KLAIPĖDA UNIVERSITY

Donalda KARNAUSKAITĖ

ASSESSING SUSTAINABLE DEVELOPMENT OF COASTAL SYSTEMS

DOCTORAL DISSERTATION

Natural sciences,
ecology and environmental sciences (N 012)

Klaipėda, 2019

Doctoral dissertation was prepared during the period 2014–2019 at Klaipėda University, based on the conferment a doctorate right which was granted for Klaipėda University by the order of the Minister of Education and Science (Republic of Lithuania) No. V-1019, signed on 8 June, 2011, by the order of the Minister of Education, Science and Sport (Republic of Lithuania) No. V-160, signed on 22 February, 2019.

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The dissertation will be defended in a public meeting of the Board in Ecology and Environmental Sciences, Klaipėda University Marine Research Institute conference hall (201 a.) at 12:30 p. m. on 16 September, 2019.
Address: University Avenue 12, LT-92294, Klaipėda, Lithuania.

The doctoral dissertation was sent out on 16 August, 2019.
The doctoral dissertation is available for review at the Library of the Klaipėda University.

KLAIPĖDOS UNIVERSITETAS

Donalda KARNAUSKAITĖ

KRANTO ZONOS DARNAUS VYSTYMOSI VERTINIMAS

DAKTARO DISERTACIJA

Gamtos mokslai,
ekologija ir aplinkotyra (N 012)

Klaipėda, 2019

Disertacija rengta 2014–2019 metais Klaipėdos universitete pagal Lietuvos Respublikos švietimo ir mokslo ministro 2011 m. birželio 8 d. įsakymu Nr. V-1019 ir Lietuvos Respublikos švietimo, mokslo ir sporto ministro 2019 m. vasario 22 d. įsakymu Nr. V-160 Klaipėdos universitetui suteiktą Ekologijos ir aplinkotyros mokslo krypties doktorantūros teisę.

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Daktaro disertacija bus ginama viešame Ekologijos ir aplinkotyros mokslo krypties tarybos posėdyje 2019 rugsėjo 16 d. 12:30 val. Klaipėdos universiteto Jūros tyrimų instituto konferencijų salėje (201 a.).
Adresas: Universiteto al. 17, LT-92294, Klaipėda, Lietuva.

Daktaro disertacija išsiųsta 2019 m. rugpjūčio 16 d.
Disertaciją galima peržiūrėti Klaipėdos universiteto bibliotekoje.

Abstract

The cumulative doctoral dissertation based on four peer-reviewed scientific publications presents the development of a tailor-made indicator set and the computer-aided user-friendly Indicator-based Sustainability Assessment Tool (InSAT). This study explores how the appropriate use of sustainability indicators, incorporation of environmental, social and economic aspects, can help to assess whether the coastal and marine management initiatives lead to a more sustainable development, and also enables evaluate the quality of the management process. The application of core and optional indicators highlights the strengths and weaknesses of the coastal management measures in different implementation levels. Moreover, the study analyses to what extent, how and when InSAT can be applied within a step-wise System Approach Framework (SAF) to support coastal management. Further, it is explored how other integrated approaches like ICZM, MSP, and Land/Urban planning can benefit from the tool which facilitates the dialogue between stakeholders, society and decision-makers.

Key words

Integrated Coastal Zone Management; Systems Approach Framework; decision support tool; sustainability indicators; public participation; stakeholder engagement

Reziumė

Disertacija parengta kumuliatyviuoju būdų, remiantis keturiomis recenzuotomis mokslinėmis publikacijomis, kurios pristato rodiklių rinkinio ir kompiuterizuoto bei lengvai vartotojui naudojamo rodikliais pagrįsto darnumo vertinimo įrankio (angl. InSAT) kūrimą. Šiame moksliniame darbe nagrinėjama, kaip tinkamai naudojami aplinkos, socialiniai ir ekonominiai aspektai ir sukurtas įrankis gali įvertinti, ar kranto zonos valdymo priemonės veda prie darnaus vystymosi, taip pat gali įvertinti valdymo proceso kokybę. Vertinimo metu, taikant pagrindinius ir pasirenkamuosius rodiklius, skirtinguose įgyvendinimo lygmenyse, pažymimos kranto zonos valdymo priemonių stipriosios ir silpnosios pusės. Be to, moksliniame darbe yra analizuojama, kokiu mastu, kaip ir kada InSAT įrankis gali būti taikomas sisteminiu požiūriu grindžiamoje struktūroje (angl. SAF), siekiant paremti kranto zonos valdymą. Taip pat darbe tyrinėjama, kaip kitiems integruotiems metodams, pavyzdžiui, integruotam kranto zonos valdymui (angl. ICZM), jūros erdviniam planavimui (angl. MSP) bei žemės ir miestų planavimui, gali būti naudinga panaudoti šį įrankį, kuris palengvina bendravimą tarp suinteresuotųjų šalių, visuomenės ir sprendimų priėmėjų.

Reikšmingi žodžiai

Integruotas kranto zonos valdymas, sisteminiu požiūriu grindžiama struktūra, sprendinių priėmimo priemonė, darnumo rodikliai, visuomenės dalyvavimas, suinteresuotųjų šalių dalyvavimas.

Contents

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications referred to by their Roman numerals in the text:

I. **Karnauskaitė, D**., Schernewski, G., Schumacher, J., Grunert, R., Povilanskas, R., 2018. Assessing coastal management case studies around Europe using an indicator based tool. J Coast Conserv, 22: 549. https://doi.org/10.1007/s11852-018-0597-x

II. Schernewski, G., Bartel, C., Kobarg, N., **Karnauskaitė, D.**, 2017. Retrospective assessment of a managed coastal realignment and lagoon restoration measure: The Geltinger Birk, Germany. J. Coast Conserv, 22: 157. http://dx.doi.org/10.1007/s11852-017-0496-6

III. Schumacher, J., Schernewski, G., **Karnauskaitė, D.**, Kataržytė, M., Pakleppa, S., Pape, K., Schönwald, S., Völzke, M., 2018. Measuring and comparing the sustainability of coastal tourism destinations in Germany, Lithuania, and Indonesia. Environ Dev Sustain, pp 1-25. https://doi.org/10.1007/s10668-018-00301-4

IV. **Karnauskaitė, D.**, Schernewski, G., Støttrup, J.G., Kataržytė, M., 2019. Indicator-based Sustainability Assessment Tool to support Coastal and Marine Management. Sustainability, 11 (11): 3175. https://doi.org/10.3390/su11113175

AUTHOR'S CONTRIBUTION

I. Karnauskaitė developed the tool and the article concept, took care of the assessment data and results analyses, and did the article writing.

II. Karnauskaitė supported the article concept development and ideas, contributed with the assessment tool, assisted in the assessment results analysis and supported the article reviewing.

III. Karnauskaitė supported the article concept development and ideas; took a part in the assessment of Lithuanian case studies and supported the article writing and reviewing.

IV. Karnauskaitė designed the tool, developed the article concept, took care of the data analyses and did the article writing.

ABBREVIATIONS

Abbreviations	Explanation
InSAT	Indicator-based Sustainability Assessment Tool
ICZM	Integrated Coastal Zone Management
MSP	Maritime Spatial Planning
SAF	Systems Approach Framework
ESE	Ecological-Social-Economic
MO	Management Option
CS	Case Study
EQ	Environmental Quality
E	Economic
SW	Social Well-being

Introduction

Coastal issues

Nowadays coastal zones are used extensively and increasingly for a large number of activities which leads to the coastal pressures. For instance, our coastal zones are facing severe threats such as the habitat loss due to coastal development, agriculture and aquaculture; the habitat degradation due to eutrophication (Neumann et al. 2017; Newton et al. 2012; European Parliament and the Council 2002). Moreover, coasts attract increasingly high-density building development and the coastal waters are being contaminated by pollutants or excessive nutrient run-off (World Ocean Review 2017). Further to this climate change, invasive species and overexploitation of fishing resources put more pressure on the coasts (Neumann et al. 2017). Natural hazards such as river flooding, storms and storm surges, and tsunamis (Newton et al. 2014) are exacerbated by climate change and sea-level rise (Wong et al. 2014), with serious socio-economic impacts from flooding and erosion (Neumann et al. 2017).

From an ecological perspective, coasts are a unique transition area between terrestrial and marine environments and present a dynamic and challenging environment for sufficient management and planning (Heidkamp et al. 2018). The multiple uses are not always sustainable, compatible and may result in a broad array of problems for resource users, coastal managers, land planners and decision-makers, who need to evaluate the full implications of their choices in managing coastal regions.

The political pressure and sustainable development

From as early as 1987 the Brundtland Report briefly defined the main concept of sustainable development, namely “to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987). Sustainable development is the framing concept assuring that resources are exploited while maintaining the ability of these natural resources to provide for future generations (Ansong et al. 2017). The environmental, economic and social importance of coastal zones is widely addressed in international policies and initiatives (Kullenberg, 2010). During the United Nations Conference on Environment and Development in Chapter 17 of the Agenda 21 it was clearly stated that oceans, seas, coast and marine resources need to be properly managed for the future (UN 1993).

Nowadays, sustainable development runs high on the political agenda and as a result, in 2015 the General Assembly of the United Nations (UN) adopted 17 sustainable development goals (SDGs). The aim of these goals is to set attainable targets that can be achieved as a 2030 agenda for sustainable development (UN 2015). Also, SDG 14 with two main targets (14.2 and 14.5) for coastal areas aims at the conservation and sustainable use of the oceans, seas, and marine resources (UN 2015; Neumann et al. 2017). SDGs are expected to be adapted at a national and local level, taking into account various factors, such as the level of development and existing national and local policies (Biermann et al. 2017a). The principle of sustainable development has become widely accepted, and it should be clearly reflected in all policies starting from global to the local level. Therefore, its integration into national policies requires significant capacities at the national level, including functioning governance systems, where their performance is expected to be improved in measurable ways (Biermann et al. 2017a; Biermann et al. 2017b).

Need for coastal management

An important approach for solving the coastal problems is Integrated Coastal Zone Management (ICZM). While ensuring the health of coasts is vital for achieving sustainable development, the impacts of key pressures are compromising the ability of the coasts to deliver economic, social and environmental benefits. The European Commission defined ICZM as a dynamic, multi-disciplinary and iterative process to promote sustainable management of coastal zones while covering the full cycle of information collection, planning, decision-making, management and monitoring of implementation (European Commission 1999). ICZM was firstly adopted in the late 1960s and early 1970s in the USA, and since then it has evolved through a combination of international programs and initiatives and research activity that took place in different geographical contexts since the early 1980s (Cincin-Sain et al. 1998). Moreover, the spreading and increasing popularity of the debate on sustainable development since the early 1990s has contributed to give ICZM the status of one of the most important ‘global discourses’ regarding resources management in coastal zones (Vallega 1999; Bille et al. 2015). In order to attain sustainable development, the EU Recommendations on Integrated Coastal Zone Management (ICZM) were adopted in 2002 (CEC 2002).

Problems and drawbacks in ICZM implementation

However, while ICZM can be regarded as a comprehensive theoretical framework aiming at contribution to design new and holistic approaches in addressing the need for sustainability in coastal zones (Burbridge et al. 2003; Soriani et al. 2015), the difficulties to translate the concepts into practice and to assess their effectiveness is still a critical point (Burbridge et al. 2003; Shipman et al. 2007; Ballinger et al. 2010; Støttrup et al. 2017). Also, the European Commission’s Demonstration program pointed out that ICZM remains a challenging process to be managed (Burbridge et al. 2003) and the difficulties that coastal managers very often find in translating ICZM concepts into every-day management practice have been confirmed (Pickaver et al. 2004; Soriani et al. 2015). The main drawbacks of ICZM implementation have been the lack of coordination and lack of cooperative attitudes, inappropriate planning systems, the poor application of a broad holistic and long-term approach, lack of adaptive management (Ballinger et al. 2010; Støttrup et al. 2017) and the complexity of participation processes, and a shortage in genuine stakeholder engagement thus ignoring vital social needs of local communities (Støttrup et al. 2017; Portman et al. 2015; Schumacher et al. 2018; Gillgren et al. 2018). Moreover, it is still limited ability to assess the success of ICZM measures, as monitoring and evaluation processes usually often concentrate only on procedural and organisational aspects, rather, than on the main ones as assessing the ICZM efforts to achieve desired outcomes (Shipman et al. 2007; Portman et al. 2012; Soriani et al. 2015).

Systems Approach Framework (SAF)

The Systems Approach Framework (SAF) has been developed as a holistic approach towards the integrated assessment of coastal systems to assist ICZM and to overcome its existing weaknesses. The SAF for use in ICZM was initially developed within the EU project SPICOSA (www.spicosa.eu) and further developed in the BONUS project BaltCoast (www.baltcoast.net). The developments made within the BONUS project BaltCoast aims at enhancing science-policy integration and preventing stakeholder fatigue. The SAF intends to provide a step-wise approach to sustainable ICZM and provides a platform for integrating scientific evidence and stakeholder knowledge (Hopkins et al. 2011; Støttrup et al. 2019).

The SAF has been tested in a wide range of case studies (Hopkins et al. 2012; Mongruel et al. 2013; Semeoshenkova et al. 2017; Schernewski et al. 2018). Due to its stringent structure the SAF provides suitable quality assurance for sustainable ICZM processes (Støttrup et al. 2017), notwithstanding that the success and implementation of ICZM measures is most often insufficiently evaluated or simply not evaluated. The application of the SAF has also uncovered several weaknesses, including the insufficient political and legal status and the need for supportive tools in engaging with stakeholders and in developing indicators (Hopkins et al. 2012).

Why indicators? Use of indicators to measure sustainability in the context of ICZM

The use of indicators is essential in the context of ICZM as a tool for evaluating the state and progress of the development of coastal zones. In recent years a shift towards a more localized use of indicators to measure coastal sustainability is recognizable throughout the academic literature (Fontalvo-Herazo et al. 2007). The indicators are intended to measure progress, to raise awareness and to support decision making while being clear, easy to communicate and to understand (O'Mahony, 2009; Schernewski et al., 2014). Also, indicators are often used because they provide a simplified view of complex phenomena, quantify information, and make it comparable (Malfait et al. 2006).

Many sets of indicators have been developed in the last two decades and applied to sustainability assessment worldwide, including Europe (Reed et al. 2006; Mascarenhas et al. 2015; Oudenhoven et al. 2012; Moldan et al. 1997). Also, many coastal indicator sets have been developed and applied for different purposes (Pickaver 2009; Schernewski et al. 2014; Schumacher et al. 2018). The EU ICZM Expert Group established a Working Group on Indicators and Data (WGID) to assist the development and application of such indicators. Within the scope of the COREPOINT project, an indicator set of the WG-ID was used to measure ICZM progress in different countries throughout Europe on the national, regional and local level (Ballinger et al. 2010; Pickaver 2009). The DEDUCE project concentrated on the application of the sustainability indicators that were developed by the WG-ID. The indicators were applied to different spatial levels, ranging from the European to the local level (DEDUCE Consortium, 2007). The project DEDUCE developed a list of 27 indicators which were simplified and streamlined into 15 coastal sustainability indicators (Gvilava et al. 2015; DEDUCE Consortium 2007). The WG-ID designed two types of indicator sets: (1) a set of indicators to measure the progress in implementing ICZM on different spatial scales; (2) a set of 27 sustainable development indicators divided into seven groups related to the goals of the EU recommendation (Pickaver et al. 2004). Project SUSTAIN provided a set of indicators designed to measure sustainable development in coastal areas on a local and regional level (Schernewski et al. 2014). Most of the existing guidelines for ICZM underline the importance of indicators to monitor states and developments in coastal zones and to assess performance (Belfiore et al. 2003; Hoffmann 2009; Gallagher 2010; Meiner 2010; Burbridge 1997; Scottish Executive Central Research Unit 2001).

