



Research Notes Letter

*Research & Innovation for a sustainable
Baltic Sea Region*

Volume 3, Issue 1, 2020

**Recent research from
BUP Member Universities**



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Programme**

Introduction

In this issue of the **Research Notes Letter** you will find a number of scientific articles on current research on different aspects of sustainable development in the Baltic Sea region.

We especially highlight last year's winners of the BUP Award for best PhD Thesis in 2018. The winner in the category Natural Sciences, Technology and Engineering is Dr. Dominika Sobotka, Gdansk University of Technology, Gdansk, Poland. Her thesis has the title "*Investigation of the efficiency of nitrogen removal in a sequencing batch reactor with anammox granular biomass*" and you will find a summary below. Dr. Natālija Cudečka-Puriņa, Liepāja University, Liepāja, Latvia, is the winner of the BUP Award for best thesis in 2018 in the category Social Sciences and Humanities. Her thesis has the title "*Ensuring municipal waste management sustainability by administration of landfill management companies*". You will find a summary of the thesis below.

We are already now planning for the BUP Award for best PhD Thesis in 2019. The award is to be announced in February. The winner will be presented at the BUP Symposium 2020 in August.

If you think we have missed, the fantastic paper you just got published either send a pdf-copy to us or fill out the [Research Notes Form](#) on the BUP web site. Then the abstract will be published on the [Research page](#) at the BUP web site and also in the next issue of the Research Notes Letter. All previous issues of the Research Notes Letter are possible to [download](#) from the web site

Editors

[Christian Andersson](#)

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Investigation of the efficiency of nitrogen removal in a sequencing batch reactor with anammox granular biomass

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Type of publication: Doctoral Thesis



Winner of the
BUP Award for
best PhD Thesis

Summary

In order to improve the energy efficiency in wastewater treatment plants (WWTPs), the processes of nitrification-denitrification can be replaced with alternative technologies employing the anaerobic ammonium oxidation (anammox) process. The anammox technologies are particularly relevant for treatment of nitrogen rich liquors with low COD/N ratio, such as sludge digester liquors (reject water). In the theoretical part it was shown based on literature data that the efficiency of anammox depends mainly on the operating parameters, such as nitrogen load ($0,02 - 6 \text{ kg N m}^{-3} \text{ d}^{-1}$), temperature ($20 - 43^\circ\text{C}$), pH ($6,5 - 8,3$) and dissolved oxygen (DO) concentration ($< 0,5 \text{ g O}_2 \text{ m}^{-3}$). The aim of these study was to development and cultivate the granular anammox-enrichment sludge, as well as to assess the impact of technological parameters (nitrogen load, temperature, pH and DO concentration) on the anammox process rate and nitrogen removal efficiency.

Granulation of anammox biomass was carried out in a sequencing batch reactor (SBR) with a capacity of 10 dm^{-3} for a period of 330 days. The SBR was inoculated with $0,57 \text{ kg m}^{-3}$ biomass containing inactive anammox biomass originating from a WWTP in Zurich. The initial operation parameters of the biogranulation experiment were set based on literature data. The start-up period of the SBR was 60 days. During the study period, the average diameter of granules ($d_{0,5}$) increased from $290 \pm 25 \mu\text{m}$ to $728 \pm 17 \mu\text{m}$. The second stage of the study, focused on the influence of operating parameters on the anammox process rate and efficiency, consisted of four measurement series. In these series, the influence of temperature, pH, DO concentration and nitrogen load on the anammox process rate were studied. In the first measurement series, short-term and long-term effects of temperature on the anammox process rate were investigated. The short-term and long-term tests were carried out in the temperature range of $10 - 55^\circ\text{C}$ and $11 - 30^\circ\text{C}$, respectively. In the following measurement series, batch tests on the short-term effects of pH ($6 - 10,5$) and DO ($0 - 1,0 \text{ g O}_2 \text{ m}^{-3}$) were carried out. Moreover, the effect of the nitrogen load on the anammox process rate and efficiency was determined based on the results of SBR operation at different nitrogen loading rates ($0,02 - 2,44 \text{ kg N m}^{-3} \text{ d}^{-1}$).

