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# Environmental Challenges in the Baltic Region: An Introduction

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The Baltic Sea is one of the largest semi-enclosed bodies of brackish water in the world. Nine countries (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden) with a population of over 90 million share the sea (Ahtiainen et al. 2014). Its geography, climatology and oceanography have great political, social, economic and cultural significance for the people in Baltic Europe and its importance has grown as the Baltic states have become a part of the European Union (HELCOM 2010). The sea is shallow and, being an almost entirely landlocked body of water, receives a considerable load of pollutants from surrounding countries. The severe environmental impact of human activities is altering the marine ecosystem, depleting renewable

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resources beyond safe biological limits, and jeopardizing the future use of the Baltic ecosystem goods and services (HELCOM 2007, 2010).

In most parts of the Baltic Sea, major concerns are related to its eutrophication (caused by nutrient pollution), hypoxia (low oxygen), hazardous substances, oil spills, invasive species, marine litter and subsequent changes in flora and fauna (Tynkkynen et al. 2014; Elofsson 2003; Conley et al. 2009; Ahlvik and Pavlova 2013). An increase in the inflow of nutrients into the sea from agriculture, wastewater, industry and traffic has led to growth in organic production considerable eutrophication (Swedish Agency for Marine and Water Management 2013; Österblom et al. 2007). The difficulty of managing this is exacerbated by the complexecological characteristics of the eutrophication problem, social differences across the Baltic Sea region, and the multiplicity of stakeholders involved in governing these efforts. This has resulted in a variation in the level of awareness of the problem, national and subnational goals, the ability to address it through national policies and the strengthening of policy implementation across the region. The absence of a legal arrangement to protect the Baltic Sea, covering all the coastal countries, makes the situation even more complex (Swedish Agency for Marine and Water Management 2013; Tynkkynen et al. 2014; Ahlvik and Pavlova 2013; HELCOM 2011).

Blue-green algal blooms at the bottom of the sea, along with hypoxia, have both extended by tenfold (Swedish Agency for Marine and Water Management 2013; Savchuk et al. 2008). Living organisms and bottom sediments are affected by hazardous substances in all parts of the Baltic Sea. Environmentally alarming shifts and imbalances appear in many habitats and across the food chain, particularly at the level of large fish (HELCOM 2010). These, in combination with overfishing, have resulted in several regime shifts in the food web. Climate change has caused the sea surface temperature to rise by 0.7 °C during the twentieth century (Swedish Agency for Marine and Water Management 2013). All these factors influence the ecosystem services of the Baltic Sea and hence diminish the benefits generated to the people and the society of this region (HELCOM 2010).

The Baltic Sea underwent a regime shift over the twentieth century (Österblom et al. 2007). Its ecological degradation has been a major challenge for the people and the governments. The surrounding

countries have struggled to protect the sea by attempting to reduce the discharges from industries, municipalities and shipping (Mosin 2011). Signed in 1974, the Helsinki Convention was one of the first agreements in the world with the objective to protect a whole sea area from different pollutants. Other initiatives, like the Local Agenda 21, have also been adopted by all the coastal states to improve democratic environmental policymaking and protection.

Given the different agendas regarding issues of exploitation and environmental protection, there is an immense potential for international conflict over the Baltic Sea, which has been studied by a few researchers. Information on the environmental history of the Baltic Sea region, however, is limited as the literature pertaining to its various aspects is in several different languages. There is often pressure on policymaking within and among states to bring about change. Such change can be empirically observed in the form of the activation of different network structures in the Baltic Sea region, especially since the collapse of the Iron Curtain, the initiation of the Rio Process and the expansion of the European Union. Contemporary theoretical debates about governance highlight the changing conditions that underline the making and implementation of policy at all societal levels. Especially evident when it comes to environmental policies, these include the emergence of new types of networks across state borders, both at the supranational and the subnational levels. Joas et al. (2007) elucidate this process of change with empirical data from the project "Governing a Common Sea" within the Baltic Sea Research Program.

Reviewing the administrative and political structures, Joas et al. (2008) note that the littoral states in the Baltic Sea region have established several new forums and modes of cooperation to manage the sea.

Kapaciauskaite (2012) emphasizes the emergent role of non-governmental actors in regional environmental governance and highlights the coming to the fore of transnationalization, Europeanization tendencies and the largely fragmented nature of existing governance structures in the region. Gilek et al. (2015) present an interdisciplinary analysis of challenges and possibilities for the sustainable governance of the Baltic Sea ecosystem. Focusing on the Ecosystem Approach to Management (EAM) and associated multi-level, multi-sector and multi-actor

challenges, they analyse the environmental governance structures and processes at the macro-regional Baltic Sea level. They conclude that the governance of the Baltic Sea may be improved by promoting environmental governance through coordination, integration, interdisciplinarity, precaution, deliberation, communication and adaptability. A comparative overview of the environmental and resource problems experienced in the Nordic and Baltic regions can be found in Aage (1998).