However, the indicator systems are hardly applied in practice. The reasons are the lack of a guided step-wise process and lack of supporting tools that enable an easy and relatively fast application process. Unfortunately, the acceptance of existing indicator sets at this level is poor, for reasons such as limited political support, expertise, data, time and uncertainty regarding potential benefits (Reed et al. 2006; Breton 2006; Schernewski et al. 2014). More importantly, a numerous number of indicator systems are kept general and do not meet the practical demand or the concrete objectives of an application. The measurement of the effectiveness of a management system requires performance measures that have easily comparable goals (Maccarrone et al. 2014). To achieve better results in implementing indicators at the local or regional level, for instance, the following aspects are recommended: consideration of different indicator functions and target groups, identification of interfaces with practical management and user needs, the participation of stakeholders and orientation towards accepted goals (Hoffmann 2004).

The need for decision support tools in coastal management

Still, the coastal problems remained unsolved, and the need for the integrated approaches in coastal and marine management still exists. There is also a lack of step-wise guided processes and supporting tools that enable an easy and relatively fast application process in the ICZM context. Therefore, the SAF can serve as a structure to embed an indicator application with the latter being able to support the ICZM process (Støttrup et al. 2017; Støttrup et al. 2019). With that being highlighted, the use of tailor-made indicators as a decision support tool to assess management planning will help to identify potential conflicts as well as initiate trade-off discussions between stakeholders, policy and decision makers. There needs to be a clear definition laying out success criteria and sustainability indicators that allow a comprehensive assessment of the situation before and after the measure (Støttrup et al. 2017; Støttrup et al. 2019). Good and reliable indicators will generally embody several characteristics, including readily measurable, cost-effective, concrete, sensitive, responsive, specific, interpretable and grounded on particular theory (Reed et al. 2006; Belfiore et al. 2006). An indicator-based pre- and post- assessment allows a systematic compilation of lessons learned for future studies and avoids double work and the repetition of mistakes. However, it requires the provision of tools that will enable fast assessment even in the absence of detailed expert knowledge (Støttrup et al. 2017).

Aim and objectives

The aim of this study is to adapt a set of environmental quality, social and economic indicators and develop an indicator-based tool for evaluating the state and progress towards sustainable development in coastal systems; and to assess the success of different coastal management measures.

The following objectives were raised:

1. To develop a tailor-made indicator system and to provide a user-friendly computer-aided tool and a stepwise application methodology to evaluate the changes in the state of sustainability of the ICZM measures, as well as to assess the success of the management process.
2. To apply the tool to a wide spectrum of thematically different coastal case studies around the Baltic regions and beyond; to demonstrate the ability of the indicator-based tool to identify strengths and weaknesses of the ICZM case studies.
3. To provide a critical analysis of fast screening and analysis in-depth assessments and to analyse the role of different evaluators, their perception and background.
4. To further-develop the tool based on the lessons learned from the previous applications and to present the improved version of Indicator-based Sustainability Assessment Tool (InSAT); to explore how the appropriate use of indicators can assess whether the coastal and marine management initiatives lead to a more sustainable development and also evaluate the quality of the management process; to demonstrate the role and value of indicators in the SAF application and to explore the use of indicators for other integrated management approaches.

Novelty of the study

The proposed InSAT framework serves as a tool to support coastal management with particular focus on sustainability and the incorporation of environmental, social and economic aspects. This methodology can be a tool for the improvement of projects or initiatives, when questioning their sustainability, allowing the identification of their weaknesses and raising the awareness about the aspects that make practices efficient from a sustainability point of view. In this study, the indicator-based tool was developed which could be adjusted to the needs of specific coastal initiatives. The indicator set is divided into two types of indicators: core and optional, which gives flexibility to tailor it to the assessment needs and enable it to serve as early warning signals when questioning the sustainability of several options for the proposed management initiatives. Also, the process indicators are a good tool in assessing the success of management measures. The tool serves as an important tool for facilitating dialogue between stakeholders, policy and decision makers. Further to this, the research (together with its corresponding results) increases the extent of knowledge and understanding of human-environment interactions in coastal and marine zones while raising the awareness on solving sustainability problems.

Scientific and applied significance of the results

The assessment of tailor-made indicators as a decision support tool to evaluate management planning is useful in identifying potential conflicts and initiating discussions towards sustainable development between stakeholders, policy and decision makers. Furthermore, when core and optional indicators come together they are likely to reveal the extent to which the implementation of coastal initiative achieves sustainability. In fact, the sustainability appraisal sheds light over the sustainability of the proposed management options. The tailor-made indicators both simplify and quantify complex information that otherwise cannot be easily measured or observed. The approach is effective, operational and reasonable subject to having the selected indicators that appropriately reflect the status of the study region. In addition, the approach supplements the scenario results where modeling is not enabled thus allowing a more comprehensive view of the system. Moreover, while indicators may be applied in the monitoring of systems, they are also useful to decision-makers in identifying, evaluating and tracking progress towards the sustainability. The InSAT provides a systematic procedure for gathering expertise and local knowledge in a way that a person using it can examine various management options results relating to potential policy decisions. Besides, the InSAT transforms the scientific information into readable formats for the benefit of stakeholders and can also prove useful in the decision-making process.

Scientific approval

Results of this study were presented by PhD candidate in 10 international and 2 regional conferences:

1. **Karnauskaitė D.**, Schernewski G., Schumacher J., 2015. Measuring sustainability of coastal regions based on indicators. The Baltic Sea Science Congress, 2015. Riga, Latvia.
2. **Karnauskaitė D.**, Schernewski G., Schumacher J., Povilanskas R., 2016. Measuring sustainability of coastal areas: the tool and examples. 7th EUROLAG Symposium, March 2016. Murcia, Spain.
3. **Karnauskaitė D.**, Schernewski G., Schumacher J., 2016. An indicator system for assessing state and progress towards sustainability in coastal areas. 34th Annual Conference “Geography of Seas and Coasts”, April 2016. Warnemunde, Germany.
4. **Karnauskaitė D.**, Schernewski G., Schumacher J., Povilanskas R., Grunert R., 2016. Evaluating the success of integrated coastal management best-practice initiatives around the Baltic Sea. Littoral 2016 conference “The changing littoral. Anticipation and adaptation to climate change”, 2016. Biarritz, France.

5. **Karnauskaitė D.**, Schernewski G., 2017. An indicator-based tool to support sustainable coastal and marine management. 2nd International Conference on Marine/Maritime Spatial Planning, March 2017. Paris, France.
6. **Karnauskaitė D.**, Schernewski G., 2017. An indicator system to support coastal and marine management. The 11th Baltic Sea Science Congress "Living along gradients: past, present, future", June 2017. Rostock, Germany.
7. **Karnauskaitė D.**, Schernewski G., 2017. Indicator-based tool to support coastal and marine management. Our Ocean 2017: Our Ocean, an Ocean for Life, October 2017. Valletta, Malta.
8. **Karnauskaitė D.**, Schernewski G., Støttrup J.S., Kataržytė M., 2018. An indicator system to support sustainable coastal and marine management. The 8th European Coastal Lagoons Symposium, March 2018. Athens, Greece.
9. **Karnauskaitė D.**, Schernewski G., 2018. Assessing sustainable development of coastal systems: Tool and Examples. Conference of Marine and Coastal Research, May 2018. Klaipeda, Lithuania.
10. **Karnauskaitė D.**, Schernewski G., Støttrup J.S., Kataržytė M., 2018. The Role of Indicator-based Sustainability Assessment in Coastal and Marine Management: Tool & Examples. 7th IEEE/OES Baltic Symposium "Clean and Safe Baltic Sea and Energy Security for the Baltic countries", June 2018. Klaipeda, Lithuania.
11. **Karnauskaitė D.**, Schernewski G., Inacio M., 2018. Using ecosystem services indicators for assessment of sustainable development in coastal and marine areas. 5th Scientific Symposium on Ecosystem Services in Transdisciplinary Approach - ECOSERV 2018, September 2018. Poznan, Poland.
12. **Karnauskaitė D.**, Schernewski G., Støttrup J.S., Kataržytė M., 2018. An Indicator-based Sustainability Evaluation for Coastal and Marine Management initiatives. Littoral 2018 conference, October 2018. Leeuwarden, Netherlands.

1

Material and methods

This cumulative thesis is based on 4 peer-reviewed publications. The original publications were published during the PhD research period and are provided in Annex V. The research methodology was developed to create the tailor-made indicator system – the Indicator-based Sustainability Assessment Tool (InSAT) to fill the gap of lack of supporting tools that enable an easy and relatively fast application process to evaluate the state and progress towards sustainable development in coastal systems and to assess the success of different coastal management measures. The study research was carried out based on four main steps (Figure 1):

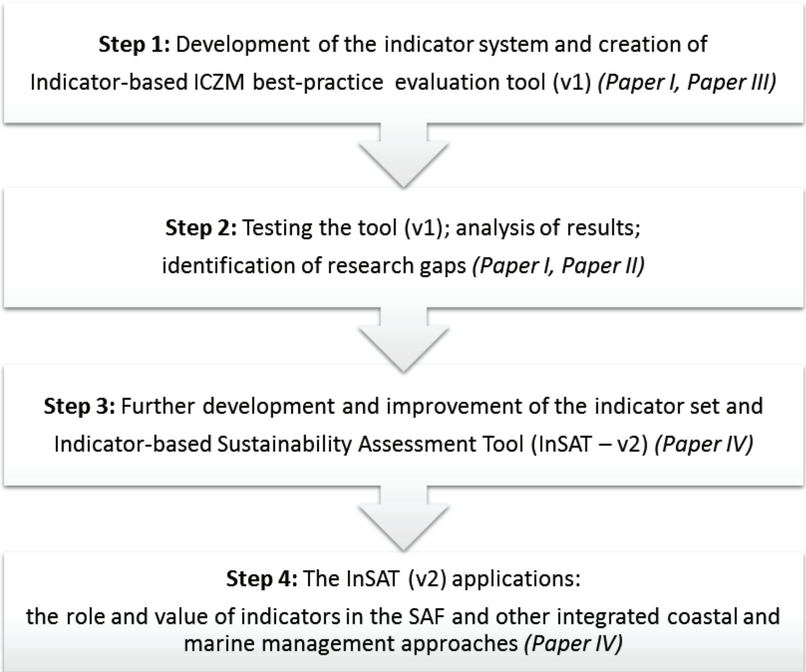

Figure 1. The methodological steps of the proposed research

The next sections provide a more detailed description of the methodological steps.

1.1 Development of the tailor-made indicator system

The process of indicators selection

Many of the indicator sets have been developed to estimate the sustainability of a region, however they remain largely unused due to the difficulty in applying them over a broad region (Paper III). In an effort to improve this situation, the indicator set developed in SUSTAIN project was merged with QualityCoast label indicators for sustainable tourism destinations. Additionally, a joint methodology was created leading to the development of an applicable self-assessment spreadsheet tool (Paper III). The tool with the set of 117 single indicators was tested in ten tourism destinations in Lithuania, Germany and Indonesia. The main aim of the applications was to test the applicability, reproducibility and utility of the tool for coastal communities. The research gaps were identified: the results were not easily reproducible and comparable within different destinations. In fact it showed that the results can be biased, stemming from an evaluator's perception of a given site or ecosystem. Also, the indicators were excessively focused on tourism. As a result, the research gaps formed basis for the development of the new tailor-made indicator set and for building up more flexible sustainability assessment tool (v1). Further to this, the stepwise approach for indicator development has been adopted, to cover different coastal themes and consider the coastal interests and concerns at local, regional and national scales. The development of indicator system comprises five steps (Figure 2):

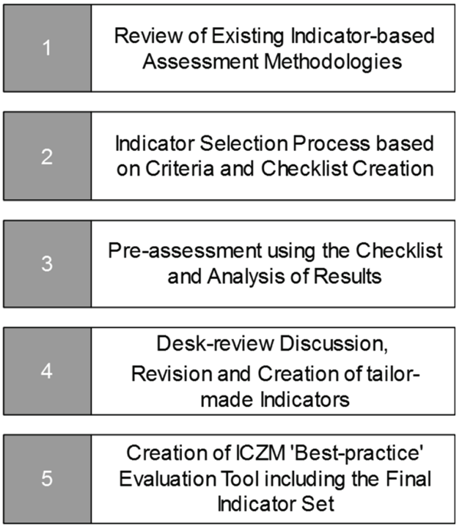

Figure 2. The indicator set (v1) research methodological steps (Paper I)

Step 1: The indicator development process started with the review of already existing indicator-based assessment methodologies from the previous projects: DEDUCE, IOC, SUSTAIN, QualityCoast and Progress indicators by Pickaver et al. (Gvilava et al. 2015; DEDUCE 2007; Olsen 2003; Pickaver et al. 2004; Belfiore et al. 2006). The indicators have been chosen to cover 3 categories of sustainability (environmental quality, economics, social well-being). Also, the governance (process) indicators were inserted to evaluate the quality of the ICZM process.

Step 2: The first screening of methodologies and the set of around 300 indicators were complicated. It demonstrated that many of the indicators covered the same objectives. It led us to define the indicator thematic and technical selection criteria which helped to extract 97 indicators. The thematic criteria proposed: (a) indicators are covering the main coastal issues themes based on European Commission OURCOAST database (adaptation to risk, sustainable use of resources, sustainable economic growth), including indicators related to (b) sustainability and (c) the ICZM progress. The technical criteria included: (d) ability to be scored, (e) data availability and (f) quality of data sets.

Step 3: The selected 97 indicators were included in the online checklist for the selection of the most suitable indicators to measure changes. This process required consultation with experts working in the field related to the coastal management. The question to experts on each indicator was: “Is this indicator suitable to measure changes in the state of sustainability before and after the implementation of the ICZM initiative?” The indicators were included in this list and answers such as ‘no effect’, ‘some effect’, ‘strong effect’ were inserted. Four coastal management experts filled in the online checklist, the results were collected and analysed. As many of these indicators were estimated to be too general to reflect single measures and they were not suitable to reflect the changes.

Step 4: Further to this, the discussion of the proposed indicators led to a reduction of the number of indicators and a rewording of their definitions. The desk-review and discussion with the scientist group provided a good overview which indicators cover various issues of the coastal zone. Additionally, some tailor-made indicators covering coastal issues were suggested. They were included in the new indicator set. In total, 45 tailor-made indicators were selected to reflect changes in the state of sustainability.

Step 5: Consequently the Indicator-based ICZM best-practice evaluation tool was created.

Description of the Indicator-based ICZM best-practice evaluation tool (v1)

The 45 indicators are grouped into four categories: 13 in the category of Environmental Quality, 9 indicators each in Economics and Social Well-Being and Governance (process) category contains of 14 indicators. The indicator list is provided in Annex I. The developed tool functions on a user-friendly Microsoft Excel Spreadsheet and it is compiled of 6 worksheets. The first sheet contains the introduction and guidelines on how to use the tool as well as a cell to provide the title and include maps and pictures of the study site. The next 4 sheets are divided by the four categories and contain the respective indicators. The tables are assembled in columns, left to right: Indicator, Description, Scoring ranges, Indicator score (aggregated) and Comments. The last sheet is the final assessment where the evaluator can see the final assessment results.

Scoring ranges

Two scoring ranges based on the Likert scale were developed through which a qualitative assessment was performed. The first scale consisted of seven scores ranging from -3 to 3 in scoring the sustainability indicators (Figure 3). The positive scores indicated a positive effect and degree of contribution to sustainability as follows: 3 (strong effects), 2 (considerable effects) and 1 (weak effects). On the other hand, the negative scores represented negative effects and a negative contribution to the sustainable development of the case study assessed. Moreover, the 0 score indicated that there was no contribution to sustainability, such as when there were no changes in respect of a particular indicator after the implementation of the ICZM measure.