The results of this study confirmed that the application of the anammox process ensures highly effective treatment of ammonia-rich liquors at a low COD/N ratio. The highest nitrogen load resulting in maintaining the efficiency of nitrogen removal above 85% ranged from $1,7 - 2,2 \text{ kg N m}^{-3} \text{ d}^{-1}$. In the pH range of $7 - 8,5$, the removal efficiency of both $\text{NH}_4\text{-N}$ and $\text{NO}_2\text{-N}$ was over 67% with the maximum of 78,9% and 80,7%, respectively (pH = 8,5). The extreme pH values in the analyzed range (i.e. 6 and 10,5) resulted in complete

reversible inhibition of anammox bacteria. While investigating the influence of temperature on the anammox process rate, the highest anammox process rate ($1,19 \text{ g N (g VSS} \cdot \text{d)}^{-1}$) and nitrogen removal efficiency (83,5%) were obtained at 40°C and 30°C , respectively. Complete reversible and irreversible inhibition of anammox bacteria was observed at 11°C and 55°C , respectively. In addition, the possibility of adapting anammox bacteria to low process temperature (14°C) was observed. This observation indicates the potential of using the anammox process not only in side-stream treatment systems (with high temperature of reject water $> 30^\circ\text{C}$), but also for treatment of municipal wastewater in mainstream systems (with lower temperatures).

Results of these study allowed to determine the optimal operating parameters, with the maximum efficiency of nitrogen removal in the anammox process in terms of temperature (30°C), pH (8,0), nitrogen loading rate ($1,0 - 2,2 \text{ kg N m}^{-3} \text{ d}^{-1}$) and DO concentration ($0,0 \text{ g O}_2 \text{ m}^{-3}$). The study also confirmed the inhibitory effect of DO on the activity of the granular anammox sludge. However, a local increase in the nitrogen removal efficiency was observed at the DO concentration of $0,5 \text{ g O}_2 \text{ m}^{-3}$, associated with an increase of the ammonia oxidizing bacteria (AOB) activity.

Ensuring municipal waste management sustainability by administration of landfill management companies

Author: Natālija Cudečka-Puriņa

Affiliation: University of Liepaja, Liepaja, Latvia

Type of publication: Doctoral Thesis



Summary

In the 21st century, the sustainable management of municipal waste will become necessary precondition for any stage of economic development. Waste disposal in the landfills is one of the six functional waste management options. Significant decrease of disposed waste in the landfills up to 10% in 2035 is an important challenge for management of landfill management companies and their economic efficiency. There are scientific works regarding diverting waste from landfill, although a research gap has been identified – lack of business management studies concerning sustainable management of landfill management companies in the situation of a crucial change of waste management hierarchy, leaving waste disposal as least favorable option. The objective of the thesis is to develop a solution for sustainable management of landfills within decrease of incoming waste volumes.

With implementation of industrial symbiosis on a landfill basis a landfill management company will have a possibility to undertake risk diversification, consequently decreasing their current direct dependence on incoming waste volume.

Management of by-products arising from landfill daily operations allows saving primary resources and enhances inter-sectoral development. Thus, landfill management companies are able to save primary resources, influence waste prevention and sustain resources for a longer time within the economic cycle.

Within this research, an industrial symbiosis model is developed, which is aimed at effective use of a landfill's available resources. With the development of scientific technological parks, regional development would encourage improvement of infrastructure and development of new jobs, which altogether will have a positive effect on improvement of a country's economic ratios.

The research provides landfill management companies with a landfill management company matrix, which facilitates decision-making in terms of choosing a company development direction and initiates intersectoral cooperation. Landfill management scenarios confirm that industrial symbiosis is a solution for 7 landfill management companies and for 3 companies it can be used as a partial solution, in combination with other development options.

Climate Change Scepticism at Universities: A Global Study



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Type of publication: Article peer review

Abstract

Scepticism about climate change is still a popular trend, despite the existence of scientific evidence that this phenomenon is taking place, and that it is influencing the lives of millions of people around the world. The aim of this paper is to assess the extent to which existing scepticism at the university level is found. The methodology consists of a survey undertaken on a sample of universities around the world, in the context of which attitudes and perceptions about climate change are identified. A total of 237 questionnaires were received from 51 countries around the world. The analysis consists basically of descriptive statistics and an investigation regarding trends on scepticism and the geographical location of the universities. The study concludes by outlining some of the presently seen scepticisms and suggests some ways to address them via curricular innovation and initiatives engaging students.

