POLICY BRIEF NO. 4

MANURE HANDLING AND EUTROPHICATION IN THE BALTIC SEA

Improved handling of manure, including storage, improved spreading equipment and timing, have potential to reduce nitrogen surplus from agriculture around the Baltic Sea, and to reduce the nitrogen loads to the Baltic Sea Basins. The effects from the nitrogen load reductions are more modest when it comes to the resulting changes in Dissolved Nitrogen during winter, but effects can be seen in Gulf of Riga and the Bothnian Bay. The simulations are performed by integrating an agricultural sector model CAPRI, a model for the changes in leaching and nitrogen transport and the loads to the sea, and finally the marine model BALTSEM. The findings might be relevant for update of the Baltic Sea Action Plan and the revisions of the EU common agricultural policy (CAP).

MANURE HANDLING PRACTICES AROUND THE BALTIC SEA

Manure handling practices and technologies vary a lot among farms across the Baltic Sea region, due to differences in farming structure and regulations.

- Sufficient storage capacity is important for farmers to be able to apply manure on fields during the period when the crops grow and utilize the nutrients from the manure most effectively. The best period is spring and early summer. The current capacity requirements differ between 6 months in Poland and Latvia, to 12 months in Finland. Data are scarce documenting current variations in capacities between regions and farm types, but from the storage capacity requirements we can conclude that there are options for improvements to facilitate a better utilization.
- The type of slurry also affects the ability to utilize the nutrients. While the share of slurry is 80% in Denmark, this share is 5-10% in Poland. Overall, nearly 50% of the manure in the Baltic Sea region is solid manure. Solid manure cannot be efficiently spread by injectors or hoses. This means that if the share of liquid manure (slurry) is increased it is possible to spread manure with injectors to the crops where this type of application is feasible. And if the storage capacity is increased it is possible to spread the manure in periods of the year when the crops are growing and utilizing the nutrient best.

SCENARIOS FOR IMPROVED MANURE UTILIZATION ACROSS ALL BALTIC SEA COUNTRIES

In BONUS GO4BALTIC we have used a cascade of models to simulate how improved manure utilization affects the nutrient loads to the sea and the resulting effects in the Baltic Sea basins.

Denmark is currently at the forefront in manure handling. We simulate investments in manure utilization technologies that assume that the present manure management in Denmark also will take place in the other 8 countries. The investments are of course highest in countries where (i) manure makes up a substantial part of total N input, and (ii) where the present manure storage and handling need to be improved. This means that nutrient load reductions from improved manure utilization are larger in areas with low nitrogen utilization and high animal density.

We call the scenario *modernization of the manure handling and spreading in the Baltic Sea region,* and we simulate these changes:

- The share of liquid manure is increased to more than 75%.
- All manure is stored in facilities with more than 9 months capacity, facilitating spreading of manure during spring and early summer.
- All liquid manure is spread using injection technology
- At the same time the greening requirement is removed.

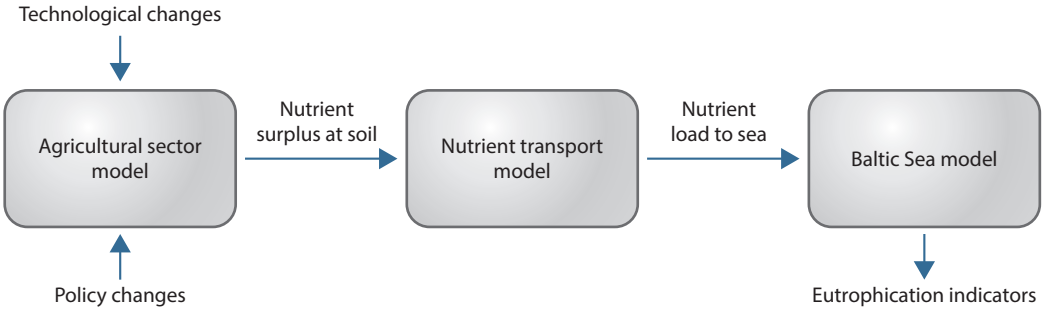

Figure 1. Model chain.