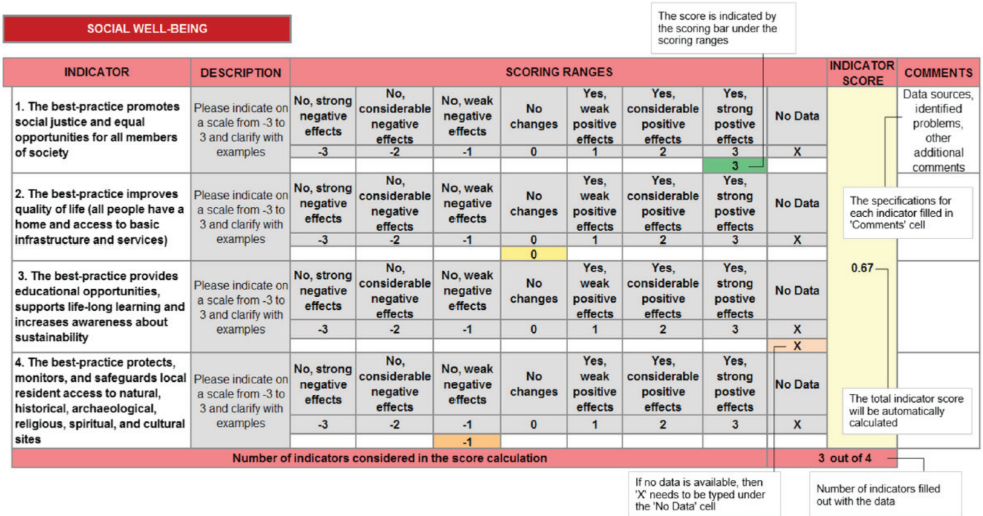

Figure 3. The tool extract of the social well-being category (Paper I)

Unlike sustainability indicators (environmental quality, economics, social well-being), process indicators were aimed at assessing the success of the management process. To this effect a different scoring scale was created for the process indicators. This scale consisted of 5 scores, ranging from 0 to 4. The 0 score showed that the objectives of the indicator were not implemented (no, not at all). The other scoring ranges represented the degree of implementation and were divided into: 1 (yes, slightly), 2 (yes, moderately), 3 (yes), 4 (yes, fully). As indicated in Figure 3 above, both sustainability and process indicator scores were included in the scoring bar below the scoring ranges.

The column 'Indicator score' directly calculates the average of indicators entered in this spreadsheet. Only one score can be given for each indicator by typing in the corresponding number in the field below. In the case that there was no data available to answer the indicator, 'X' has to be typed in the last cell below 'No Data'. Moreover, there is a cell for comments for each of the indicators, where the evaluator should refer to the data source, the identified problems and other additional comments serving as personal notes as well as for better comparison later on. Furthermore, the time consumed for the application filling should be entered in the "Final assessment" sheet.

Based on the score of each indicator, an average will be aggregated in the respective categories. The score will be calculated automatically and all 4 scores are shown in the final assessment sheet. The average is shown in decimal numbers from 0 to 3 in the first three categories and from 0 to 4 in "Gov-ernance" category. In the case that an 'X' is entered for 'No Data' the respective indicator will be excluded from the calculations.

1.2 An indicator set (v1) application process and study sites

The Indicator-based ICZM best-practice evaluation tool (v1) was applied to 18 thematically different coastal case studies using two different methods: a fast screening and an analysis of in-depth assessment which were used to identify strengths and weaknesses of the ICZM together with their contribution towards sustainable development. Likewise, 7 study sites covering different coastal themes and policy objectives in Lithuania, Germany and Finland were selected for the in-depth analysis with the objective of assessing whether the studies are considered as best practice examples (Figure 4).

Figure 4. Locations of research study sites. The in-depth analysis:
(a) Geltinger Birk, (b) Timmendorf, (c) Markgrafenheide, (d) Klaipeda/Palanga,
(e) Rusne, (f) Western Finland, (g) Southwest Finland (Paper I)

Further to this, 14 study sites from Sweden, Netherlands, Germany, Denmark, the United Kingdom and Ireland were selected for a fast screening analysis (Figure 5). The carefully selected studies were picked as described with the aim of having an international comparison of different ICZM best practice examples.

Figure 5. Locations of research study sites. Fast screening method: (1) Geltinger Birk, (2) Timmendorf, (3), Markgrafenheide, (4) Gotland, (5) Ystad, (6) Køge Bay, (7) Tryggelev Nor, (8) Odense, (9) Rotterdam, (10) Perkpolder, (11) Coastline: Weybourne to Lowestoft, (12) Abbott's Hall, (13) Horsey Islnad, (14) Inch Beach, Co. Kerry (Paper I)

The main criteria for choosing the case studies were as follows: the best practice describes a measure implemented in coastal areas; the spatial scale; a broad variety in key approaches given, in order to test the tool in different cases to ensure it is widely applicable; sufficient data availability. Additionally, 3 German case studies (Geltinger Birk, Markgrafenheide and Timmendorf) were chosen to compare the in-depth analysis and fast screening, with focus being placed on the differences between the evaluations and study sites covering different themes, key approaches, objectives and measures (Paper I). Moreover, a comparison of the different assessments was made on Abbot‘s Hall (see Figure 5, number 12), which was evaluated 4 times by different evaluators. The detailed description of the case studies features and the main objectives are provided in Annex II and III.

An indicator set application process was based on two steps methodology, which was adopted from European INTERREG-IVC-Project SUSTAIN (SUSTAIN partnership 2012). Firstly, the evaluator collected the data related to the indicators. Secondly, the indicators were scored based upon the data using a Likert scale. The indicator set was applied to different case studies using two methods: a fast screening and in-depth analysis. Whereas the time for an in-depth analysis of one study is unlimited the given time frame for the evaluation of one study via screening is restricted to an exact time limit of a maximum of 12–16 h. Furthermore, the time restriction was included in order to find out if a fast screening method by non-experts of study site will be comparable to the in-depth evaluation and if the available time resources are restricting. The indicator set was applied in-depth to seven different case studies of Lithuania, Finland and Germany by experts of the study sites. Additionally, in order to compare the two methods, the three applications were repeated using the fast screening method for three German cases by a non-expert evaluator. The applications for the coastal management case study of Abbott's Hall using the fast screening method were done by 4 evaluators with different backgrounds. The experts conducting the in-depth analysis had various data available, due to their long involvement into the respective studies, ranging from different literature, online resources, observations in site, interviews and talks with locals and other specialists. The search of data by fast screening method is regulated by the evaluator and was mostly based on personal knowledge, opinion, theoretical considerations, information publicly available in the OURCOAST database of European Commission and other internet sources. The evaluators had to complete the evaluation on their own and were not allowed to talk to each other, neither about the meaning of a specific indicator nor about anything in regard to the content of the best practice in order to achieve the best comparable results. Furthermore, they were not allowed to share their data amongst each other. Questions that arose during the application, especially concerning the understanding of the indicators, had to be solved self-dependently. This way, the comprehensibleness of indicators is tested as well as the possibility to transfer this tool to an application on local levels and by non-scientists. Applications were carried out using the same available data and with the time restrictions without contact to site experts.

1.3 Indicator-based Sustainability Assessment Tool (v2)

The Indicator-based Sustainability Assessment Tool (InSAT) framework and indicator set have been further-developed and improved:

1. The proposed tailor-made system was designed to: a) assess changes in the state of sustainability before and after coastal and marine management measure implementation; (b) measure the quality of management process from initiation to implementation.
2. The list was improved through the inclusion of specific, tested and tailor-made indicators considered to cover essential aspects of coastal and marine sustainability.
3. The indicators were tailored to the strategic goals and requirements of the ICZM measures.
4. The indicator set was divided in core and optional indicators which made their use more flexible.

Therefore, the total number of the selected indicators was an important factor to consider in avoiding time-consuming and ineffective assessment processes. In this regard, it was suggested that using 65 indicators which gives flexibility with the choice of optional indicators in an assessment was reasonable (Figure 6). This struck a healthy balance between allowing for a manageable number of indicators and avoiding a scenario of having too few, which would otherwise have resulted in the exclusion of important information. On the other hand, while too many indicators would likely have taxed resources, there could also have been insufficient data available. The core indicators were to be used and applied at all times when relevant data was available for assessment. The optional indicators reflected local and regional specificities, the selection and application of which adjusted to circumstances.

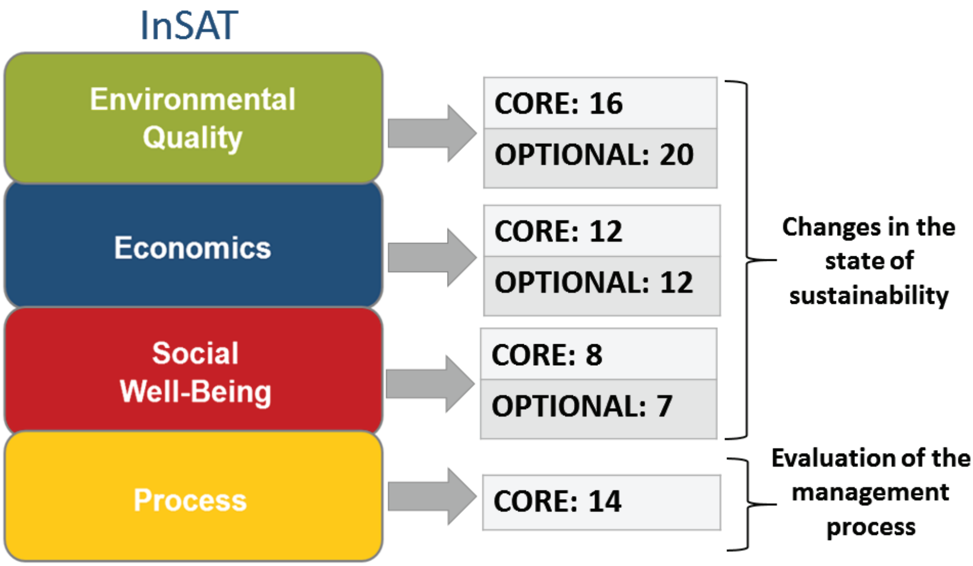

Figure 6. This graphic shows: InSAT sustainability categories (on the left), main objectives (on the right) and the total number of core and optional indicators included in the tool (Paper IV)

The proposed indicator-based sustainability assessment framework using InSAT involved 6 application steps (Figure 7):

Figure 7. The indicator-based sustainability assessment framework using InSAT (Paper IV)

1. The first methodological step of the sustainability assessment was the definition of the concrete objective of the coastal or marine management measure, which was planned to be practiced, improved or revised. The objective of the management initiative laid out the potential and aimed direction of the same focused initiative in respect of achieving sustainability.

2. Once the strategic management initiative objective was determined, the main targets of the different Management Options (MO) could be subsequently established (Figure 7, Step 2). The principal goal of this step was to understand the nature of what was to be achieved and also within which limits of the focused sector, area or region it was to be achieved. If this was clearly identified at an early stage, more suitable tailor-made indicators could be selected, with more satisfactory outcomes expected from the assessment.

3. The third step of the sustainability assessment framework was the selection of the most relevant indicators. However, due to significant differences between sustainability concepts and aims in different coastal and marine management solutions, the

proposed framework under this study encouraged a careful analysis of the outcomes and needs of a specific management measure. To this effect it was suggested selecting specific, more flexible tailor-made *core* and *optional* indicators (Figure 7, Step 3). The proposed list of indicators was based on the sustainability criteria covering both the technical and thematic spheres. Without the determination of the sustainability criteria, indicator selection and consideration of different management options, it would not have been possible to obtain reasonable results of sustainability. The selected optional indicators had to be technically capable of assessing the determined management options in terms of the sustainability criteria.

The following criteria were used for selecting indicators: a) scope (selecting indicators that fit into the main aim and targets of the studied management initiative with particular focus on sustainability issues); b) relevance (selecting the most suitable indicators for a specific coastal or marine study subject); c) data availability (taking into account the accessibility of data) and; d) quantification (considering the quantification capacity of an indicator as a selection parameter or reference value for making comparisons) (Paper IV). Moreover, the selection of the indicators was carried out according to the following criteria: a) theoretically well founded; b) relatively stable and independent; c) clear in content; d) measurable and comparable, easy to quantify; e) regionally specific; f) based on data that is acquirable (Paper I). Additionally, the selected indicators are used to guide decisions in managing human activities in coastal and marine areas. Therefore, they had to be specifically oriented towards guiding the decision-making process.

The InSAT was provided in an easily applicable Microsoft Excel spreadsheet format. The indicator set consisted of 16 core and 20 optional indicators in Environmental Quality (EQ) category, 12 core and 12 optional indicators in Economic category (E) and 8 core and 7 optional indicators in Social Well-being category (SW). Finally, the process category consisted of 14 separate and distinct indicators which were suitable to evaluate the success of coastal and marine management Processes (P) (Figure 6). The indicators were inserted in the InSAT and covered 3 sustainability categories which were further divided into sub-categories (Figure 8). Each sub-category had its own indicators with specific objectives to assess the specific coastal and marine management initiatives.

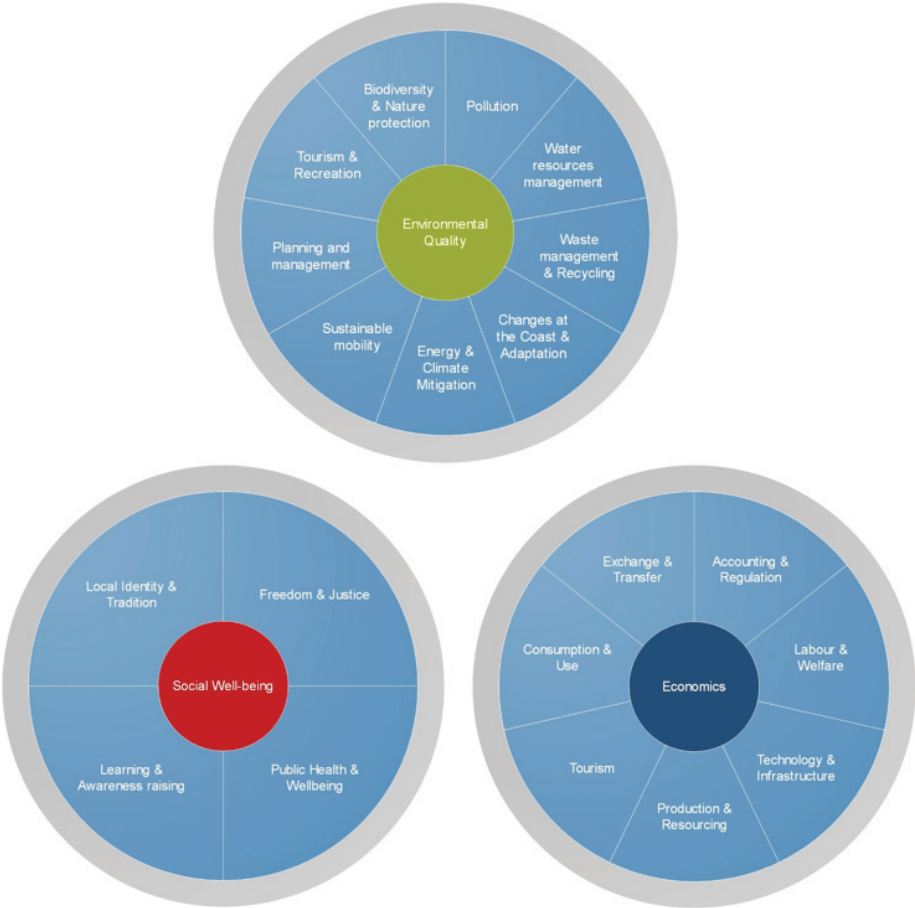

Figure 8. The sub-categories of the sustainability indicators of the InSAT (Paper IV)

1.4 Study sites and InSAT application process

The InSAT with final indicator set was applied to 3 case studies in Lithuania: (1) Liquefied natural gas (LNG) terminal in Klaipėda; (2) Renewal of the Port of Šventoji; (3) New beach opening in Nida (Paper IV) (Figure 9).

