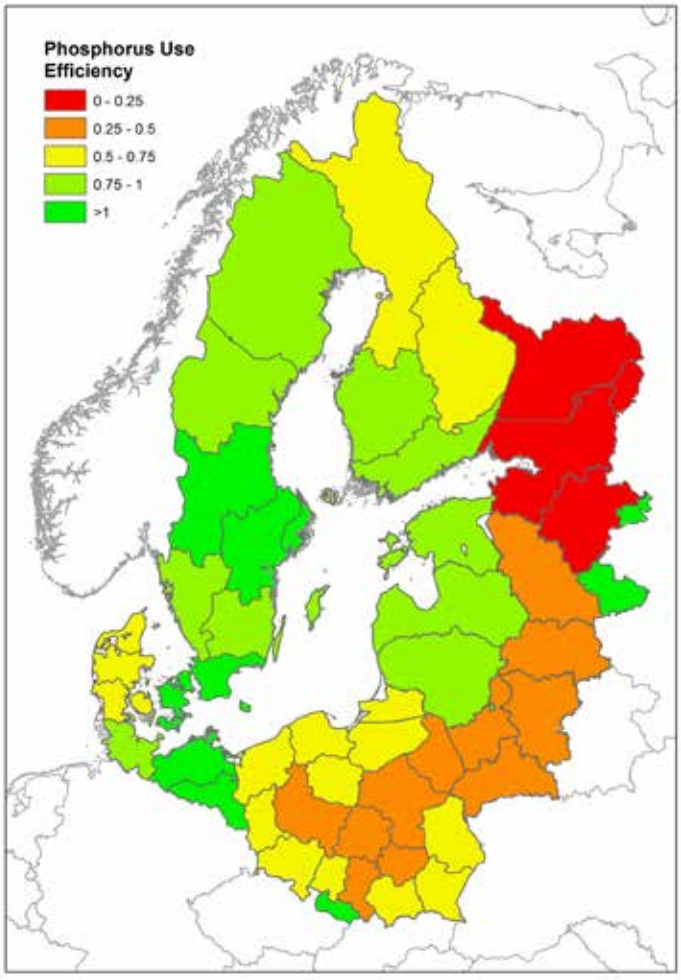
Nutrient Use Efficiency in agriculture (NUE)

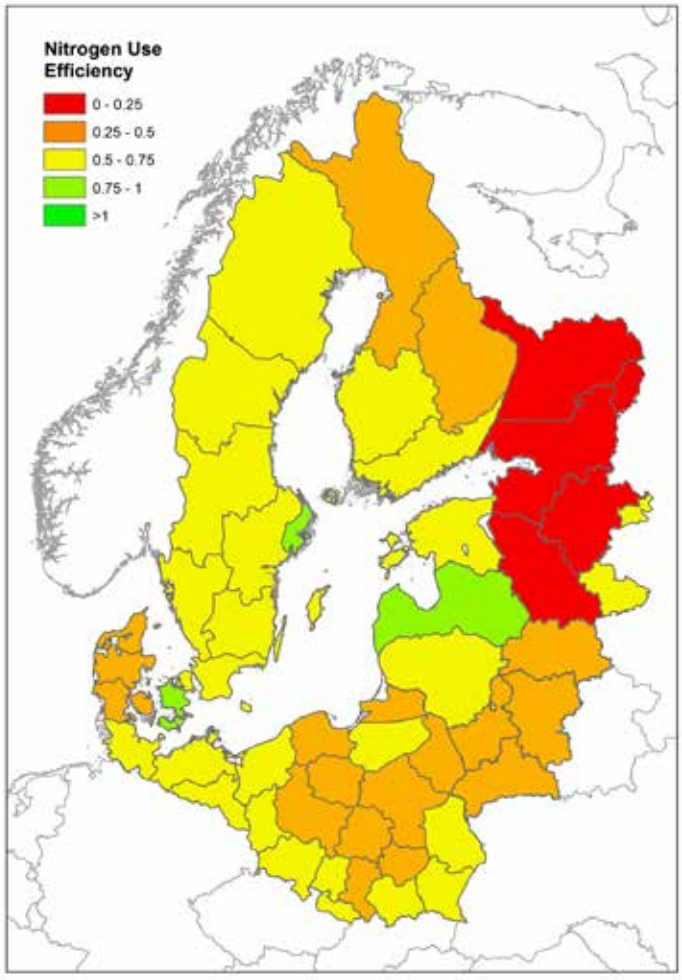
Efficiency is the effectiveness of the conversion of “inputs” to “outputs”. In the case of crops, nutrient use efficiency is the ratio of nitrogen and phosphorus in crops (outputs) to nitrogen and phosphorus in mineral fertiliser and livestock manure (inputs). Agricultural systems will never be perfectly efficient because of unavoidable nutrient losses. Nitrogen is especially susceptible to losses because it can escape as a gas. But in the Baltic Sea region, there is room for improvement: an average of only 43% of nitrogen and 62% of phosphorus in mineral fertilisers and manure are converted to harvested crops.