Citation:

Leal Filho, W.; Mifsud, M.; Molthan-Hill, P.; J. Nagy, G.; Veiga Ávila, L.; Salvia, A.L. Climate Change Scepticism at Universities: A Global Study. *Sustainability* **2019**, *11*, 2981. DOI [10.3390/su11102981](https://doi.org/10.3390/su11102981)

Baltic herring for food: Shades of grey in how backcasting recommendations work across exploratory scenarios



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Type of publication: Article peer review

Abstract

Scenario methods can be used to cope with future uncertainties by envisioning plausible futures and identifying paths to reach desirable targets. The objective of this paper is to develop novel proposals revealing generalized dynamics on “HOW” the different normative recommendations can work under different exploratory scenarios. Previous literature has focused more on developing methods for integrating normative and exploratory scenarios than on theorizing dynamics of the HOW question. We examine this theoretical question via a case study on potential futures of use and governance of Baltic herring catch. The case study: 1) develops recommendations on how the use of Baltic herring as food can be increased based on a participatory back casting workshop with fisheries experts; 2) identifies four exploratory scenarios on the future of Baltic fisheries governance based on a literature review; 3) assesses how the recommendations work under four alternative plausible futures. We identify and discuss six generalized dynamics answering the HOW question. Together, these stress the need to analyze simultaneously multiple drivers, stakeholders, exploratory scenarios, normative recommendations, and synergies and frictions between recommendations. This work contributes to capacities to cope with future changes and proactively develop practical means to make our world more sustainable.

Citation:

Sarkkia, S. and Pihlajamäki, M. 2019. Baltic herring for food: Shades of grey in how backcasting recommendations work across exploratory scenarios. *Technological Forecasting and Social Change*, 139: 200-209.

DOI [10.1016/j.techfore.2018.11.001](https://doi.org/10.1016/j.techfore.2018.11.001)

Learning by doing. Case study: Education for sustainable development at the University of Latvia



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Type of publication: Article peer review

Abstract

Junction of possibilities offered by European research programmes in the tertiary education and technology enhanced learning open up new borders for students and young researchers; especially for the ones from institutions with less strong collaboration links to Western-Europe and overseas.

University of Latvia has undertaken the challenge of designing master's programme on education for sustainable development called 'Natural Sciences, Global Change and Technologies for Sustainable Development' combined with application of digital learning tools. Teaching staff was formed from several faculties of the University of Latvia, other universities, respective companies as well as foreign partner institutions to ensure transdisciplinarity and broad application of different learning tools. Along with the tuition, also international conferences and summer schools were organised. Open discussions among foreign professors and youngsters facilitate more rapid promotion of the latter. Now our students demonstrate recognised success, e.g., have joined research community in Max Planck Society, and have won the Energy Globe Award in the field of education for sustainable development.

The paper describes a case study of transforming the master's programme curriculum by employing various methods and tools.

Citation

Berzina, D. 2019. Learning by doing. Case study: Education for sustainable development at the University of Latvia. *Periodicals of Engineering and Natural Sciences*, vol. 7, no. 1. DOI [10.21533/pen.v7i1.356](https://doi.org/10.21533/pen.v7i1.356)

Toward the Baltic Sea Socioeconomic Action Plan



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Type of publication: Article peer review

Abstract

This paper analyzes the main weaknesses and key avenues for improvement of nutrient policies in the Baltic Sea region. HELCOM's Baltic Sea Action Plan (BSAP), accepted by the Baltic Sea countries in 2007, was based on an innovative ecological modeling of the Baltic Sea environment and addressed the impact of the combination of riverine loading and transfer of nutrients on the ecological status of the sea and its sub-basins. We argue, however, that the assigned country-specific targets of nutrient loading do not reach the same level of sophistication, because they are not based on careful economic and policy analysis. We show an increasing gap between the state-of-the-art policy alternatives and the existing command-and-control-based approaches to the protection of the Baltic Sea environment and outline the most important steps for a Baltic Sea Socioeconomic Action Plan. It is time to raise the socioeconomic design of nutrient policies to the same level of sophistication as the ecological foundations of the BSAP.

Citation

Ollikainen, M., Hasler, B., Elofsson, K. *et al.* 2019. Toward the Baltic Sea Socioeconomic Action Plan. *Ambio* 48: 1377.