Figure 9. Study sites: (a) Port of Šventoji; (b) Klaipėda LNG floating storage and regasification unit; (c) Nida beach (Paper IV)

The InSAT was applied to assess the changes in sustainability where the management options cover different measures and implementation levels, ranging from fully implemented to implementation in progress as well as hypothetical scenarios. Furthermore, the application of InSAT enabled exploration into how the appropriate use of indicators can be a powerful tool in addressing the sustainability and quality of the coastal and marine management process. The main targets of the case studies and indicator applications are provided in Table 1 and Annex III.

Table 1. **The list of study sites and their main targets (Paper IV)**

Case Study (CS)	Objective of CS	Implementation Level: Application Objectives	Management Options (MO)
Klaipeda liquefied natural gas (LNG) floating storage and regasification unit terminal construction	To implement the LNG terminal which allows Lithuania to import natural gas from various countries around the world	Fully implemented: to assess the indicators' suitability in identifying strengths and weaknesses of the implemented initiative and to measure the success of the implementation process; to assess the indicators' suitability as a monitoring tool	LNG terminal is in place
Port of Sventoji renewal	To renew the port of Sventoji to develop and increase tourism	Implementation in progress: to demonstrate how indicators could be used in the planning process; to assess changes in sustainability comparing the situation now and after renewing port; to illustrate advantages and disadvantages of renewing a port; to identify the implementation shortcomings (the port renewing process was stopped)	Situation after renewing a port
Beach opening in Nida at Curonian Lagoon site	To establish the new beach for prolonging the bathing season	Hypothetical scenarios being proposed: to assess the indicators' suitability in measuring sustainability of proposed hypothetical management options	Advertisement campaign: Advertisement campaign combined with change in infrastructure

The applications were carried out with experts who are actively working in the field of coastal and marine management or experts who form a part of the research case studies and students possessing local knowledge. Experts were chosen from different institutions based on backgrounds and knowledge of the study area. The InSAT, the description of the tool and written explanation of the application procedure were provided to the evaluators before the assessment. For the purposes of this study, 9 experts (18 applications) and 2 student groups (6 applications) were involved. Two applications were carried out by students (a group of 20 persons) who attended the BONUS project BaltCoast Summer School 2017: "System Approach Framework (SAF) for Coastal Research and Management: from theory to practice" in Latvia. Additionally, four applications were carried out by students (a group of 12 persons) from Klaipeda University who attended the intensive course "Coastal and Marine Management Course 2018" in Klaipeda (Lithuania). For the assessment, the evaluators assessed management options, which differed from the main aim, objectives, and implementation level (see Table 1). The assessments with students were conducted over two days. The students received a lecture about sustainability and coastal indicator systems as well as the InSAT and instructions how to apply it. Furthermore, the students were given one day to apply the indicators to all case studies, for which they were divided into groups. Following the assessment, they had a one-hour round table discussion where they could interpret results, come up with solutions as to how the tool, indicators, or case studies (CS) could be improved, and present their findings. Through the process, the students had an opportunity to apply their local knowledge since all case studies were in Lithuania, while also being able to use all internet resources. Furthermore, the experts had a week to carry out assessment and the time used for the assessment the evaluators planned individually. Following the assessment process, all experts were contacted, either by phone, email, or during face-to-face round table discussions. The latter discussions helped to address any uncertainty, which arose in the comment cells with reasons explaining why particular scores were assigned to specific indicators as well as to find out about the total time used for assessment. In fact, the scoring indicator process did not take more than one day. Furthermore, discussions took place to obtain a better understanding of the evaluators' view and insight over the scoring and result interpretation. The assessment results did not change as a result of the discussion, but they helped to analyse misunderstandings and any possible shortcomings of the indicators and tool.

2

Results

2.1 Strengths and weaknesses of the ICZM measures: are they best practice examples?

Firstly, the evaluation based on the indicators covered the full cycle of the ICZM. Also, indicators evaluated the extent to which an action was sustainable and revealed to which extent targets and objectives towards sustainable development have been met. Moreover, the process indicator results demonstrated to what extent the ICZM was implemented. In fact, the indicator-based sustainability assessment tool helped to evaluate whether the case study could have been defined as the best practice example. As a result, a case study was identified as the best practice if it had a broad overall perspective covering all sustainability aspects and if its measures collaborated with natural systems while respecting their capability, particularly when it was seminal and promising. Also, the provision of a systematic solution, which was responding to the practical needs of the area was important as well as the involvement of all parties concerned. As an example, the results of several case studies are presented as following (from Paper I).

The case study of Geltinger Birk improved the local state of sustainability and showed considerable positive effects on sustainability, especially had positive impacts on environmental quality based on the indicator level results (see Figure 10).

Environmental Quality Indicators \ Study sites	Geltinger Birk	Timmendorf	Markgrafenheide	Klaipeda	Rusne	Southwest Finland	Western Finland
1. Reduces waste, prevents air, water and soil pollution and stimulates material reuse and recycles	0	3	3	0	2	2	2
2. Promotes flood prevention, protection and mitigation	3	0	3	0	2	0	0
3. Improves the status of water (ecological and chemical)	3	0	3	0	0	1	2
4. Supports policy and system to conserve key natural sites (including marine and nature scenic, cultural, and wild landscapes)	3	0	2	3	2	2	2
5. Effects land use planning and management, supports environmentally friendly rural activities	3	2	0	2	3	2	1
6. Supports urban planning and effects urban development	0	1	3	3	2	2	3
7. Supports natural habitats, biodiversity and their quality	3	1	3	-3	3	2	3
8. Improves sustainable management of coastal erosion	3	0	1	3	0	0	0
9. Increases the resilience and reduces vulnerability to climate change impacts	3	0	0	2	0	0	2
10. Increases energy efficiency	0	0	0	0	0	0	2
11. Increases the use of low-impact transport and supports sustainable mobility in the destination (including public transport)	0	1	2	0	1	2	2
12. Contributes to increase environmental awareness of the population	3	0	0	1	2	1	2
13. Promotes environmentally-friendly processes and products	2	3	3	-1	2	2	1
Average score by category	**2.00**	**0.85**	**1.77**	**0.92**	**1.46**	**1.23**	**1.69**

Figure 10. Indicators application results of Environmental quality category. The scores indicate a degree of contribution to sustainability of environmental quality. Scale from −3/dark red = strong negative effects; −2/light red = considerable negative effects; −1/orange = weak negative effects; 0/yellow = no effect; 1/light green = weak positive effects; 2/lime green = considerable effects; 3/green = strong positive effects (Paper I)

Due to the realignment of the coast, which included the construction of a new dyke, the nearby village is protected from flooding. The re-wetting of the area enhanced the development of biodiversity and the establishment of flora and fauna, which were formerly domiciled here. Moreover, the measure promoted the local economy, increased the low-impact tourism, as well as had considerable positive effects on social well-being with the 60% score for this category (Figure 11, Paper I, II).

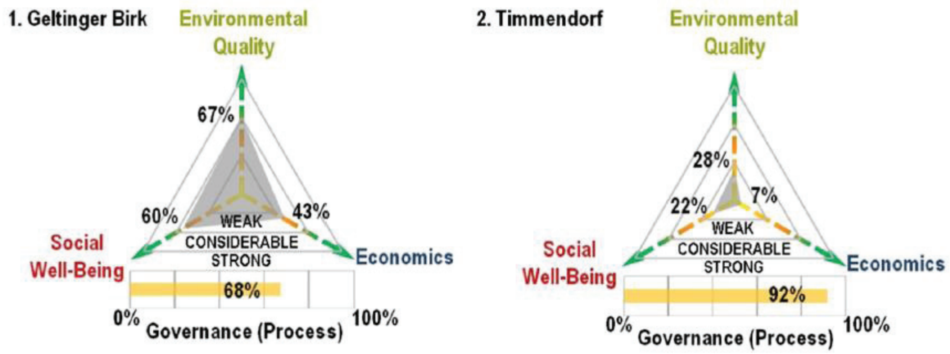

Figure 11. The application results of the in-depth evaluation at category level (extract from Paper I)

The evaluation of Timmendorf case study management process showed that the implementation of the ICZM initiative on Timmendorfer Strand is estimated as very high with 92% (Figure 11). It has several shortcomings, for instance, the management team, which was not fully built to lead the planning. Besides, the measure was successful implementation according to the guidelines of the Systems Approach Framework. Consequently, a successful flood protection system was established after argumentative and strong public participation into the planning and implementation process. The issue was chosen driven by ecological, social and economic needs and targets were set. The possible consequences on these were identified and a strategy was developed regarding the assessment of these effects. All stakeholders were determined and included into the process and impacts on them were assessed. This led to an accepted and successful implementation. Further following the SAF ensured the overall success. The results of the process showed that a good implementation process could have weak positive effects on sustainability. Due to the flood protection walls, the inhabitants living in the area, as well as their tangible values, are protected. Economic stability and resilience is enhanced and changes in the foreshore area are improving the management of coastal erosion, which is leading to reduced vulnerability to climate change impacts.

The overall results showed that the study sites application results have different characteristics and some studies have a greater impact on environment while others indicate greater investments in the economy. Additionally, the relations between the categories should have been contemplated as they influenced one another. For instance, in Finland a cultural tradition is to construct holiday houses along the coast but it affects coastal management plans and the conservation of habitats and species.

Furthermore, during the application process two key words were a common feature i.e. ‘public participation’ and ‘development strategy’. Consequently the public and the authorities played an important role. In fact the results showed that case studies where public participation was emphasised and where all kind of stakeholder groups were involved from the very beginning of the planning process were successful. This can be further highlighted through the Geltinger Birk process where the exclusion of stakeholders and the public from the beginning of the process in fact led to problems which hampered the project. As discussed in Paper II the acceptance of the scheme was poor as not all scenarios were put into account with the affected groups and individuals feeling excluded. A proper application of the SAF would have assisted to avoid this problem.

Due to the novelty of the ICZM, long-term studies are rare. For this work, only the initiative in Køge Bay, which was planned in the 1930s and implemented in the 1970s, was evaluated as a long-term study where a long-term development is observable. However, the data availability for this case is limited. Online resources are rare and data is available in Danish only. This applies as well for the initiative in Perkpolder, which is documented in Dutch. The documentation is not enough for a distinct application of the indicator tool. A first attempt is the OURCOAST website which holds an ICZM database, containing summaries describing 350 cases where the ICZM principles and tools that have been applied. For a decent evaluation the availability of data is therefore decisive.

The time-frame for evaluation and comparison of results showed high importance. If one evaluation shows a development observed over 5 years and the other considered 20 years of the development, the reproducibility of data is insufficient. Initially the study of Timmendorf promoted the communication and cooperation between citizens and local authorities but as the whole process took over 20 years before the implementation, these assets were lost until then. Each case study has to be evaluated separately, with regards to its previous state and the objectives that were predetermined.

Moreover, all analysed studies have been conducted on a rather small scale, focusing on municipalities and shorter coastal strips. Therefore, based on this research, a distinct statement about the applicability of this tool on different spatial scales is possible.

The tool and application results demonstrated the ability to identify strengths and weaknesses of the ICZM initiatives and their contribution to sustainable development. Also, if basically all ICZM key elements are fulfilled, the respective case study can be described as a best-practice example. Furthermore, the indicators pose a perfect instrument to provide learning and awareness-raising processes for communities.

2.2 The comparison of the in-depth analysis and fast screening, the role of evaluator

The indicator-based tool was applied to thematically different coastal case studies using two different methods: a fast screening and an in-depth analysis assessment. While comparing in-depth and fast screening assessments resulted in significant differences, both methods used helped to identify strengths and weaknesses of the ICZM and their contribution towards sustainable development. The fast-screening assessment results which were the less time consuming of the two methods showed that this method served to attain a good overview and a first impression of a case study state towards sustainable development. In comparison, the in-depth analysis proved to bring more comprehensive results from the assessed case studies. When comparing the screened evaluations of the three German case studies (Markgrafenheide, Timmendorf, Geltinger Birk) with the applications of the in-depth analysis done by the expert the differences in results occurred. For instance, Markgrafenheide showed considerable positive effects on the development towards sustainability (Figure 12).

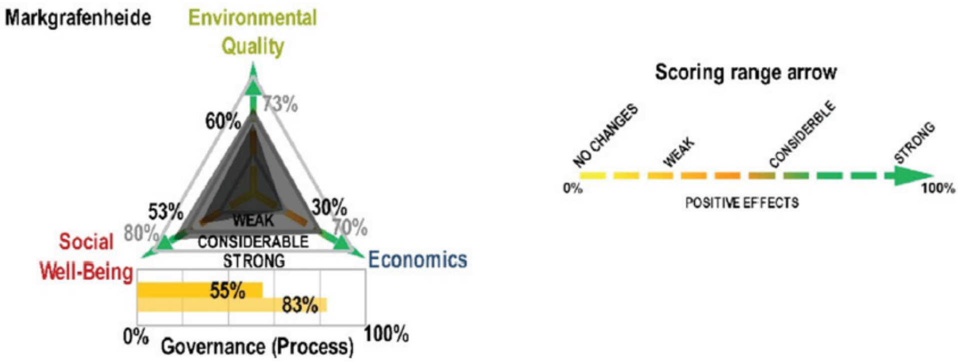

Figure 12. The application results comparison of the fast screening (grey triangle; light yellow bar) and in-depth analysis (black triangle; dark yellow bar) (extract from Paper I)

The aspects that stand out of the most are: the prevention, protection and mitigation of floods, the support of natural habitats, their biodiversity and quality. The realignment of the coast is a new approach towards a more sustainable development in this area. According to the evaluation, the process of implementing the measure had several shortcomings; however, the process was criticized as the inclusion of the local community and stakeholder groups failed with the start of the project and not all concerns had been considered. Yet, the measure can be evaluated as a success retrospectively because it is an outstanding example of coastal protection and nature conservation. The results of applications using two different methods are slightly comparable, although their outcomes do not have the same quality.

Furthermore, the application process demonstrated that the time frame of 12-16 hours for fast screening evaluations is not always enough to gather all the information needed to assess the best practice thoroughly. However, in most cases, an extension of the time frame would solve this problem. Also, some data is not obtainable for the fast screening evaluations due to the need of the inspection on the site and expert consultation. The expert, who participated in the case study implementation process, would be necessary for a successful evaluation to the respective indicator.

Moreover, throughout the applications, it was identified that experts of the ICZM measures showed relatively quick application even if there was no fixed time for applying the indicator set within the in-depth application. In fact, indicator applications could have been carried out not only by experts of ICZM measures but also by scientists or young scientists and non-scientists. Despite this, experts proved to possess better knowledge and perception of the study sites. The assessment results showed some differences when it came to understanding the meaning of indicators. Besides, the sustainability indicators were rather wordy and as such could have led to different interpretations and variations of scores. Furthermore, the results could have been influenced by overall worldview, regardless of whether the evaluator was an optimist or pessimist. Moreover, as the indicators were scored on the Likert Scale, they were already prone to subjectivity. In addition, the academic or professional background affected the scoring of indicators. For instance, the evaluator with a background in natural sciences most likely was more critical in the environmental category in comparison with the evaluator having a business management background. Additionally, the assessment results also depended on the evaluators' expertise in the specific case study. Moreover, the variations in results occurred due to differences in language skills. All in all, the results were not easily reproducible because they were affected by evaluators' perception, personal perspective and background.

The general overview can be obtained in a short time, yet to achieve reliable results either various applications or an expert-led evaluation should be performed. The fast-screening assessment results showed that this method serves to attain a good overview and a quick first impression of a case study state towards sustainable development. On the other hand, the in-depth analysis proved to deliver more comprehensive results. With that said both methods presented the improved sustainability and achieved positive changes with regards to sustainable development of the specific case studies assessed. Further to this, the tool using both methods benefits for teaching and learning processes.