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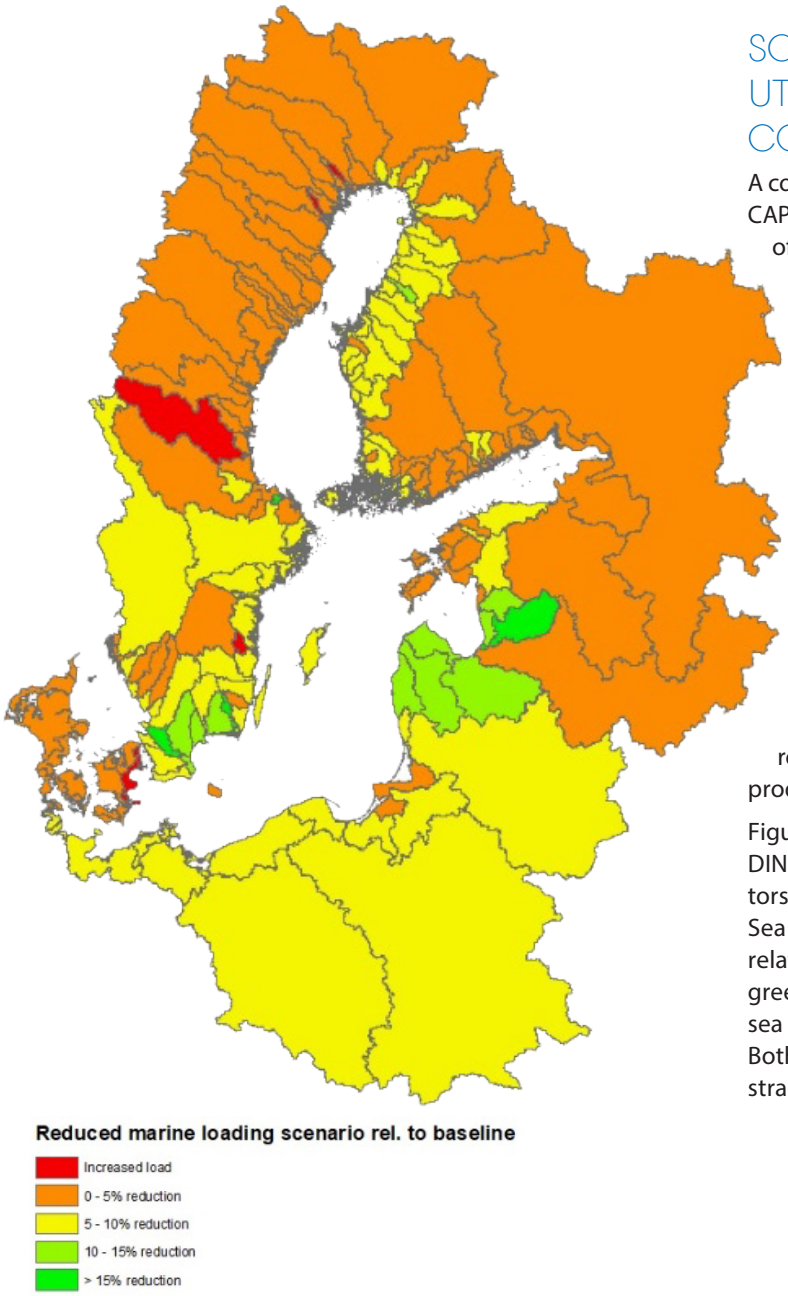

Figure 2. Relative change in N loading to the Baltic Sea from increased manure utilization.

The scenario implies large investments in storage capacity, spreading technologies and changes in handling the manure in the barns. Our suggestion is that the subsidies spent for the CAP greening requirement could be used for this type of modernization. The simulations therefore include removal of the greening requirement to be able to judge the effect of this requirement on the nutrient loads to the Baltic Sea basins. Thorough decomposition of the parts of the simulation scenario has been done, and this decomposition shows that removing the greening had no effect on the nitrogen loads to the sea basins.