DOI [10.1007/s13280-019-01264-0](https://doi.org/10.1007/s13280-019-01264-0)

Stakeholders' perceptions on ecosystem services in Östergötland's (Sweden) threatened oak wood-pasture landscapes

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Type of publication: Article peer review

Abstract

Ecosystem services (ES) research is currently widely utilized. However, qualitative approaches and socio-cultural valuations of ES are still limited. This may undermine future landscape conservation initiatives because important services for people may not be captured. We performed 29 face-to-face semi-structured interviews to capture stakeholders' perceptions of ES from the largest area with oak wood-pasture landscapes in Sweden (Östergötland County). A total of 34 ES were mentioned, and compared among stakeholders from public, private and civil sectors at local and regional levels of governance. Cultural ES were highlighted the most by respondents from both levels of governance. At the local level, respondents appreciated especially provisioning services. In contrast, regional level respondents showed more appreciation for supporting services. Private sector stakeholders emphasized provisioning ES, whereas the civil and public sector stakeholders highlighted cultural ES in terms of recreational values and landscape beauty. Supporting ES were considered only in relation to biodiversity, especially species and habitats linked to old oaks. Farmers and farming activities (especially grazing regimes) are crucial to support important oak wood-pasture ES. We discuss important ES as expressed by stakeholders and challenges for wood-pasture conservation in Sweden and elsewhere. To integrate the different demands of stakeholder groups into policy, enable cross-sectorial flexibility and policy regional adaptation for wood-pasture conservation, are current challenges future research should focus upon.

Citation

Garrido, P., Elbakidze, M. and Angelstam, P. 2017. Stakeholders' perceptions on ecosystem services in Östergötland's (Sweden) threatened oak wood-pasture landscapes. *Landscape and Urban Planning*, 158: 96-104.

DOI [10.1016/j.landurbplan.2016.08.018](https://doi.org/10.1016/j.landurbplan.2016.08.018)

From Nature Conservation to Sustainable Development

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Type of publication: Conference paper

Abstract

This paper presents the author's vision about some essential results of many years international cooperation in the environmental sciences and practice development in the Baltic countries and regions, including Kaliningrad District of Russian Federation. First interest would be given to a long-term and very successful International cooperative projects, integrated in "The Baltic University Programme" (BUP), which was coordinated by Uppsala University, Sweden. Short description of some important series of courses, which was formed by participants, would be presented. For Would Climate Research Programme was organized project "Baltic Sea Experiment" with our participations and presentation of papers about climate change in Kaliningrad District and their consequences for agriculture. The study also pays special attention to annual German–Russian Days in Kaliningrad with connection to international programme "Man and Biosphere" and development of biosphere reserves between Russia, Lithuania, and Poland. Finally, author suggest some tasks for students about modernization traditional curriculum schemes.

Citation

Krasnov E.V. (2020) From Nature Conservation to Sustainable Development. In: Fedorov G., Druzhinin A., Golubeva E., Subetto D., Palmowski T. (eds) Baltic Region—The Region of Cooperation. Springer Proceedings in Earth and Environmental Sciences. Springer, Cham DOI [10.1007/978-3-030-14519-4_12](https://doi.org/10.1007/978-3-030-14519-4_12)

Measuring the Effectiveness of Sustainability-Related Course Towards Strengthening the University's Sustainability Strategy in Teaching and Learning Programmes

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Type of publication: Book chapter

Abstract

Mainstreaming sustainability into the education system is a key strategy for Universiti Sains Malaysia (USM) to strengthen its position as one of the custodian institutions in the global sustainability agenda. In pursuit of becoming a sustainability-led university, USM has undertaken numerous transformational adaptations, especially in teaching and learning (T&L) programmes that emphasize principles and best practices of sustainable development. Therefore, an undergraduate course, Sustainability: Issues, Challenges and Prospects or code-named WSU 101, was introduced by the Centre for Global Sustainability Studies (CGSS), since 2012. Through multi-research approaches, this paper reviews USM's strategies in integrating key sustainability drivers into T&L programmes and evaluates the effectiveness of this initiative through the course evaluation. The findings found that several sustainability-related courses have been established and offered to postgraduate and undergraduate in USM. Evidently, the inclusion of sustainability-related courses like WUS 101 into the university curriculum has significantly improved awareness among students. The information garnered is useful for USM to strengthen its institutional strategies, besides it can act as baseline data for the implementation of education for sustainable development (ESD) by institutions worldwide.