2.3 Indicators as an early warning signals in different implementation levels

In this study, the indicators were split into core and optional tailor-made indicators as an early warning signal that helps to identify strengths and weaknesses within the quantitative assessment of coastal management initiatives. The InSAT tool with tailor-made core and optional indicators presented flexibility within applications on a wide spectrum of coastal case studies. Additionally, the main advantage of optional indicators related to the fact that during the assessment procedure they were very helpful in assessing particular case studies and to showing their specificities. For instance, the InSAT assessment results of the construction of the LNG floating storage and regasification unit terminal implemented in Klaipeda (CS 1) proved that both indicators and the tool are suitable for the identification of strengths and weaknesses of the implemented management initiative. The assessment results of the case study on the LNG terminal showed weak positive effects on environmental quality (25%) and social well-being (28%) and showed considerable positive effects on the economic category (41%) (Figure 13). The process indicators were applied to assess the success of the management process. The results indicate that this case study covered quite a number of SAF steps and reached a high score in managing the implementation process (70.3%). The factors leading to success were namely the fact that a management team with broad competence and sufficient representation was built to lead the planning process, that stakeholder groups were determined, and that a strategy was developed on how to assess the economic, ecological, and social consequences of different scenarios. An environmental impact assessment (EIA) was carried out before the construction of the LNG terminal. Moreover, the feasibility, costs, and efficiency of scenarios were reviewed and evaluated. In addition to this, some data relating to the project was missing; for example, it is not known whether there was a strategy to tackle issues of missing data and uncertainty during the implementation process. The case study implementation demonstrated several weaknesses. The problem identified by the process indicators points towards a lack of communication with society and public in general. The concept was implemented but not fully accepted by the public and consequently caused many demonstrations and discussions. Moreover, whereas the entire process was documented, only a part of the information was publicly available. As a case in point, the EIA is no longer publically accessible, though during the implementation procedure it was available on the website of the Klaipėda Nafta organisation. While the LNG terminal construction has several shortcomings, it is fair to say that it also presents a number of positive effects in terms of the regional and national economy.

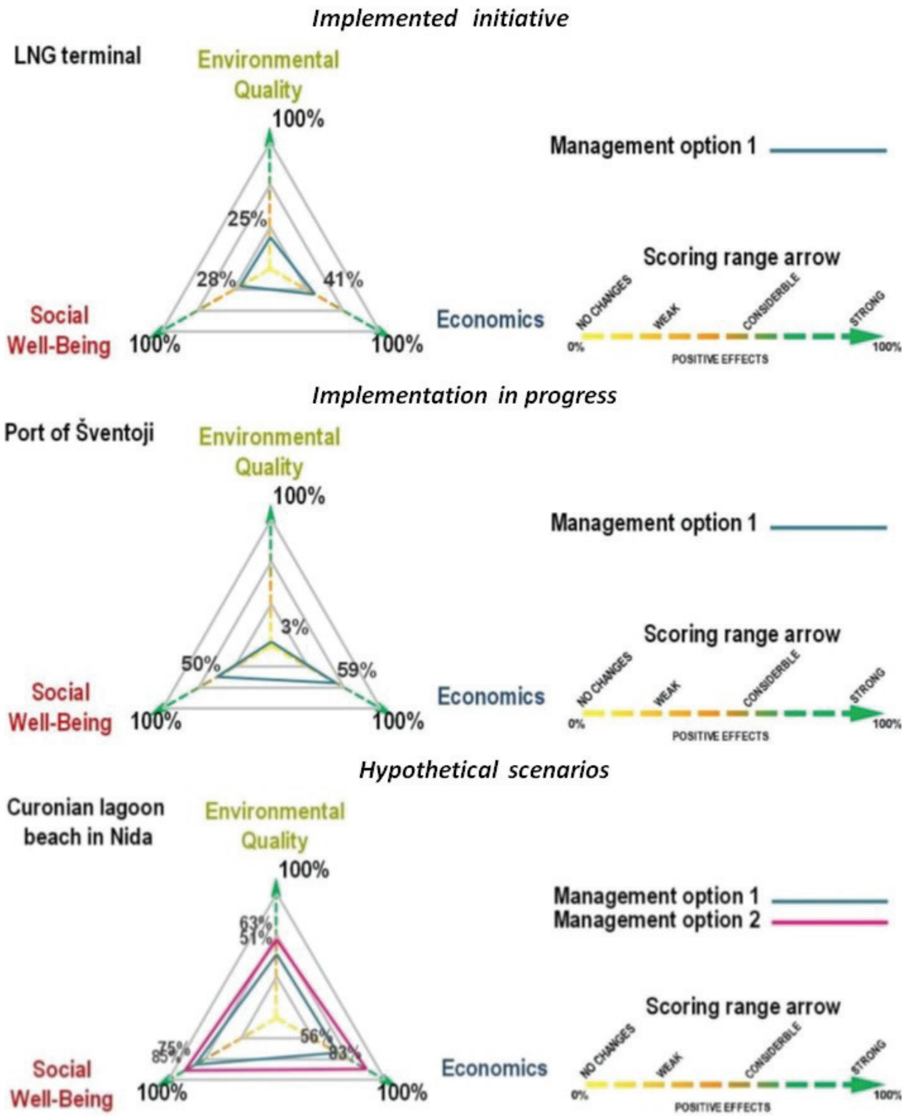

Figure 13. Results of the InSAT applications (Paper IV)

The InSAT demonstrated that the indicators are suitable in the planning process since they were helpful to assess changes of sustainability and to illustrate the pros and cons of the port of Sventoji renewal (CS 2). The main aim for renewing the port of Sventoji is to develop and increase tourism in the area and contribute to the local economy. The InSAT application results showed that CS 2 considerably contributes to the social well-being (50%) and economic (59%) categories but just weakly to the environmental quality category (3%) (Figure 13). CS 2 contributes negatively to the environmental quality sub-categories such as pollution, biodiversity & nature protection, and tourism & recreation. The port renewal has weak negative effects on air, water, and land pollution, natural habitats, biodiversity, and their quality and increases coastal erosion. Moreover, CS 2 has considerable and strong positive effects on land use planning and urban development but increases pressure due to coastal and marine recreation, which leads to increased amounts of beach and marine litter.

Furthermore, the Port of Sventoji (CS 2) improves quality of life and increases awareness about sustainability. It promotes communication and cooperation between citizens and local authorities. Furthermore, this case study increases the production of local and fair-trade goods and services. In addition, the optional indicators indicated that CS 2 boosts public events, concerts, and festivals organised to strengthen the area's local identity. The renewed port encourages visitors to volunteer or contribute to community development, cultural heritage, and biodiversity conservation. The higher number of tourists increases the consumption of goods that are locally produced. Additionally, CS 2 supports providing interpretive information at the site, with the information being communicated in relevant languages. The assessment results demonstrated the importance of port renewal for the local economy. The case study considerably affects financial policies and instruments to support economic stability and resilience, while it ensures an acceptable level of employment by providing more new job positions in the region. Additionally, CS 2 enhances investments in coastal management, promotes infrastructure development, and increases environmentally friendly transport. CS 2 has strong positive effects on tourism management and its strategy. As a result, there is a plan to use bicycles and small boats on site to limit air, water, and land pollution. The optional indicators selected from the economic category showed that CS 2 considerably increases the volume of port traffic because of incoming and outgoing passengers as well as the volume of goods. In addition, it increases recreational boating and seasonal tourism pressure.

The assessment of CS 2 indicates that the process has not been implemented fully, and several weaknesses were identified. As a case in point, a management team with broad competence was built to lead the planning process, but there is no information relating to stakeholder involvement in the plan development and management initiative implementation process. Likewise, assessments were not made of impacts on different stakeholders. Furthermore, there is no strategy relating to the issues of missing data and uncertainty in the implementation process. As a result, the entire process was not documented or made publicly available, and the success of the measure was not evaluated. The weaknesses identified could be improved upon in the future, perhaps in the eventual management procedure when renewing the Šventoji port. The assessment identified shortcomings in the implementation process, which could be improved through future planning at the Palanga municipality level as well as at a national level.

The assessment results also suggested that InSAT is a valuable tool in the case of hypothetical scenarios particularly since when data is not available, the indicators and their corresponding results can still support scenario modeling. The indicator-based tool was applied for the case study of the new beach opening in Nida (CS 3) to analyse which management option out of two (advertisement campaign (MO 1) or advertisement campaign combined with change in infrastructure (MO 2), see Table1) is better in terms of sustainability for the strategic goal of establishing a new beach, taking into consideration the main aim of prolonging the bathing season. The main aim of this assessment was to assess the suitability of the indicators in measuring the sustainability of the proposed hypothetical management options. MO 1 was based on advertising the newly established beach, the possibility for cheaper seasonal accommodation rental prices, and on offering discounts for the Klaipeda-Nida ferry. Tourists are attracted by the bird watching during the migration season, possibility to stay at camping sites along the Curonian Lagoon, and increased number of concerts and activities, especially designed for nature lovers and kids. The difference between the two management options is that MO 2 also includes a change in infrastructure. It covers beach preparation such as beach cleaning, sand nourishment, water purification, constructing benches, trash bins, changing rooms, toilets, and a rescue station and involves setting up information boards about air and water temperature and other conditions and setting up a sign that reads “Beach.” Moreover, MO 2 covers renewing old, and building up new, nature paths for nature lovers. As a result, the “advertisement campaign” (MO 1) and the “advertisement campaign combined with change in infrastructure” (MO 2) have considerable and strong positive effects on sustainability (Figure 13). The results of MO 2 assessment, to a greater extent than results of MO 1, demonstrated that all sustainability categories have strong positive effects (EQ 63%, E 83%, SW 85%). Moreover, MO 1, showed strong positive effects on social well-being (75%) and considerable positive effects on the environmental quality (51%) and economics (56%). The results of screening through the indicators showed that both management options have some positive and some negative effects on the environment quality. For example, there are some negative effects posed by the increasing number of tourists who come to the Curonian Spit by road transport (car and motorcycles). People most likely come by cars, and, as the indicators identify, it will increase air pollution. In fact, during summer, different measures are implemented to increase green travel options, including bicycle promotion, a fast ferry from Klaipeda, and a waived ecological fee for hybrid cars. Consequently, there are fewer options and fewer financial advantages when reaching the area in spring and autumn. In the case of the official beach opening, some measures will be applied to ensure that pollution by litter and other organic matter (macroalgea, fish, insects, etc.) affecting the soil and water quality will be removed and monitored more often. In fact, the results showed a very small and local positive effect. MO 2 has a significant effect on land use planning, urban development and management because the beach establishment area belongs to the city and the city infrastructure will be slightly changed. Both management options increase pressure on coastal and marine recreation due to the increasing number of tourists in the pre- and post-season periods. However, when we focus on natural habitats, biodiversity, and the quality of them, the area is too small to be affected significantly. Moreover, both management options contribute to increased environmental awareness among the population since one of the planned main attractions is to promote nature sights. Moreover, the management options increase opportunities to observe coastal and marine fauna, with one of the activities being related to bird watching in spring and autumn. Firstly, MO 1 showed that it could attract more tourists without significant expense. The expenses are much higher for the beach establishment and maintenance of MO 2, which will not be covered by increased tourism. Secondly, there needs to be a minor investment for MO 1 for advertising and significant investment in beach infrastructure for MO 2. Additionally, the management options affect patterns of sectorial employment in that people can be employed for a longer period, which increases seasonal employment. The new jobs created by the beach establishment have positive effects on the economy and social well-being in the area. In fact, according to the assessment, the beach opening has a very small effect on the local economy but significant positive effects on social well-being. The indicator-based assessment showed that the case study implementation of MO 2 compared to MO 1 contributes more to sustainable development and would increase the attractiveness of the municipality, reduce seasonality, have minimal effects on environmental quality, lower economic costs, and enhance inhabitants' satisfaction.

However, the selection process of optional indicators reflected both positive and negative points. Starting with the latter, as a result of a misunderstanding the evaluators incorrectly selected optional indicators by applying the tool on a hypothetical management option. For instance, the evaluators incorrectly selected optional indicators by applying the tool on the hypothetical management option of CS 3 (the beach opening in Nida). In fact, the evaluators chose exactly the same optional indicators for both management options (MO 1 and MO 2), even if the selection process was clearly described and given in written form before the evaluation actually started. To this effect the selection of optional indicators should be clearly highlighted in the tool to facilitate the detailing of specificities of the different management options. In this regard, it will allow for more accurate findings.

However, the tool does not provide any solutions with regards to identified weaknesses of coastal initiatives. On the other hand the tool is good at assessing the concrete management initiatives by helping to provide a deeper look into environmental and socio-economic issues. The proposed sustainability scores could be compared at different layers of sustainability assessment, starting from a category level through to sub-categories and down to the level of indicators, with particular objectives which allow the adaptation of indicators for the assessment needs while enabling an easy way to communicate results. Further to this, the assessment results also demonstrated the applicability and efficiency of the tool in raising awareness about sustainability aspects by helping to initiate a discussion between stakeholders and society on the identified hot spots during the development of management initiatives process.

2.4 Indicators along the SAF process

The analysis of results demonstrated to what extent, how and when along the SAF multi-step process the InSAT could be applied to support the SAF. The InSAT can be used in several steps of the SAF (System Design, System Assessment, Monitoring & Evaluation) (see Figure 14). The first step of SAF is the Issue Identification that initiates the SAF process to achieve the sustainable ICZM. The second step in the SAF is the System Design. In this step, the concrete indicators should be selected from the InSAT list provided, as described in the InSAT application section of this paper. The potential management options should be discussed with the stakeholders. The indicators selected for each success criterion are used at a later stage in evaluating the success of the management initiative. The management options will form the basis for scenario simulations in the next SAF step (System Formulation). The step involving indicator selection highlights how stakeholder involvement plays an important role in that stakeholders could be helpful in reviewing and discussing relevant problems and issues and in further planning future management options.

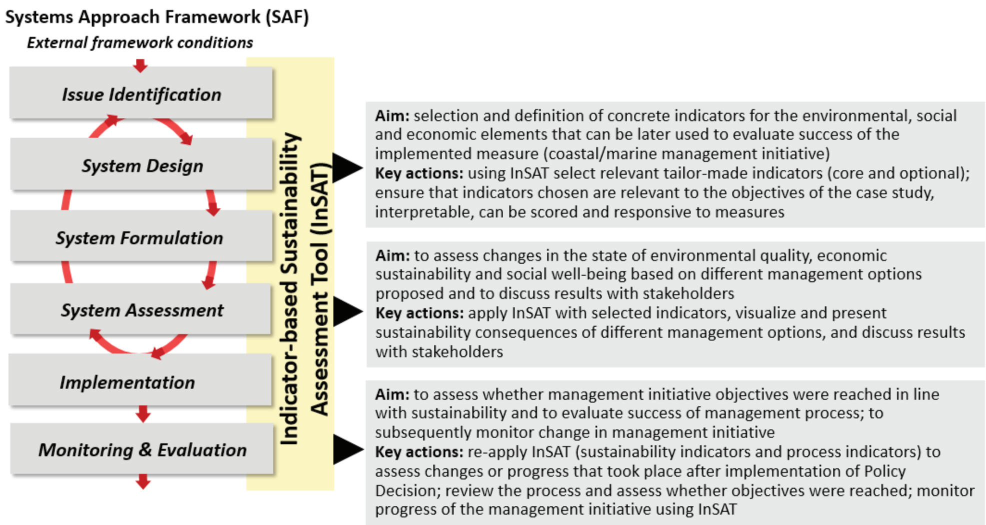

Figure 14. Indicators along the SAF and Ecological-Social-Economic (ESE) assessment process, for more information could be assessed http://www.safhandbook.net/ (Paper IV)

In the System Assessment step, the InSAT role is to provide easily communicable results to stakeholders for further discussion. The application of the InSAT provides a good overview of consequences of potential management options in resolving the issue at hand. The InSAT increases the awareness on aspects relating to sustainability. The tool provides an opportunity to compare sustainability scores at different layers, all the way from a category level through to sub-categories and down to the level of indicators, with particular objectives, which allow us to adopt it to the assessment needs while enabling an easy way to communicate results. After the implementation of management initiatives, the InSAT assessment allows a comparison of assessing the success of measures following the SAF steps.