The main challenges at different governance levels include: differences between coastal countries in terms of environmental conditions, environmental awareness, policy overlap, inadequate spatial and temporal specification of policies, and the lack of policy integration. To meet these challenges, some researchers suggest the closer involvement of stakeholders and the public, improvement in the interplay of institutions and the introduction of a "primus motor" to govern themitigation of eutrophication in the Baltic Sea (Tynkkynen et al. 2014).

The initial sections of the book discuss the various aspects of eutrophication in the Baltic Sea. The food system and the specialization of agriculture have been the main source of this eutrophication (HELCOM 2005; Granstedt 2000). In Chap. 2, "Towards a Sustainable Food System in the Baltic Sea Region", Larsson compares conventional agriculture and Ecological Recycling Agriculture (ERA) in terms of their environmental and socio-economic effects, with a focus on nutrient losses. Larsson argues that socio-economic effects include production, costs and benefits at the macro, firm and household level. At the regional level, the main challenge is to make agriculture more environmentally friendly and reduce nutrient losses while maintaining food production. At the national level, it is to shift the product mix towards more vegetables and less meat and to address the geographical division between animal and crop production. Finally, at the local level, the challenge is to achieve sustainable environmental, economic and social rural development.

Larsson scales up the empirical findings at the regional level to create three scenarios. In the first,agriculture in Poland and the Baltic states is transformed to resemble the Swedish average structure and resource use, which results in a 58% increase in nitrogen and an 18% increase in

phosphorus surplus in agriculture, with a substantial rise in food production. In the other two scenarios agriculture in the entire Baltic Sea area is converted to ERA. This results in a 47–61% reduction in nitrogen surplus in agriculture and eliminates the phosphorus surplus, while food production either decreases or remains stable, conditional on the strategy chosen.

On comparing the environmental effects of different production methods, modes of transport and food baskets at the national level, Larsson finds that the food basket content is as important as the production method in reducing the environmental effects. Local production and processing are less significant. He sees the expansion of the EU as an opportunity for better governance of the Baltic Sea and the agriculture sector. According to him, a new agricultural regime with large-scale ERA would produce several environmental gains. The sustainable governance of the Baltic Sea, as agreed in the Baltic Marine Environment Protection Commission (HELCOM) or the Helsinki Commission, cannot be achieved while simultaneously maximizing agricultural production in surrounding countries. Agricultural production has large external costs. There is substantial willingness to pay for an improved Baltic Sea environment among the public, justifying environmentally sound farming practices. Larsson argues that the contracting parties to HELCOM, including the Swedish government, have environmental and economic incentives to use the opportunities offered by the EU membership of Poland and the Baltic states.

Chapter 3, "Cost-effective Management of a Eutrophicated Sea in the Presence of Uncertain Technological Development and Climate Change", investigates the effects of climate change and technological development on the cost-effective abatement of nitrogen and phosphorus on a eutrophied Baltic sea. In this chapter, Gren develops a dynamic model, which accounts for differences in the sea's adjustment to changes in the nitrogen and phosphorus loads under two types of uncertainty. One is the uncertainty of climate change effects, which is approached with probabilistic constraints on nutrient pool targets. The other is uncertainty of technological development, which is treated within a mean-variance framework in the objective function. The analytical results show that the effects of introducing uncertainty on marginal

abatement cost differ for the two types of uncertainty. Marginal abatement cost is increased by technological uncertainty but decreased by the reduction in the risk discount of climate change uncertainties. Gren also shows that abatement along the optimal time path is delayed by the introduction of technological uncertainty, but occurs earlier when considering climate change uncertainty. Applying this to the eutrophied Baltic Sea reveals that climate change and technological development can reduce the total abatement cost by one-third, but also increase it considerably when uncertainty is included.

Eutrophication of the Baltic Sea has been recognized as a major problem since the 1960s. Nutrient emissions originate from point and non-point sources in the agricultural, transport, energy and wastewater sectors. Elofsson examines the "Optimal Strategies for Inland and Coastal Water Monitoring" in Chap. 4. Over the last few years, there has been some success in nutrient load reduction in the Baltic Sea, but the environmental conditions of the sea have not improved significantly. Many large aquifers across the world suffer from increased eutrophication with negative consequences for biodiversity, fishery, recreation and ecosystem health. Challenges include identification of the relationship between activities at upstream sources and the state of the recipient, evaluation of the environmental status of the recipient and identification of the benefits of abatement.