Citation

Ng T.F., Wee M.I., Ariffin F.N., Ahmad Shabudin A.F., Hassan M.S. (2020) Measuring the Effectiveness of Sustainability-Related Course Towards Strengthening the University's Sustainability Strategy in Teaching and Learning Programmes. In: Leal Filho W. et al. (eds) Universities as Living Labs for Sustainable Development. World Sustainability Series. Springer, Cham

DOI [10.1007/978-3-030-15604-6_33](https://doi.org/10.1007/978-3-030-15604-6_33)

Baltic Sea: A Recovering Future From Decades of Eutrophication

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Type of publication: Book chapter

Abstract

The eutrophication development of the Baltic Sea since early 20th century has been driven by human activities causing increasing nutrient loading, impaired ecosystem status, negative impacts on human welfare, and changing responses in governance. Both the Baltic Sea ecosystem and the surrounding countries have gone through major changes during the last 100 years. The social and ecological regime shifts have been driven by political change and economic development of the region, from the landscape divided by the 'Iron Curtain' into the environmentally advanced governance system of the European Union. Thanks to the policies and action plans coordinated by the environmental protection convention, HELCOM, nutrient loading trends have been curbed, but with little impact on environmental status. Future climate change projections imply that an improvement of the Baltic Sea ecosystem status will need even stronger measures. A transition to adaptive governance and the circular economy could provide sustainable solutions.

Citation:

Heiskanen, A-S, Bonsdorff, E. and Joas, M. 2019. Baltic Sea: A Recovering Future From Decades of Eutrophication. In: *Coasts and Estuaries, Chapter 20, page: 343-362*. Elsevier BV.

DOI [10.1016/B978-0-12-814003-1.00020-4](https://doi.org/10.1016/B978-0-12-814003-1.00020-4)

Biodiversity's contributions to sustainable development

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Type of publication: Review article

Abstract

International concern to develop sustainably challenges us to act upon the inherent links between our economy, society and environment, and is leading to increasing acknowledgement of biodiversity's importance. This Review discusses the breadth of ways in which biodiversity can support sustainable development. It uses the Sustainable Development Goals (SDGs) as a basis for exploring scientific evidence of the benefits delivered by biodiversity. It focuses on papers that provide examples of how biodiversity components (that is, ecosystems, species and genes) directly deliver benefits that may contribute to the achievement of individual SDGs. It also considers how biodiversity's direct contributions to fulfilling some SDGs may indirectly support the achievement of other SDGs to which biodiversity does not contribute directly. How the attributes (for example, diversity, abundance or composition) of biodiversity components influence the benefits delivered is also presented, where described by the papers reviewed. While acknowledging potential negative impacts and trade-offs between different benefits, the study concludes that biodiversity may contribute to fulfilment of all SDGs.

Citation

Blicharska, M., Smithers, R.J., Mikusiński, G. et al. Biodiversity's contributions to sustainable development. *Nat Sustain* (2019)

DOI: [10.1038/s41893-019-0417-9](https://doi.org/10.1038/s41893-019-0417-9)

Analysing the use of tools, initiatives, and approaches to promote sustainability in corporations

Author: Rodrigo Lozano

Affiliation: University of Gävle, Gävle, Sweden

Type of publication: Article peer review

Abstract

Interest in sustainability from the corporate sector is evidenced by over 13,000 companies in 160 countries that have signed the United Nations Global Compact. In this context, a number of tools, initiatives, and approaches (TIAs), e.g., circular economy, corporate social responsibility, eco-efficiency, life cycle assessment, and sustainability reporting have been developed by and for corporations to engage and promote sustainability within their systems. Each of the TIAs has advantages when addressing sustainability issues and the company system's elements, but it has disadvantages in dealing with their complexities and interactions. Relying only on one TIA results in a limited contribution to sustainability, whereas using too many TIAs wastes resources and energy. The Corporate and Industrial Voluntary Initiatives for Sustainability (CIVIS) has been proposed to better combine the TIAs. A survey was developed to investigate the use of 24 TIAs. The survey was sent to a database of 5,299 organisations (of which 3,603 were companies), from which 202 responses were obtained. The responses were analysed using ratio analysis, principal component analysis, and cluster analysis. The responses show that some TIAs are well known and provide good results when used, for example, corporate social responsibility, corporate sustainability, and Global Reporting Initiative reports. The analyses show a number of groups of the TIAs that can help to better combine them. The paper updates the CIVIS framework in order to provide clearer guidance on how to combine the TIAs. A combination of between four and six initiatives appears to be most effective way to promote sustainability. The TIAs can help to promote sustainability in corporations, but they need to be combined correctly in order to address holistically the four dimensions of sustainability, the system elements, and stakeholders, while avoiding duplication of tasks and wasting resources.