The last step of the SAF application is Monitoring & Evaluation which involves the agreement over the indicators to be used for the evaluation of sustainability and success of the management measure and the appropriate monitoring. During this step it is necessary to go through the indicators of the InSAT list and check whether these are aligned with the objectives of measure. In the System Assessment step, the selected indicators could be included and re-applied in the monitoring plan to assess changes after the implementation of the policy decision. The results of the assessment should be made visible to the stakeholders.

The SAF issue identification as well as the system assessment phase includes strong and intensive interaction and involvement of the stakeholders. Initial tasks include, for example, the development of potential management options and scenarios. Further down the line the focus is shifted towards comparing and discussing alternative options and choosing the most suitable one. Therefore, the InSAT indicators could be used as early warning signals to discuss and avoid possible problems in the future. SAF and InSAT working together help to better understand the sustainability concept and measure the level of sustainability of current, planned or hypothetical management options.

The application results have shown that the InSAT assessment is more suitable for supporting and guiding SAF discussion processes, rather than delivering explicit results. The InSAT assessments deliver quick results; this allows the comparison between management options and a subsequent discussion thereon with the stakeholders. Typically, evaluations are time consuming, requiring the involvement of experts. The InSAT provides clear insights into sustainability of management initiatives.

2.5 InSAT as a decision support tool for coastal management

The InSAT could be used to support other integrated approaches like MSP and Land/Urban Planning (Figure 15) which follow the similar management process compared to the ICZM and SAF. The InSAT can be used independently from the SAF in different planning and implementation steps of each concept. Also, stakeholder participation in the management process plays an important role and as such it is vital to involve stakeholders from the very beginning for a higher process success rate (Paper I). In fact, stakeholders were helpful in reviewing and discussing relevant problems, issues and further planning of future management options.

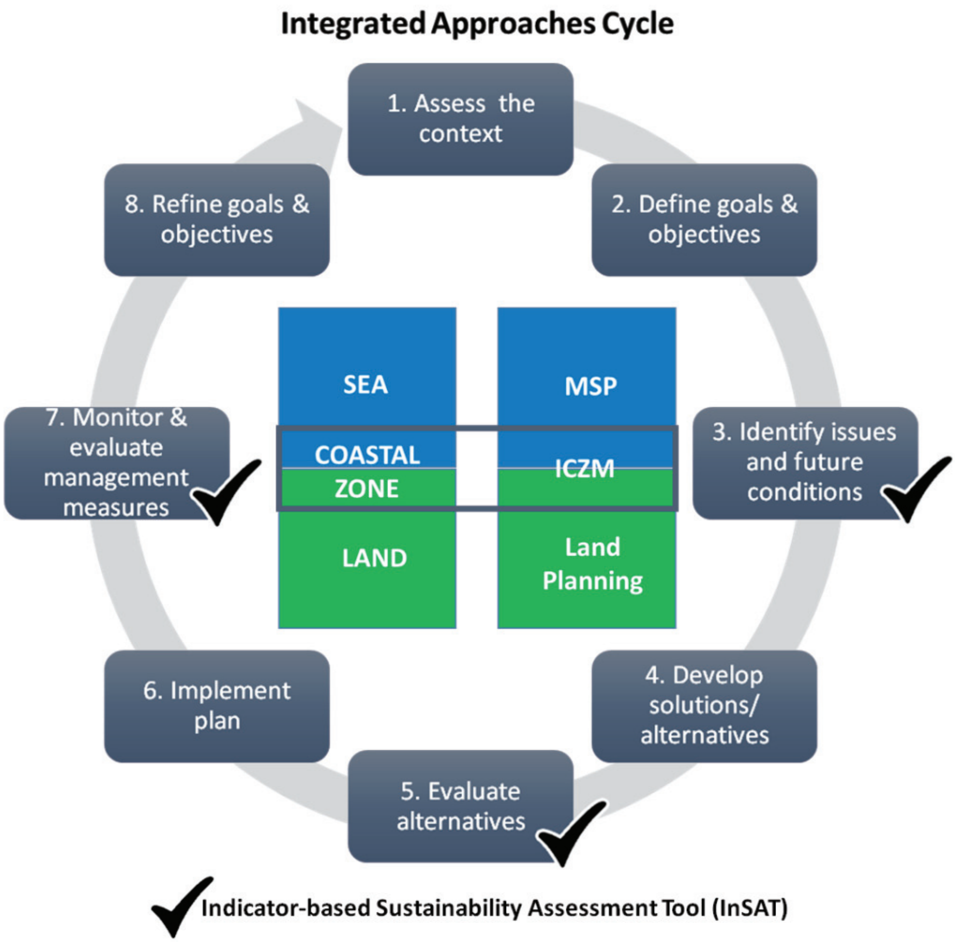

Figure 15. Integrated management approaches cycle and possible use of the InSAT (Paper IV)

The ICZM planning, the SAF issue identification and the system assessment phase include intensive interaction and involvement of stakeholders. Initial tasks include the development of potential management options and scenarios. Later the focus is shifted towards comparing and discussing alternative options and choosing the most suitable one. Therefore, the InSAT indicators could serve as early warning signals to discuss and avoid possible problems in the future. After the implementation of management initiatives, the InSAT assessment allows a comparison for assessing the success of measures following the implementation of coastal management initiatives.

The methodology is useful to support strategic planning and to develop both a sustainability vision and development strategy for the future. When data is not available for modeling, the InSAT provides structure for collecting expert and local knowledge in a manner that can analyse scenario results of potential policy decisions. Furthermore, it supplements scenario results when scenario modelling is possible in that it gives a more comprehensive view of the system in question. An integrated approach provides a means for drawing information together from individual indicators; however, the reliability of its results relies on the suitability of the selected indicators. Using an integrated evaluation method based on a sustainable indicator system of the coastal region, a fuller view of the coastal zone development process towards sustainability can be clearly achieved. The approach is effective, operational and reasonable if the selected indicators appropriately reflect the status of the study region.

3

Discussion

The InSAT tool with a tailor-made core and optional indicators presented flexibility within applications on a wide spectrum of coastal case studies. While the local regional case studies provided valuable insights, the merit of this study is that it is relevant beyond the study area, including the possibility to transfer results to other coastal regions for assessing and comparing management initiatives' success and sustainability. However, as already been mentioned by Schernewski et al. (2014), based on previous applications of the SUSTAIN indicator set, there is the risk that the spatial coverage of an indicator might go beyond the level of municipalities and results then rather reflect the regional conditions. Another important factor for the subsequent evaluation of the assessments is the given comments especially for comparison reasons. Without comments, the given scores are neither comprehensible nor comparable, which decreases the relevance of the evaluation and the tool. Moreover, what has already been stated by O'Mahony (2009) is that data is not always collected with sustainability in mind and a reliance on surrogate data may tamper the results.

Besides, some research criticised that sustainability (and the progress to achieve it) could not be effectively assessed using the indicators because of the latter's complexity and the equivocality of the concept itself (Mori et al. 2002, Reed et al. 2006). To use the indicators optimally, the cross-linking of different indicators is needed (Maelfait et al. 2006). Furthermore, the main criticism was the reductionism or over-simplification and the subjectivity when applying the indicators (Singh et al. 2009). Even though the indicators have been carefully worded in order to make them understandable and applicable for evaluators, some of the indicators were somewhat verbalised incomprehensibly. In addition to this, as stated by O'Mahony (2009), the semantic of indicator sets is decisive.

In this study, the indicators were scored on the Likert Scale, they were already prone to subjectivity. Also, the academic or professional background affected the scoring of indicators. For instance, the evaluator with a background in natural sciences most likely was more critical in the environmental category in comparison with an evaluator having a business management background. For this reason, Breton (2006) and Pickaver et al. (2004) suggested building evaluator groups having different backgrounds rather than a single evaluator to apply indicators. Taking this stance could have further increased the potential in data processing and could have led to more significant results.

Furthermore, the sustainable management of coastal systems requires an iterative process using a multidisciplinary approach that integrates the three pillars of sustainable development: environmental protection, social progress and economic growth (Støttrup et al. 2019). It is good to note that the SAF framework is considered to be the efficient way of structuring the coastal and marine management process and it contributes to better management in terms of sustainability priorities (Støttrup et al. 2019). Further to this, the InSAT and the indicator set support along the SAF process and contribute to the present-day lack of practical methodological and guidance tools (Støttrup et al. 2019; Ridder et al. 2010).

This new robust indicator system is designed to instigate discussions between stakeholders with the purpose of exposing weaknesses related to the proposed coastal management strategy. The assessment results and indicators objectives can be determined in line with the concerns and expectations of local stakeholders. In this regard, even if the tool may not give clear-cut results or solutions, it can still serve to support, guide and supplement participation and discussion processes. This can be further highlighted through the Geltinger Birk process where the exclusion of stakeholders and the public from the beginning of the process in fact led to problems which hampered the project. As discussed in Schernewski et al. (2017) the acceptance of the scheme was poor as not all scenarios were put into account with the affected groups and individuals feeling excluded. A proper application of the SAF would have assisted to avoid this problem.

The broader social and political context for incorporating expert advice into decision-making for coastal development is a potential avenue of research. It is widely recognized that there is a need for engagement between stakeholders to establish locally accepted strategies for sustainable coastal management solutions around the world. During the process of the development of management options, the InSAT can help initiate discussions between stakeholders and society. As a result, it will help decision-makers to generate information, to compare effects on the sustainable development of the municipality, and to provide a common understanding about the specific problems and the requirement for potential solutions.

Moreover, the indicator-based tool has been proven to be applicable and efficient in raising awareness about sustainability by helping to initiate discussion on the identified hot spots. In addition, the InSAT could be used together with the Stakeholder Preference and Planning Tool in supporting the main aspects of stakeholder engagement within the ICZM (Schumacher et al. 2018b). Both tools working together can identify success criteria and contribute to the identification of a problem or a conflict that needs to be resolved.

However, while the tool indicates the management measure weaknesses, the assessment results do not indicate what kind of solutions should be undertaken. The tool is also valuable in the evaluation of concrete management initiatives by helping to provide a deeper look into environmental, social, and economic objectives. The methodology seems to be useful to support strategic planning and to develop both a sustainability vision and a development strategy for the future. When data is not available for modelling, the InSAT provides structure for collecting expert and local knowledge in a manner that can analyse scenario results of potential policy decisions. Moreover, the tool could be used for teaching purposes as a sustainability awareness tool.

For the future research, it is recommended to explore the proposed indicator-based methodology and tool for coastal systems, to compare and merge it with the Ocean Health Index (OHI) framework for marine systems. OHI is a tailorable marine assessment framework to comprehensively and quantitatively evaluate ocean health. The framework originally is developed by an interdisciplinary team of scientists (Halpern et al. 2012) and the global assessments have been repeated every year since 2012 (Halpern et al. 2015). The combination of coastal and marine system frameworks could contribute to better understanding of land-sea interactions and the state of coastal and marine systems, and can continue providing human benefits now and in the future.

Conclusions

1. The tailor-made indicator set helped to assess whether the ICZM case study can be defined as a best practice example. The sustainability assessment results showed to what extent the ICZM initiative objectives have been met, what progress the measure has achieved towards sustainability and to which extent targets have been met. However, the tool will only provide an indication to the existing weaknesses but does not detail why and how changes occur and what solutions should be undertaken in tackling such weaknesses.
2. The fast-screening assessment results showed that this method serves to attain a good overview and a quick first impression of a case study state towards sustainable development. On the other hand, the in-depth analysis proved to deliver more comprehensive results. However, both methods presented improved sustainability and achieved positive changes with regards to sustainable development of the specific case studies assessed. Further to this, the tool using both methods benefits for teaching and learning processes.
3. The evaluator as an expert brought a better knowledge of the study area. However, subjectivity in terms of understanding data and indicators coupled with personal perception make a significant influence on results. The availability of time and data is decisive for a successful and reliable evaluation. Therefore,

the idea of building groups of evaluators in order to stabilise results and minimise subjectivity should be deepened and the method further tested thereafter.

4. A categorisation of the sustainability indicator set between core and optional indicators proved their flexibility and ability in being tailored to the needs of the strategic goals of coastal measures. In this regard the indicator set reveals the degree to which implementation of coastal and marine initiative reach sustainability.
5. The InSAT could be used as a supporting tool for SAF as well as with other integrated assessments. The proposed InSAT framework serves as a tool to support coastal management with particular focus on sustainability and the incorporation of environmental, social and economic aspects. Subject to the selected indicators being appropriately reflective of the status of the study region, the approach is effective, operational and reasonable. Furthermore, the InSAT supplements scenario results when modelling is not possible and gives a more comprehensive view of the system.

Acknowledgments

With God all things are possible (Matthew 19:26)

I consider myself fortunate indeed to have had the opportunity to pursue research work towards the PhD. The last four years of being a PhD student have been an interesting, enjoyable and educational journey. Many people helped me throughout this period. Therefore, I would like to use this opportunity to express my sincere gratitude to those who supported me.

First of all, I am deeply grateful to Prof. dr. Audronė Žukauskaitė. She was my Master thesis supervisor and mentor, who was involved from my very first baby-steps of research. Apart from her encouragement to undertake the PhD at Klaipėda University, Audronė was the person whom I could trust and get advice from; an ever-present support.

I would like to give special thanks to my supervisor Prof. dr. habil. Gerald Schernewski, who gave me the opportunity to explore the science world and to be part of his scientific team. I will never forget the many beautiful moments we shared throughout these years: several exciting discussions and interesting findings with all their ups and downs. I would like to thank Gerald for challenging me when I needed challenging while supporting me in his own way, which made me grow.

Throughout my research journey I had the pleasure of collaborating with many other knowledgeable fellow researchers. I would like to thank all the colleagues of the Marine Research Institute of Klaipėda University and Leibniz Institute for Baltic Sea Research (IOW) for their inspiring conversations and for being supportive all along my PhD research period. I thank Klaipėda University for the opportunity to pursue research in a friendly and supportive environment. A special note of thanks for my IOW mates for making my stay in Rostock & Warnemünde such a memorable time. I am also grateful to some amazing people: Fatima, Greta, Marija, Jurgita, Lucie, Viktorija, Mirco, René and Arūnas for offering a stimulating work environment and for sharing interesting and pleasant discussions about many aspects of work and life. In particular I would like to thank my colleague and very good friend Johanna for endless deep conversations, relaxing walks on the beach and rock-steady support throughout the work.

Furthermore, it would not have been possible to write this thesis without the support of my closest friends who have been a constant source of encouragement in my life. They always ensured I did not forget to enjoy countless cups of coffee and the many other beautiful things life has to offer. I am grateful to my friend Miguel for the endless hours spent chatting about the PhD challenges and the meaning of life. I consider him my best friend. He was always there for me while I was planning my research, patiently going through my drafts and providing me with valuable feedback. I also want to thank my special and wise friend, Eglė, for believing in my ideas when I started to doubt them. I recall numerous times when I felt discouraged and unsure of my work and at such instances she was the one who never failed to offer advice and encouragement. Thank you both for listening, for offering me advice and supporting me through this time and always.

A warm thank you goes to my friends Raimonda, Ineta, Linutė and Svetlana for their prayers, advice, patience and faith.

Moreover, I wish to express my deepest gratitude to the special person of my life, my friend, motivator and the winner of my heart, Andrew, for his support, love, care, patience and encouragement. A special thanks to him for keeping my momentum going, for always showing how proud he is of me, and for the enjoyable time at the gym together which was and remains key in balancing out my mental and physical health. You are the best.

A big thanks also goes to my brother Mindaugas, his wife Vilma and their beautiful kids Ieva and Mažvydas who are my sunshine, for their support throughout the years.

Thanks to my dear mother, Marija, for all her love and support.

This thesis is dedicated to the memory of my father, who passed away, accidentally, in 2017. I always knew that you believed in me and wanted the best for me. I miss you, dad.

Finally, I would like to thank the Doctorate Study Programme in Ecology and Environmental Sciences of Klaipeda University and the BONUS BaltCoast project, not only for providing the funding which allowed me to undertake this research but also for giving me the opportunity to travel, attend the conferences and to meet so many interesting people from different parts of the world.