Nutrient use efficiency for crops varies greatly between and within countries in the Baltic Sea region and has generally improved in the past decade, with some exceptions.

In regions that import livestock feed and produce manure in excess of what crops need, manure often becomes a problematic waste product, not a resource. These excesses cause nutrient imbalances and increase the risk of losses to the aquatic environment. There is opportunity for agricultural systems in the Baltic Sea region to adopt the principles of the circular economy – and close the nutrient cycle – by using manure more efficiently to substitute for imported mineral fertilisers.

Recycling and increased NUE is especially important in the case of phosphorus, because mineral phosphorus fertilisers derive from phosphate rock, which is energy intensive to mine, brings toxic cadmium into the agricultural system, and often comes from politically unstable regions. The European Commission has added phosphate rock to the list of 20 Critical Raw Materials, for which supply security is at risk and economic importance is high. However, production of nitrogen fertilisers is also energy intensive and increasing NUE for nitrogen is also important.





Nutrient use efficiency (for years 2008 - 2012) varies across the Baltic Sea catchment and there is room for improvement. Values greater than one suggest that soil nutrient reserves are being used or crops are under-fertilised. Sources: Baltic Eye compilation of data from Eurostat, the Russian Federation Federal State Statistical Service, and Belarusinfo.

Photo: Bengt Ekberg/Azote

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POLICY RECOMMENDATIONS TO IMPROVE NUTRIENT USE EFFICIENCY (NUE)

Both short- and long-term actions are needed to improve NUE in agriculture. It is essential, however, that short-term strategies do not counteract long-term ones or are seen as replacements. Therefore, actions to reduce problems with large nutrient surpluses, such as manure trading, should be combined with reductions of livestock numbers in areas with high densities. Otherwise, manure transport and trading would treat the "symptoms" instead of the "cause" and have the effect of preserving or strengthening inefficient farm structures that lead to nutrient imbalances.

Policy instruments supporting increased NUE are:

- The circular economy promotes more efficient use of nutrients. The proposed EU regulation on fertiliser trade can become an important tool for recycling available nutrients, closing the nutrient cycle, and reducing the input of new nitrogen and phosphorus sources.
- The reform of the Common Agricultural Policy, CAP, should promote livestock production that balances animal density with agricultural land and produces a greater proportion of the feed locally in order to optimise manure handling and reduce the risk of nutrient losses. This could be achieved by reducing income support (Pillar I) and increase payments for public goods, for instance, via the Rural Development Programme (Pillar II).
- Rural Development Programmes should also:
  Support farm investment for improved storage, handling, and transport of manure;
  Support education of farm advisors and farmers about nutrient management;
  Require nutrient balances at farm/field level.
- EU member states should fully implement EU Water Framework Directive, specifically by adopting river basin management plans that meet the HELCOM Baltic Sea Action Plan.
- Under the Nitrates Directive, member states should designate nitrate vulnerable zones and adopt nutrient management practices that are adequate to reduce nitrogen losses.

BALTIC EYE – BRIDGING THE GAP BETWEEN SCIENCE AND POLICY

This policy brief is produced by Baltic Eye, a part of the Baltic Sea Centre at Stockholm University.

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We analyse and synthesise scientific research on the Baltic Sea and communicate it to stakeholders in the decision-making process.

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