SCENARIOS FOR IMPROVED MANURE UTILIZATION ACROSS ALL BALTIC SEA COUNTRIES

A combined model system, linking the agricultural sector model CAPRI, to leaching and marine models, is used to assess the effects of improved utilization of animal manure on eutrophication of the Baltic Sea environment, using the model BALTSEM.

REDUCED MARINE LOADING OF NITROGEN AND RESULTS IN THE SEA

Results of modelling with the integrated model system presented in figure 1 indicate that an improvement of manure utilization can reduce Nitrogen loads to the Baltic Sea by 7.4%, with an uneven distribution between the littoral countries. The distribution can be seen from the map in figure 2. The reductions in nitrogen loads will be highest in the areas marked as green in the map (more than 10% reduction), while the loads are reduced between 5 and 10% in the yellow areas. The reduction will be less than 5% in the brown areas, and in the red area the load will increase. This result might be explained by unintended changes in livestock production in the model.

Figure 3 shows how the changes in nitrogen loads changes the DIN (dissolved nitrogen) during winter. This is one of the indicators used for the evaluation of eutrophication in HELCOM's Baltic Sea Action Plan. The changes in DIN are measured as changes relative to baseline, i.e. current manure handling and with the greening requirement. The changes are measured for the seven sea basins (mentioned from North to South-West): Bothnian Bay, Bothnian Sea, Baltic proper, Gulf of Finland, Gulf of Riga, Danish straits and Kattegat. Largest changes in DIN will be achieved in

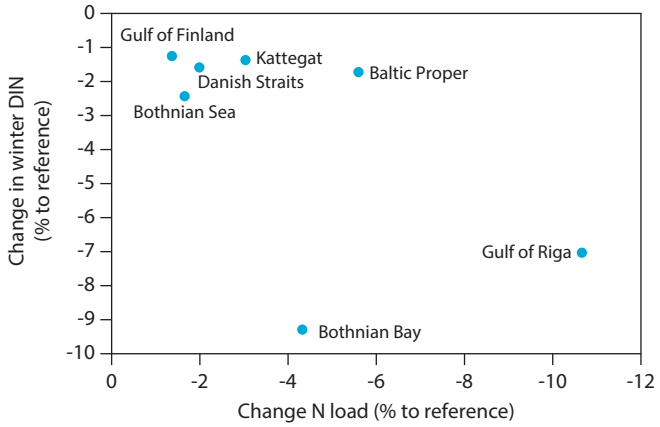

Figure 3. Changes (% to baseline) in total N-loads per Baltic Sea basin and resulting change in winter DIN concentration (% to baseline).

the Bothnian Bay and Gulf of Riga. The changes in the Gulf of Riga can be explained by the relatively large change in nitrogen load (more than 10%), which can also be seen from Figure 2 , while the change in N loads in the Bothnian Bay are much smaller. In the Baltic Proper the change in loads is close to 6%, and the resulting change in DIN about 1.5%.

RECOMMENDATIONS

- Measures that reduce fertilization rates and improve manure utilization can lead to reductions of nitrogen loads to the Baltic Sea. The effects will not solve the eutrophication problem however, as the effects are modest in most of the sea basins. But the effect on the nutrient loads show, that changes in manure handling will affect the nitrogen loads in the right direction, being important for the achievement of the Baltic Sea Action Plan.
- Experiences from Denmark, where similar measures have been compulsory, support that requirements of improved manure handling are manageable, and increased utilization leads to saved fertilizer costs.
- Greening requirements in the CAP has shown to be of modest effect on nutrient management, and we recommend that greening is substituted with more focused regulations and requirements. This recommendation might fit into the ongoing changes in the CAP. We have however not assessed the effects on biodiversity of this change.

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This policy brief disseminate results from the **BONUS Go4Baltic** project (2015-2018). The aim of the project is to

- provide policy relevant advice and recommendations for reductions of the eutrophication in the Baltic Sea in coherence with climate and agricultural policies
- examine national and international environmental and agricultural policies across the Baltic countries, to analyze and propose cost-effective solutions
- point at coherence and conflicts between the policies.

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