Thank you all who have touched my life since completing my PhD. This time was precious. I believe that the completion of a PhD is not the end of a journey, rather, it is a license to have access to the interesting and dynamic world of science, and I am looking forward to experiencing it deeper.

With love,
Donalda

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Santrauka

ĮVADAS

Pakrančių regionuose gyvena didžioji dalis Žemės gyventojų (Rumson ir kt., 2018). Tokie regionai teikia darbo vietas, uostus, poilsio zonas, energijos gamybos ir ekosistemų paslaugas (Kron 2013; Rumson ir kt., 2018). Pastaruoju metu pakrantės zonos patyrė pernelyg didelį išnaudojimą (Roberts 2012; 2017 m. Pasaulio vandenyno apžvalga), o pakrančių ekosistemos yra per daug naudojamos, atsparumas prarandamas ir padidėjo pažeidžiamumas (Heidkamp ir kt., 2018). Visame pasaulyje pateikti pavyzdžiai parodė, kad gyventojų ir ekonomikos augimas neigiamai paveikė pakrančių zonų tvarumą (Godschalk ir kt., 2019 m., World Ocean Review 2017). Ekologiniu požiūriu pakrantės yra unikalus pereinamasis plotas tarp sausumos ir jūrų aplinkos (Heidkamp ir kt., 2018), ir joms įtakos turi ir sausumos, ir jūros zonos (Pasaulio vandenyno apžvalga 2017). Dėl šių sąveikų pakrantė sudaro dinamišką ir sudėtingą aplinką, kuriai reikia tinkamo valdymo ir planavimo (Heidkamp et al. 2018).

Vis dėlto pakrantės problemos yra neišspręstos ir vis dar egzistuoja poreikis integruotiems pakrančių ir jūrų valdymo metodams. Taip pat trūksta laipsniškai valdomų procesų ir pagalbinių priemonių, leidžiančių lengvai ir palyginti greitai taikyti ICZM kontekstą. Todėl Sisteminiu požiūriu grindžiama struktūra (SAF) gali tapti struktūra, į kurią įterpiamas rodiklių taikymas ir gali paremti ICZM procesą (Støttrup ir kt. 2017). Tai pabrėžiant, pritaikytų rodiklių, kaip sprendimų pagalbinės priemonės, skirtõs įvertinti valdymo planavimą, naudojimas padės nustatyti galimus konfliktus ir inicijuoti kompromisines diskusijas tarp suinteresuotųjų šalių, politikų ir sprendimų priėmėjų. Reikia aiškiai apibrėžti sėkmės kriterijus ir tvarumo rodiklius, kurie leistų išsamiai įvertinti padėtį prieš priemonės įgyvendinimą ir po to (Støttrup et al. 2017; Støttrup et al. 2019). Geri ir patikimi rodikliai apima keletą savybių, įskaitant lengvai išmatuojamus, ekonomiškus, konkrečius, jautrius, reaguojančius, konkrečius, aiškinamus ir pagrįstus konkrečia teorija (Reed ir kt., 2006; Belfiore ir kt., 2006). Rodikliu grindžiamas išankstinis ir vėlesnis vertinimas leidžia sistemingai įvertinti įgytas patirtis ir išvengti dvigubo darbo bei klaidų kartojimo. Tačiau tam reikia priemonių, kurios leistų greitai įvertinti net ir neturint išsamių ekspertų žinių (Støttrup et al. 2017).

Tyrimo tikslas ir pagrindiniai uždaviniai

Mokslinio darbo tikslas – pritaikyti aplinkos kokybės, socialinių ir ekonominių rodiklių rinkinį, sukurti rodikliais pagrįstą įrankį, skirtą įvertinti kranto zonos priemonių darnaus vystymosi būseną ir pažangą, taip pat įvairių kranto zonos priemonių sėkmę.

Buvo iškelti šie uždaviniai:

1. sukurti pritaikytą rodiklių sistemą ir pateikti lengvai naudojamą kompiuterizuotą įrankį ir laipsnišką taikymo metodiką, skirtą įvertinti ICZM priemonių darnumo pokyčius, taip pat įvertinti valdymo proceso sėkmę;
2. pritaikyti įrankį plataus spektro tematikos pakrančių atvejų tyrimams Baltijos šalyse ir už jos ribų; parodyti rodikliais pagrįsto įrankio gebėjimą nustatyti ICZM priemonių stiprybes ir silpnybes.
3. kritiškai išanalizuoti greitojo patikrinimo ir nuodugniosios analizės vertinimus bei išanalizuoti įvairių vertintojų vaidmenį vertinimo procese;
4. įrankį tobulinti, atsižvelgiant į įgytą patirtį iš ankstesnių vertinimų ir pateikti patobulintą, rodikliais pagrįstą darnumo vertinimo įrankį (InSAT); ištirti, kaip tinkamas rodiklių rinkinio naudojimas gali įvertinti kranto zonos darnaus vystymosi pažangą ir valdymo proceso kokybę; parodyti rodiklių vertę ir vaidmenį SAF vertinimuose ir ištirti rodiklių panaudojimą kitiems integruotų valdymo metodams.

Darbo naujumas

Pristatytas InSAT įrankis remia pakrančių valdymą, ypatingą dėmesį skiriant darnumui ir aplinkos, socialinių ir ekonominių aspektų įtraukimui. Ši metodika gali būti taikoma kaip priemonė projektų ar iniciatyvų darnumui pagerinti, leidžianti nustatyti jų trūkumus ir gerina suvokimą apie aspektus, kurie didina veiksmingumą darnumo požiūriu. Šiame moksliniame darbe, buvo sukurtas rodikliais pagrįstas įrankis, kuris gali būti pritaikytas prie specifinių pakrančių iniciatyvų poreikių. Rodiklių rinkinys yra suskirstytas į dviejų tipų rodiklius: pagrindinius ir pasirenkamuosius, kurie suteikia lankstumo prisitaikyti prie vertinimo poreikių ir veikia kaip išankstinio įspėjimo signalai, kai kyla klausimų dėl vertinamų valdymo iniciatyvų darnumo. Be to, proceso rodikliai yra gera priemonė vertinant valdymo priemonių sėkmę. Ši priemonė yra svarbi priemonė siekiant palengvinti dialogą tarp suinteresuotųjų šalių, politikų ir sprendimų priėmėjų. Tyrimai (kartu su atitinkamais rezultatais) didina žinių ir supratimo apie žmogaus ir aplinkos sąveiką pakrančių ir jūrų zonose mastą, taip pat sustiprina sąmoningumą sprendžiant darnumo problemas.

Rezultatų mokslinė ir praktinė reikšmė

Individualiai pritaikomų rodiklių, kaip sprendimų priėmimo priemonės, skirtõs įvertinti valdymo planavimą, vertinimas yra naudingas nustatant galimus konfliktus ir diskusijoms dėl darnaus vystymosi tarp suinteresuotųjų šalių, politikų ir sprendimų priėmėjų, inicijuoti. Pagrindiniai ir pasirenkamieji rodikliai, naudojami kartu gali atskleisti pakrančių iniciatyvų įgyvendinimo darnumo lygį. Individualiai pritaikomi rodikliai supaprastina ir kiekybiškai įvertina sudėtingą informaciją, kuri kitaip negali būti lengvai matuojama ar stebima. Šis metodas yra efektyvus, veiksmingas ir tinkamas, jei atrinkti rodikliai tinkamai atspindini studijų regiono statusą. Be to, metodika papildo scenarijų rezultatus, kai modeliavimas yra negalimas, ir leidžia pamatyti išsamesnį sistemos vaizdą. Taip pat rodikliai gali būti pritaikyti stebėsenos sistemose. Jie taip pat yra naudingi sprendimo priėmėjams nustatyti, įvertinti ir stebėti darnumo pažangą. InSAT įrankis pateikia sistemingą atlikimo metodiką, siekiant patirties ir vietinių žinių, kad būtų galima išnagrinėti įvairius valdymo pasirinkimų rezultatus, susijusius su galimais politiniais sprendimais. Be to, InSAT paverčia mokslinę informaciją į aiškius formatus suinteresuotųjų šalių naudai, taip pat įrankis gali būti naudingas priimamų sprendimų procese.

TYRIMŲ MEDŽIAGA IR METODAI

Tyrimo metodika buvo sukurta, rodiklių sistemos ir rodikliais pagrįsto darnumo vertinimo įrankio (InSAT) kūrimui, kad prisidėti prie pagalbinių priemonių trūkumo, kurios leistų palengvintų ir pagreitintų vertinimo procesą ir įvertintų darnaus vystymosi būseną ir pažangą priekrančių sistemose ir įvertintų skirtingų kranto zonos valdymo priemonių sėkmę. Tyrimas atliktas remiantis krturiais pagrindiniais etapais:

1. rodiklių sistemos ir indikatoriais pagrįsto ICZM gerųjų praktikų vertinimo įrankio (v1) kūrimas (I, III publikacijos);

2. įrankio (v1) testavimas; rezultatų analizė; tyrimo trūkumų identifikavimas (I, II publikacijos);
3. įrankio ir rodiklių rinkinio tobulinimas, rodikliais pagrįsto darnumo vertinimo įrankio (InSAT – v2) kūrimas (IV publikacija).
4. InSAT (v2) vertinimai: rodiklių vertė ir vaidmuo SAF ir kituose integruotuose pakrančių ir jūrų valdymo procesuose.

InSAT buvo pritaikytas 18 skirtingų temų pakrančių tyrimams, taikant du skirtingus metodus: greitąjį vertinimą ir išsamią analizę, kurie buvo naudojami įvertinti ICZM privalumus ir trūkumus bei prisidėjimą prie darniojo vystymo. Papildomai 7 studijų atvejai Lietuvoje, Vokietijoje ir Suomijoje buvo pasirinkti išsamiai analizei tam, kad būtų įvertinta, ar šie studijų atvejai yra gerosios praktikos pavyzdžiai. Be to, 14 studijų atvejų iš Švedijos, Nyderlandų, Vokietijos, Danijos, Didžiosios Britanijos ir Airijos buvo pasirinkti greitajam įvertinimo metodo pritaikymui.

InSAT su galutiniu rodiklių rinkiniu buvo pritaikytas 3 atvejų tyrimams Lietuvoje: 1) suskystintų gamtinių dujų (SGD) terminalui Klaipėdoje; 2) Šventosios uosto atnaujinimui; 3) naujo paplūdimio atidarymui Nidoje (IV publikacija).

REZULTATAI IR DISKUSIJA

ICZM priemonės privalumai ir trūkumai: ar tai yra geriausios praktikos pavyzdžiai?

Įrankis ir vertinimo rezultatai parodė gebėjimą nustatyti ICZM iniciatyvų pivalumus ir trūkumus bei jų indėlį į darnųjį vystymąsi. Be to, jei iš esmės yra įvykdyti visi ICZM pagrindiniai elementai, atitinkamas atvejo tyrimas gali būti apibūdinamas kaip geriausios praktikos pavyzdys. Rodikliai yra puiki priemonė bendruomenės mokymosi ir sąmoningumo ugdymo procesams.

Greitojo vertinimo ir išsamios analizės metodų palyginimas ir vertintojo vaidmuo procese

Bendrą apžvalgą galima gauti per trumpą laiką, tačiau, norint pasiekti patikimų rezultatų, reikia atlikti įvairius vertinimus arba ekspertų vertinimą. Greitojo vertinimo metodo rezultatai parodė, kad šis metodas padeda pasiekti gerą apžvalgą ir greitą pirmąjį įspūdį apie tyrimo atvejį ir jo darnųjį vystymąsi. Kita vertus, išsami analizė parodė išsamesnius rezultatus. Abiejų metodų rezultatai parodė, kad vertintose studijose gali nustatyti darniojo vystymosi linkmę.

Rodikliai – ankstyvojo įspėjimo signalai skirtinguose įgyvendinimo lygmenyse

Šiame tyrime rodikliai buvo suskirstyti į pagrindinius ir pasirenkamuosius individualius rodiklius, kurie veikia kaip išankstinio įspėjimo signalai ir padeda nustatyti stipriąsias ir silpnąsias puses, susijusias su kiekybiniu pakrančių valdymo iniciatyvų įvertinimu. InSAT įrankis su specialiai pritaikytais pagrindiniais ir pasirenkamaisiais rodikliais parodė lankstumą įvairiuose pakrančių atvejų tyrimuose. Be to, pagrindiniai pasirenkamųjų rodiklių privalumai susiję su tuo, kad vertinimo procedūros metu jie buvo labai naudingi vertinant konkrečius atvejų tyrimus, parodant jų ypatumus.

Rodikliai SAF procese

Mūsų taikymo rezultatai parodė, kad InSAT vertinimas labiau tinka paremti SAF diskusijų procesus, o ne pateikti aiškius rezultatus. InSAT vertinimai pateikia greitus rezultatus ir tai leidžia palyginti valdymo pasirinkimą ir rezultatus aptarti tarp suinteresuotųjų šalių. Paprastai vertinimai užima daug laiko, todėl išsamesniems rezultatams reikalingi ekspertai.

InSAT sprendimų palengvinimo priemonė kranto zonos valdymo procese

Ši metodika yra naudinga remiant strateginį planavimą ir plėtojant tiek darnumo viziją, tiek ateities plėtros strategiją. Kai nėra duomenų modeliavimui, InSAT suteikia galimybę rinkti ekspertų ir vietos žinias taip, kad galėtų analizuoti galimų politinių sprendimų scenarijų rezultatus. Integruotas požiūris suteikia galimybę sujungti atskirų rodiklių informaciją, tačiau jos rezultatų patikimumas priklauso nuo pasirinktų rodiklių tinkamumo. Naudojant integruotą vertinimo metodą, pagrįstą darnios pakrančių regiono rodiklių sistema, galima aiškiai įvertinti, kad pakrantės zonos plėtros procesas būtų tvaresnis. Šis metodas yra veiksmingas, veikiantis ir pagrįstas, jei atrinkti rodikliai tinkamai atspindi studijų regiono statusą.

Tačiau, nors įrankis nurodo valdymo priemonės trūkumus, vertinimo rezultatai nenurodo, kokių sprendimų reikėtų imtis. Ši priemonė taip pat vertinga vertinant konkrečias valdymo iniciatyvas, padedant giliau pažvelgti į aplinkos, socialinius ir ekonominius tikslus. Be to, ši įrankis galėtų būti naudojamas mokymo tikslams kaip informavimo apie darnumą priemonė.

IŠVADOS

1. Individuliai pritaikomų rodiklių rinkinys padėjo įvertinti, ar ICZM iniciatyvos gali būti apibrėžtos kaip geriausios praktikos pavyzdys. Darnaus vysty-

mosi vertinimo rezultatai parodė, kokiu mastu buvo pasiekti ICZM iniciatyvų tikslai, kokia pažanga pasiekta siekiant darnumo ir kokiu mastu buvo pasiekti tikslai. Tačiau šis įrankis gali parodyti tik esamas silpnąsias vietas, tačiau nepateikia išsamios informacijos apie tai, kodėl ir kaip vyksta šie pokyčiai ir kokių sprendimų reikėtų imtis sprendžiant tokius trūkumus.