Eutrophication of inland recipients, often but not always, occurs together with the eutrophication of downstream coastal waters. Sometimes, however, one of these recipients is eutrophicated but not the other. For example, high nutrient retention could imply that emissions from a source reach nearby lakes and rivers but do not reach downstream coastal waters. Also, downstream coastal waters could be in good condition even when nutrient loads from upstream sources are high, for example, if there is a high degree of dilution.

Elofsson investigates the optimal monitoring and abatement strategies in a situation where both upstream and downstream water quality is a potential problem. In particular, she examines how monitoring and abatement costs, and the regulators' degree of risk aversion, affect the choice of monitoring strategy. A stylized model with two upstream sources and one upstream and one downstream recipient is used for the

analysis, and generic data are used for the simulations. Elofsson suggests that the optimal choice is either to not monitor, or to first monitor the sources and based on the outcome, decide whether to proceed with downstream monitoring. The latter strategy is preferred if the cost of upstream monitoring is relatively low, or abatement costs or risk aversion are relatively high.

The EU Marine Strategy Framework Directive (MSFD) requires countries to suggest new measures to achieve Good Environmental Status (GES) of the marine environment by 2020. MSFD explicitly asks member states to ensure that planned measures are cost-effective, technically viable and that impact assessments, including cost-effectiveness and cost-benefit analyses, have been carried out prior to the introduction of new measures.

In Chap. 5, "Public Policies towards Marine Protection: Benchmarking Estonia to Finland andSweden", Nõmmann and Pädam compare the approaches for cost-effectiveness analysis (CEA) and cost-benefit analysis (CBA) of the new measures proposed by Estonia, Finland and Sweden. Due to uncertainties, the lack of background studies and multidisciplinary models of sea ecosystem management, these countries have employed qualitative expert assessments. While Sweden and Estonia have applied standard methods to appraise impacts, Finland has adopted an innovative probabilistic approach.

Proposed measures are expressed in terms of intended objectives rather than in terms of their implementation. Administrative measures, awareness raising, research and development, and other means of information provision are part of the country's first National Programme of Measures. However, as means of implementation, the impact of information is often minor. Uncertainty regarding the choice of policy instruments for implementation complicates both the appraisal of the impact on the environmental target and the estimation of costs and benefits. For the next cycle, it is important to build up knowledge about policy instruments and implementation. There is a need for reviews of existing ex-post studies and further studies, which evaluate existing policy instruments to protect marine environments. Nõmmann and Pädam argue that in order to achieve GES in the entire Baltic Sea, it is important to consider cross-country coordination of measures, as one country

alone cannot achieve GES in its national marine area. Limited public resources at the national level to conduct the requisite valuation studies for CEA and CBA is a problem, but coordination opens up opportunities for collaborations at the regional level and for valuation studies to arrive at the CEA and CBA across neighbouring countries.

The process of economic growth leads to several other modes of environmental degradation. In Chap. 6, Poltimäe and Jüssi study the "Factors Affecting Travel Mode Choice in Tallinn". Cars are increasingly being used for daily commuting as compared to modes ofpublic transport, cycling and walking. The city of Tallinn in Estonia has made several efforts to advance a sustainable transport policy: public transport is free of charge for its citizens, parking fees have been increased and the area of paid parking expanded. Still, car use is on the rise and the use of public transport is decreasing.

Poltimäe and Jüssi aim to investigate the key factors related to choice of mode of transport among Tallinn's citizens, specifically with respect to the use of cars and public transport. In this chapter they analyse the household travel survey data collected by TNS Emor in Tallinn during 2015. Although the number of trips made and daily time spent on travelling in Estonia is still lower than in most highly developed countries, these figures are rising rapidly. They find that increasing car use is not only related to income but also to car compensation, which is offered by employers and enabled by the Estonian tax system. Some of the daily car drivers prefer it for the independence and comfort. However, most of the respondents claim to use cars because of distance and accessibility. These people could potentially be weaned off cars in the presence of a public transport system or cycling network that could meet their needs.

A large share of public transport users claim to opt for it because it is comfortable. Poltimäe and Jüssi suggest building on this, both in terms of the quality of and accessibility to public transport. Urban planning is also significant since parts of Tallinn city have expanded without integrating public transport and mobility planning, which limits the choice of mode of transport available to its inhabitants.

Chapter 7 discusses the "Environmental Impacts of Rural Landscape Change During the Post-communist Period in the Baltic Sea Region".