Citation

Lozano, R. 2019. Analysing the use of tools, initiatives, and approaches to promote sustainability in corporations. *Corp Soc Resp Env Ma.* 2019: 1–17.

DOI [10.1002/csr.1860](https://doi.org/10.1002/csr.1860)

Future socioeconomic conditions may have a larger impact than climate change on nutrient loads to the Baltic Sea



Authors: Alena Bartosova¹, René Capell¹, Jørgen E. Olesen², Mohamed Jabloun³, Jens Christian Refsgaard⁴, Chantal Donnelly¹, Kari Hyytiäinen⁵, Sampo Pihlainen⁵, Marianne Zandersen⁶ and Berit Arheimer¹

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Type of publication: Article peer review

Abstract

The Baltic Sea is suffering from eutrophication caused by nutrient discharges from land to sea, and these loads might change in a changing climate. We show that the impact from climate change by mid-century is probably less than the direct impact of changing socioeconomic factors such as land use, agricultural practices, atmospheric deposition, and wastewater emissions. We compare results from dynamic modelling of nutrient loads to the Baltic Sea under projections of climate change and scenarios for shared socioeconomic pathways. Average nutrient loads are projected to increase by 8% and 14% for nitrogen and phosphorus, respectively, in response to climate change scenarios. In contrast, changes in the socioeconomic drivers can lead to a decrease of 13% and 6% or an increase of 11% and 9% in nitrogen and phosphorus loads, respectively, depending on the pathway. This indicates that policy decisions still play a major role in climate adaptation and in managing eutrophication in the Baltic Sea region.

Citation

Bartosova, A., Capell, R., Olesen, J.E. et al. *Ambio* (2019) 48: 1325.

DOI [10.1007/s13280-019-01243-5](https://doi.org/10.1007/s13280-019-01243-5)

Search for Measure of the Value of Baltic Sustainability Development: A Meta-Review



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Affiliation: SGH Warsaw School of Economics, Warsaw, Poland

Type of Publication: Article peer review

Abstract

The purpose of the study is to identify a sustainability development measure. The United Nations announced 17 development objectives in Agenda 2030. This research attempts to identify a measurement which captures all of the UN objectives. It uses the Baltic Sea Region as a natural laboratory for the sustainability discussion. This paper provides an analysis of a sample from the population of 159 research papers, published between 1990 and 2019. With the application of citation count regression, the population of papers is reduced to a sample of the heterogenic papers. These papers were then analysed for the existence of an integrated sustainability development measurement. The results indicate that there is no available applied or theoretical model for an integrated measurement of sustainable development across all of the United Nation's goals. The study provides the framework for a further matrix in reference to gross domestic product. The results are robust in terms of different sample specifications. The identified research gap has a policy implication. There is a need to develop a universal and comprehensive sustainable value measure to support policymakers and their public choices.

Citation

Staszekiewicz, P. 2019. Search for Measure of the Value of Baltic Sustainability Development: A Meta-Review. *Sustainability* 11 (23): 6640

DOI [10.3390/su11236640](https://doi.org/10.3390/su11236640)

The importance of sustainable phosphorus management in the circular economy (CE) model: The Polish case study



Author: Marzena Smol

Affiliation: Polish Academy of Sciences, Cracow, Poland

Type of publication: Article peer review

Abstract

In the transition to the circular economy (CE) model, the sustainable management of raw materials plays a key role in the whole value chain. One of the most important critical raw materials (CRM) for the European economy is Phosphorus (P), which cannot be replaced by any other element. This paper presents the current P management structure in Poland taking into account the sources of P, its consumption and recycling. At present, no phosphates are produced in Poland and the demand for P-bearing raw materials is satisfied entirely by imports. There is high potential for recovery of P from selected secondary sources due to an increase in the generation of P-rich waste, such as municipal and industrial sludges (947.2 thous. Mg of dry solid waste in 2016), sewage sludge ash (45 thous.Mg /year) or biomass ash (4.2 million Mg/year); however, P recycling is not commonly undertaken in Poland. In order to transfer the Polish economy to the CE model, the government is working on strategies and programmes that take into account the sustainable management of raw materials. The most promising sources of P are municipal and industrial wastewater, sewage sludge and sewage sludge ash and, therefore, basic legal recommendations for nutrient recovery in the wastewater sector were proposed by Polish organisations dealing with environmental concerns. The paper also presents the basic action that is recommended to be undertaken with the objective of improving the sustainable management of this CRM in the Polish economy.