In this chapter, Lehtilä and Dinnetz discuss the environmental effects of rural land use change in Eastern Europe during the post-communist period. They compare rural land use change and its effects in Eastern and Northern Europe, two areas with different histories of landscape change. They focus on the impact of land use change on biodiversity. They argue that landscape change is one of the most important anthropogenic processes affecting ecosystems. Throughout history, there have been several far-reaching transformations of Eastern and Northern European ecosystems due to agricultural transitions. The most recent one, which took place due to the collapse of the Soviet Union, resulted in large-scale changes in the rural landscapes of Eastern Europe. In many countries, more than 20% of agricultural land was abandoned, and the trend is especially strongin Estonia, where 54% of arable land was abandoned between 1992 and 2005. Land abandonment can affect a variety of ecosystem traits such as biodiversity, water supply, nutrient cycling and carbon sequestration. Lehtilä and Dinnetz argue that the effects of land abandonment on these environmental variables are diverse, and there are several possible outcomes depending both on the type of land that is abandoned and the management following the abandonment. The implications for environmental governance are similarly diverse and depend on perspectives on environmental and socio-economic development.

Blomskog, in Chap. 8, presents "An Analysis of Permission Processes for Wind Power in Sweden". He investigates the formal reconstruction of the legal permission processes concerning permits establishing wind power stations. Reconstruction is based on the concepts applied in multiple-criteria decision making (MCDM). The motivation for reconstruction is drawn from the fact that the extensive academic analysis of these permission processes is performed in an informal everyday language. Many of the intricate conceptual problems that arise during the permission processes are, therefore, treated in an inappropriate manner. Blomskog reconstructs a typical permission process completed by the Swedish authority according to the guidelines of the Swedish Environmental Code. The reconstruction is performed in four stages. *First*, the basic decision problem and the basic norm applied in these legal permission processes are specified. In the *second stage*, according to

a planned wind power installation, the expected value conflicts between value gains as production of "green" electricity and value losses as negative impacts on various environmental aspects are defined. In the *third stage,* Blomskog analyses the meaning of the application of *critical threshold values*, which is the first way of solving the value conflicts. He concludes that critical threshold values ultimately depend on the authorities' subjective, discretionary and situation-dependent judgements. In the *fourth stage*, he analyses *weighing*, which is the second way of solving value conflicts. Based on the reconstruction, Blomskog concludes that the weighing of decisions in these permission processes seems to be based on conceptual mistakes due to the use of the notion of importance. He concludes that one way to remedy misconceptions would be to implement a conceptual framework developed and applied in MCDM.

Pädam and Bali Swain investigate "Attitudes towards Paying for Environmental Protection in the Baltic Sea Region", in Chap. 9. They compare public attitudes to environmental protection in Estonia across neighbouring countries around the Baltic Sea. Responses to three questions covered by the Estonian Environmental Survey from 2010 and by the ISSP Environment III are compared and analysed using ordered logit regressions. Support for environmental protection is measured in the form of the willingness of individuals to make financial sacrifices through higher prices and higher taxes or accepting a cut in their standard of living, in order to protect the environment.

The cross-Baltic country comparison puts Estonia in the middle position. Estonia seems to have a lower-than-average acceptance to cuts in standard of living for environmental protection among countries in the Baltic Sea region. Country-level data suggest that Estonia is similar to Latvia, Lithuania, and Russia in this regard. On the other hand, its willingness to pay higher taxes and prices for environmental protection is higher than the average among countries in the region, placing it at a similar level to that of the Nordic countries and Germany.

Pädam and Bali Swain find that the demand for the protection of the environment tends to increase with income. This is true for both personal income and country-level income. Some difference can be detected between public attitudes in terms of willingness to accept cuts

in standard of living, and the willingness to pay higher taxes and prices. A study of attitudes concerning monetary sacrifices shows a larger number of significant income categories than attitudes towards cuts in living standards. It is also interesting to note that the results reflect earlier findings of a stronger positive influence of personal income than of country-level wealth. Supported by previous research, this indicates that adjustments in GDP per capita do not perform well for the purposes of benefit transfer. It suggests that further attention should be paid to other variables when value estimates are transferred from one context to another.

Higher education is the second main determinant of support for environmental protection. Pädam and Bali Swain find that completion of university studies has a significant influence on the willingness to pay for environmental protection in the Baltic region. In Estonia, higher education significantly influences attitudes towards paying higher taxes. These results suggest that there is support among the general public to pay higher taxes for the purpose of environmental protection.

The final chapter in the book addresses the important question, "Is International Cooperation in the Baltic Sea Drainage Basin Possible?" Zylicz outlines the notion of Baltic Sea protection in terms of an economic public good. He argues that such a good is doomed to insufficient provision unless a financial mechanism is created to undertake abatement to a level which is justified by global considerations rather than local ones. By applying the Chander–Tulkens model of international cooperation, hypothetical transfers are estimated in order to conclude that the Baltic region is not yet ready to develop effective region-wide clean-up programmes.

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