Citation

Smol. M. 2019. The importance of sustainable phosphorus management in the circular economy (CE) model: the Polish case study. *Journal of Material Cycles and Waste Management* 21 (2): 227–238.

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What evidence exists relating to effectiveness of ecotechnologies in agriculture for the recovery and reuse of carbon and nutrients in the Baltic and boreo-temperate regions? A systematic map protocol



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Abstract

The degradation of the water quality of the Baltic Sea is an ongoing problem, despite investments in measures to reduce external inputs of pollutants and nutrients from both diffuse and point sources. Excessive inputs of nutrients coming from the surrounding land are among the primary causes of the Baltic Sea eutrophication. Diffuse sources, of which most originate from agricultural activities, are two dominant riverine pollution pathways for both nitrogen and phosphorus. Recently, there is growing attention on the reuse of carbon, nitrogen and phosphorus from agricultural waste streams. However, to our knowledge, no comprehensive and systematic assessment of ecotechnologies focusing on recovery or reuse of these substances in the agricultural sector is available.

Citation

Haddaway, N.R., Piniewski, M. & Macura, B. 2019. What evidence exists relating to effectiveness of ecotechnologies in agriculture for the recovery and reuse of carbon and nutrients in the Baltic and boreo-temperate regions? A systematic map protocol. *Environ Evid* 8, 5

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Effects of ship emissions on air quality in the Baltic Sea region simulated with three different chemistry transport models



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Abstract

The Baltic Sea is a highly frequented shipping area with busy shipping lanes close to densely populated regions. Exhaust emissions from ship traffic into the atmosphere do not only enhance air pollution, they also affect the Baltic Sea environment through acidification and eutrophication of marine waters and surrounding terrestrial ecosystems. As part of the European BONUS project SHEBA (Sustainable Shipping and Environment of the Baltic Sea region), the transport, chemical transformation and fate of atmospheric pollutants in the Baltic Sea region were simulated with three regional chemistry transport model (CTM) systems, CMAQ, EMEP/MSC-W and SILAM, with grid resolutions between 4 and 11 km. The main goal was to quantify the effect that shipping emissions have on the regional air quality in the Baltic Sea region when the same shipping emission dataset but different CTMs are used in their typical set-ups. The performance of these models and the shipping contribution to the results of the individual models were evaluated for sulfur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃) and particulate matter (PM_{2.5}). Model results from the three CTMs for total air pollutant concentrations were compared to observations from rural and urban background stations of the AirBase monitoring network in the coastal areas of the Baltic Sea region. Observed PM_{2.5} in summer was underestimated strongly by CMAQ and to some extent by EMEP/MSC-W. Observed PM_{2.5} in winter was underestimated by SILAM. In autumn all models were in better agreement with observed PM_{2.5}. The spatial average of the annual mean O₃ in the EMEP/MSC-W simulation was ca. 20% higher compared to the other two simulations, which is mainly the consequence of using a different set of boundary

conditions for the European model domain. There are significant differences in the calculated ship contributions to the levels of air pollutants among the three models. EMEP/MSC-W, with the coarsest grid, predicted weaker ozone depletion through NO emissions in the proximity of the main shipping routes than the other two models. The average contribution of ships to PM_{2.5} levels in coastal land areas is in the range of 3.1% – 5.7% for the three CTMs. Differences in ship-related PM_{2.5} between the models are mainly attributed to differences in the schemes for inorganic aerosol formation. Differences in the ship-related elemental carbon (EC) among the CTMs can be explained by differences in the meteorological conditions, atmospheric transport processes and the applied wet-scavenging parameterizations. Overall, results from the present study show the sensitivity of the ship contribution to combined uncertainties in boundary conditions, meteorological data and aerosol formation and deposition schemes. This is an important step towards a more reliable evaluation of policy options regarding emission regulations for ship traffic and the planned introduction of a nitrogen emission control area (NECA) in the Baltic Sea and the North Sea in 2021.

Citation

Karl, M., Jonson, J. E., Uppstu, A., Aulinger, A., Prank, M., Sofiev, M., Jalkanen, J.-P., Johansson, L., Quante, M., and Matthias, V. 2019. Effects of ship emissions on air quality in the Baltic Sea region simulated with three different chemistry transport models, *Atmos. Chem. Phys.*, 19, 7019–7053.

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Perspectives on Sustainable Bioeconomy in the Baltic Sea Region



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Abstract

‘Bioeconomy’ is a complex concept that cuts across many sectors and covers several policy areas. To achieve an overall understanding and support a successful bioeconomy, a cross-sectorial approach is necessary. In practice, due to the concept’s wide scope and varying international approaches, fully understanding bioeconomy is challenging on policy level. This paper provides a background of the topic through an analysis of bioeconomy strategies in the Baltic Sea region. Expert interviews and a small survey were conducted to discover the current and intended focuses of these countries’ bioeconomy sectors. The research shows that supporting sustainability is one of the keys in developing the future bioeconomy. The results highlighted that the bioeconomy has to be sustainable and based on circular economy principles. Currently, traditional bioeconomy sectors like food, wood, fish & waters as well as fuel & energy, which are in the core of national bioeconomy strategies, are best known and are considered more relevant than other bioeconomy industries. However, there is increasing potential for novel sectors, such as textiles and pharmaceuticals. The present research indicates that the opportunities presented by these bioeconomy sectors should be recognised and promoted. Education, research and innovation can play key roles in developing transformative and sustainable improvements in primary production and renewable resources. Furthermore, cooperation between businesses and educators is important.

Citation:

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<https://pdfs.semanticscholar.org/40ab/a4a7a154ab3f6314d96118d030647792df20.pdf>

Identifying barriers and opportunities for a circular phosphorus economy in the Baltic Sea region



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Type of publication: Article peer review

Abstract

Phosphorus (P) is one of the essential elements needed for global food security. However, the phosphate life cycle is currently predominantly linear, from P-rock mining to fertiliser production, agriculture, and food consumption, with the P excess ending up in soil and runoff. Eutrophication coupled with limited global commercial phosphorus reserves call for increased efforts toward creating a circular economy for P in many populated drainage basins such as the Baltic Sea region. To identify barriers and opportunities for such a transition, we employ an analytical framework that merges an innovation systems perspective with elements from the socio-technical transitions literature. Combining a literature review with key informant interviews, we find that lack of appropriate policy steering and insufficient knowledge on the performance of technologies for reuse remain key obstacles for closing the P loop. There are, however, structural opportunities presented by the new EU Fertilising Products Regulation that are likely to level the playing field between conventional and waste-derived fertilisers and thereby improve the market opportunities for recovered P. However, the system currently appears to be moving towards a narrow focus on a few new technologies for P recovery and reuse which could lead to new lock-ins. Solutions need to address users' acceptability of the technologies and waste-derived products while the vision of a circular economy needs to be better articulated through government interventions to capture environmental externalities of phosphate mining. The paper further highlights knowledge gaps and proposes recommendations for policy and research related to the circular economy of P.

Citation

Barquet, K., Järnberg, L., Rosemarin, A. and Macura, B. 2020. Identifying barriers and opportunities for a circular phosphorus economy in the Baltic Sea region. *Water Research*, Volume 171, 115433.

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Future projections of record-breaking sea surface temperature and cyanobacteria bloom events in the Baltic Sea

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Abstract

Aiming to inform both marine management and the public, coupled environmental-climate scenario simulations for the future Baltic Sea are analyzed. The projections are performed under two greenhouse gas concentration scenarios (medium and high-end) and three nutrient load scenarios spanning the range of plausible socio-economic pathways. Assuming an optimistic scenario with perfect implementation of the Baltic Sea Action Plan (BSAP), the projections suggest that the achievement of Good Environmental Status will take at least a few more decades. However, for the perception of the attractiveness of beach recreational sites, extreme events such as tropical nights, record-breaking sea surface temperature (SST), and cyanobacteria blooms may be more important than mean ecosystem indicators. Our projections suggest that the incidence of record-breaking summer SSTs will increase significantly. Under the BSAP, record-breaking cyanobacteria blooms will no longer occur in the future, but may reappear at the end of the century in a business-as-usual nutrient load scenario.

Citation

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