2. Greito patikrinimo vertinimo metodo rezultatai parodė, kad šis metodas yra naudingas siekti geros apžvalgos ir greito pirmojo įspūdžio apie atvejo tyrimo darnaus vystymosi būseną. Kita vertus, išsamios analizės metodas parodė išsamesnius rezultatus. Tačiau abu metodai buvo tinkami įvertinti darnumą ir pokyčius, susijusius su įvertintų įvairių atvejų darniuoju vystymusi.
3. Vertintojas, kuris buvo ekspertas, parodė geresnes žinias apie tyrimo sritį. Tačiau, subjektyvumas, suprantant duomenis ir rodiklius, kartu su asmeniniu vertintojo suvokimu daro didelę įtaką vertinimo rezultatams. Laiko ir duomenų prieinamumas yra svarbus siekiant sėkmingo ir patikimo vertinimo. Todėl reikėtų išplėsti vertintojų grupių kūrimo idėją, siekiant stabilizuoti rezultatus ir sumažinti subjektyvumą ir po to, patikrinti siūlomą metodą.
4. Darnaus vystymosi rodiklių rinkinio padalijimas į pagrindinius ir pasirenkamuosius, įrodė jų lankstumą ir gebėjimą prisitaikyti prie strateginių pakrančių priemonių tikslų. Šiuo atžvilgiu rodiklių rinkinys atskleidžia, kokiu mastu pakrančių ir jūrų iniciatyvos įgyvendinimas pasiekia darnumą.
5. InSAT įrankis gali būti naudojamas kaip pagalbinė priemonė SAF ir kitiems integruoto valdymo vertinimams. InSAT sistema veikia kaip įrankis paremti kranto zonos valdymą, ypatingą dėmesį skiriant darnumui ir aplinkos, socialiniams ir ekonominiams aspektams. Atsižvelgiant į tai, kad tinkamai parinkti darnaus vystymosi rodikliai atspindi studijų regiono statusą, o tai rodo, kad taikomas metodas yra efektyvus, veiksmingas ir tinkamas. Be to, InSAT papildo scenarijų rezultatus ir tuo atveju, kai modeliavimas yra negalimas bei suteikia išsamesnį sistemos vaizdą.

Annexes

ANNEX I

An Indicator Set: 4 categories, 45 indicators

Environmental Quality

Indicators scoring: 7 ranges and 'No Data'

1. The best-practice reduces waste, prevents air, water and soil pollution and stimulates material reuse and recycles
2. The best-practice promotes flood prevention, protection and mitigation
3. The best-practice improves the status of water (ecological and chemical)
4. The best-practice supports policy and system to conserve key natural sites (including marine and nature scenic, cultural, and wild landscapes)
5. The best-practice effects land use planning and management, supports environmentally friendly rural activities
6. The best-practice supports urban planning and effects urban development
7. The best-practice supports natural habitats, biodiversity and their quality
8. The best-practice improves sustainable management of coastal erosion
9. The best-practice increases the resilience and reduces vulnerability to climate change impacts
10. The best-practice increases energy efficiency
11. The best-practice increases the use of low-impact transport and supports sustainable mobility in the destination (including public transport)
12. The best-practice contributes to increase environmental awareness of the population
13. The best-practice promotes environmentally-friendly processes and products

Social Well-Being

Indicators scoring: 7 ranges and 'No Data'

1. The best-practice promotes social justice and equal opportunities for all members of society
2. The best-practice improves quality of life (all people have a home and access to basic infrastructure and services)
3. The best-practice provides educational opportunities, supports life-long learning and increases awareness about sustainability
4. The best-practice protects, monitors, and safeguards local resident access to natural, historical, archaeological, religious, spiritual, and cultural sites
5. The best-practice supports the conservation of cultural heritage (includes rural heritage)
6. The best-practice contributes to crime prevention and increases perception of safety among population
7. The best-practice increases production of local and fair trade goods and services
8. The best-practice promotes communication, cooperation between citizens and local authorities
9. The best-practice reduces vulnerability of people to climate change and promotes comprehensive risk based assessment and prioritised action in area

Economics

Indicators scoring: 7 ranges and 'No Data'

1. The best-practice effects financial policies and instruments to support economic stability and resilience
2. The best-practice increases economic diversification
3. The best-practice ensures acceptable employment and training opportunities for local residents
4. The best-practice increases payments and investments in coastal management
5. The best-practice promotes infrastructure development and increases environmental friendly transport
6. The best-practice increases culturally and environmentally friendly, low-impact tourism
7. The best-practice increases investment in innovation for green economy
8. The best-practice increases productivity and use of sustainable agriculture and fisheries
9. The best-practice increases investment on climate change and flood risk management

Governance (Process Indicators)

Indicators scoring: 5 ranges and 'No Data'

1. A management team with broad competences and sufficient representation was built to lead the planning process
2. Human activities and associated stakeholder groups were determined
3. The issue was chosen driven by ecological, social or economic needs and targets were set
4. All possible measures were identified and compiled into alternative hypothetical scenarios
5. A strategy was developed how to assess the effect and ESE (Economic, Social, Ecologic) consequences of different scenarios (e.g. modelling)
6. Different alternative scenarios were simulated and results discussed with stakeholders
7. Assessments were made of impacts on different stakeholders
8. Costs were calculated for different optional measures considered in the scenarios
9. There was a strategy for the issues of missing data and uncertainty in implementation process
10. The feasibility, costs end efficiency of scenarios were reviewed and evaluated
11. The entire process was documented and publicly available
12. The concept was implemented and accepted by the public
13. Effects of implemented measure are monitored on regular basis with respect to identified targets
14. The success of measure was evaluated

ANNEX II

Case studies and Abbreviation	Themes	Key Approaches	Main objectives	Measures
1. Coastal nature restoration and flooding in the Geltinger Birk, DE (Geltinger Birk)	Sustainable use of resources; Sustainable economic growth	Integration Participation Knowledge-based Ecosystems based approach Socio-economic	Re-flooding of protected salt meadows – Realignment of the coast in order to regain the erstwhile character of the area	Decommission of an old dyke, building of a new dyke
2. Public participation in Integrated Flood Risk Management in Timmendorf, DE	Sustainable use of resources; Sustainable economic growth	Integration Participation	Promotion of flood prevention, protection and mitigation thus reducing the vulnerability to cli-mate change impacts.	Sensitivity analysis in a participatory process; building of a flood wall and bank protection
3. Coastal protection & realignment and the role of public participation in Markgrafenheide, DE	Adaptation to risk; Sustainable use of resources	Integration Ecosystems based approach Socio-economic Technical	Coastal protection & realignment and the role of public participation	Abandonment of old protection scheme leading to the nourishment of sand and breaching of the dyke towards Hüttelmoor, installation of a groundsill
4. Moving towards total sustainability of an island, Gotland, SE	Sustainable use of resources; Sustainable economic growth	Integration Participation Knowledge-based Ecosystems based approach Socio-economic Technical	Achievement of a 100% renewable energy balance by 2025, a fully sustainable society within the course of a generation	Energy plan, Establishment of a Regional Energy Agency, promoting the development of a sustainable energy system
5. Preventing beach erosion for tourism, Ystad, SE	Adaptation to risk	Ecosystems based approach Technical	"Hold the line" with a "Limited intervention" against coastal erosion to preserve the present position of the coastline to protect tourism assets	Hold the line in maintaining the hard protection measure

Case studies and Abbreviation	Themes	Key Approaches	Main objectives	Measures
6. Land reclamation for coastal defence and tourism development, Køge Bay, DK	Adaptation to risk; Sustainable use of resources	Ecosystems based approach Technical	Land reclamation for the provision of a flood defence protection for the hinterland and for the provision of a recreational area for the capital city population	Building of a 20 m wide dyke and three groynes; new perpendicular orientation of the coastline
7. Improving the status of the coastal lagoon Tryggelev Nor, DK	Sustainable use of resources	Participation Ecosystems based approach Socio-economic Technical	Improvement of the hydrological status of the coastal lagoon and its supporting biodiversity through reducing agricultural in-puts	Establishment of a sea-water inlet, shutting down the pumping systems re-established wetland area, clearance of unwanted vegetation and more organized grazing
8. Implementing the Water Framework Directive, the Odense river system, DK	Sustainable use of resources	Integration Participation Knowledge-based Ecosystems based approach Socio-economic	Focus on agricultural nutrient pressure and its impact on achieving WFD objectives, Development of a river basin management plan	Demonstrating and testing of the methodology laid down in the WFD
9. Nature compensation for port development, Rotterdam, NL	Adaptation to risk; Sustainable use of resources; Sustainable economic growth	Integration Participation Knowledge-based Ecosystems based approach Socio-economic Technical	Nature and recreation compensation from the destruction of natural areas due to port development	Construction of a sea-wall in the sea, Sand sprayed into the enclosed area, creating new land, 750 ha of land designated for nature and recreation
10. Managed realignment to create a Nature area and give an economic stimulus in Perkpolder, NL	Adaptation to risk; Sustainable use of resources; Sustainable economic growth	Integration Ecosystems based approach Technical	Managed realignment scheme creating a new nature area of 75 ha, renovation of old ferry port	Building of a new dyke, landward of the old one and breaching the latter

Case studies and Abbreviation	Themes	Key Approaches	Main objectives	Measures
11. Managing the twin risks of flooding and erosion in coastal areas, UK	Adaptation to risk; Sustainable use of resources	Knowledge-based Socio-economic	Managing the twin risks of flooding and erosion, risk analysis under scenarios of future climate and socio-economic change	Analysing alternative coastal management options on a 72 km stretch of coastline experiencing flooding and cliff erosion
12. A sustainable coastal defence re-creating wildlife habitats alongside economic farming methods, Abbott's Hall Farm, UK	Adaptation to risk; Sustainable economic growth	Integration Participation Technical	Implementation of a realignment scheme creating new wetland habitats whilst providing protection against flooding	Establishing new salt marsh through the breaching of hard sea defence realigning the shore line
13. Recycling harbour dredging for new habitat: foreshore recharge, Horsey Island, UK	Adaptation to risk; Sustainable use of resources	Integration Socio-economic Technical	Creation of an improved coastal defence, better economical and sustainable state, Increasing the overall extent and quality of salt marsh habitat	Foreshore recharge using dredged materials
14. Coastal erosion management at Inch Beach, Co. Kerry, IE	Adaptation to risk; Sustainable use of resources; Sustainable economic growth	Integration Socio-economic Technical	Protection of the road infrastructure and safety of life through the institutionalisation of a new framework for erosion management, implementation of site specific management policies	Development Plan, GIS database.

ANNEX III

Marked in map	Study site	Application objective	The tool applied; number of evaluators; time and location	Detailed description
1, a	Coastal nature restoration and flooding in the Geltinger Birk (Germany)	Analysis in-depth (to assess if studies are considered as best practice examples); Fast screening analysis (to check suitability of indicators in wider spectrum of topics; an international comparison of different ICZM best practice examples)	Tool (v1); 2 evaluators; Rostock, 2016	Publication I, II
2, b	Public participation in Integrated Flood Risk Management in Timmendorf		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
3, c	Coastal protection & realignment and the role of public participation in		Tool (v1); 3 evaluators; Rostock, 2016	Publication I, III
g	Coastal management measure for Southwest Finland (Finland)	Analysis in-depth (to assess if studies are considered as best practice examples)	Tool (v1); 2 evaluators; Klaipeda, 2016	Publication I
f	ICZM in the Bothnian Sea (Finland)		Tool (v1); 2 evaluators; Klaipeda, 2016	Publication I
e	Restoration of important habitats through sustainable agricultural practices,		Tool (v1); 2 evaluators; Klaipeda, 2016	Publication I
d	Integrated shorelinemanagement for a large harbour city and an adjacent seaside resort, Klaipeda/Palanga (Lithuania)		Tool (v1); 2 evaluators; Klaipeda, 2016	Publication I
4	Moving towards total sustainability of an island, Gotland (Sweden)	Fast screening analysis (to check suitability of indicators in wider spectrum of topics; an international comparison of different ICZM best practice examples)	Tool (v1); 2 evaluators; Rostock, 2016	Publication I
5	Preventing beach erosion for tourism, Ystad (Sweden)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
6	Land reclamation for coastal defence and tourism development, Køge Bay		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
7	Improving the status of the coastal lagoon Tryggelev Nor (Denmark)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
8	Implementing theWater Framework Directive, the Odense river system		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
9	Nature compensation for port development, Rotterdam (Netherlands)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
10	Managed realignment to create a Nature area and give an economic stimulus in Perkpolder (Netherlands)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
11	Managing the twin risks of flooding and erosion in coastal areas, Weybourne to Lowestoft (United Kingdom)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
12	A sustainable coastal defence re-creating wildlife habitats alongside economic farming methods, Abbott's Hall Farm (United Kingdom)	Fast screening (to compare results from diffrenet assessments which have been done by 4 different evaluators using the same data; to check suitability of indicators in wider spectrum of topics; an international comparison of different	Tool (v1); 4 evaluators; Rostock, 2016	Publication I
13	Recycling harbour dredgings for new habitat: foreshore recharge, Horsey Island (United Kingdom)	Fast screening analysis (to check suitability of indicators in wider spectrum of topics; an international comparison of different ICZM best practice examples)	Tool (v1); 2 evaluators; Rostock, 2016	Publication I
14	Coastal erosion management at Inch Beach, Co. Kerry (Ireland)		Tool (v1); 2 evaluators; Rostock, 2016	Publication I
Klaipeda	Klaipeda liquefied natural gas (LNG) floating storage and regasification unit terminal construction (Lithuania)	To assess the indicators' suitability in identifying strenghts and weaknesses of the implemented initiative and to measure the success of the implementation process; to assess the	Tool (v2); 4 evaluators; 1 student group; Klaipeda, 2018	Publication IV
Sventoji	Port of Sventoji renewal (Lithuania)	To demonstrate how indicators could be used in the planning process; to assess changes in sustainability comparing the situation now and after renewing port; to identify the implementation shortcomings	Tool (v2); 4 evaluators; 1 student group; Klaipeda, 2018	Publication IV
Nida	Beach opening in Nida at Curonian Lagoon site (Lithuania)	To assess the indicator's suitability in measuring sustainability of proposed hypothetical management options	Tool (v2); 5 evaluators; 2 student group; Riga, 2017; Klaipeda, 2018	Publication IV

ANNEX IV

ENVIRONMENTAL QUALITY

CORE INDICATORS (MO - Management Option)	Categories
1. Management Option (MO) prevents air pollution and greenhouse gas emissions	Pollution
2. MO prevents water pollution	Pollution
3. MO prevents land and soil pollution	Pollution
4. MO improves the status of water (ecological and chemical) quality	Pollution
5. MO improves quality of water for human consumption	Water resource management
6. MO reduces waste, supports and stimulates material reuse and recycling	Waste management & Recycling
7. MO promotes flood prevention, protection and mitigation	Changes at the Coast & Adaptation
8. MO increases coastal erosion	Changes at the Coast & Adaptation
9. MO increases the resilience and reduces vulnerability to climate change impacts	Energy & Climate Mitigation
10. MO improves sustainable management of coastal erosion	Planning and management
11. MO effects land use planning and management	Planning and management
12. MO supports urban planning and effects urban development	Planning and management
13. MO increases the use of low-impact transport and supports sustainable mobility in the destination (including public transport)	Sustainable mobility
14. MO supports natural habitats, biodiversity and their quality	Biodiversity & Nature Protection
15. MO supports policy and system to conserve key natural sites (including marine and nature scenic, cultural, and wild landscapes)	Biodiversity & Nature Protection
16. MO contributes to increase environmental awareness of the population	Biodiversity & Nature Protection
OPTIONAL INDICATORS	**Categories**
1. MO supports environmentally friendly rural activities	Biodiversity & Nature Protection
2. MO increases use of renewable energies	Energy & Climate Mitigation
3. MO increases local production of renewable energy	Energy & Climate Mitigation
4. MO increases pressure for coastal and marine recreation (Number of berths and moorings for recreational boating)	Tourism & Recreation
5. MO increases land take by intensive agriculture	Biodiversity & Nature Protection
6. MO promotes environmentally-friendly processes and products	Biodiversity & Nature Protection

7. MO effects fish passage	Biodiversity & Nature Protection
8. MO extends the length of artificially defended coastline (the coastline that has hard coastal defences)	Changes at the Coast & Adaptation
9. MO increases green buildings in the area	Changes at the Coast & Adaptation
10. MO increases forested land area	Biodiversity & Nature Protection
11. MO increases amount of beach and marine litter	Tourism & Recreation
12. MO improves bathing water quality	Tourism & Recreation
13. MO contributes to wastewater treatment	Waste management & Recycling
14. MO effects of oil spill on the ecosystem	Pollution
15. MO improves quality of coastal rivers	Pollution
16. MO increases opportunities to observe coastal & marine fauna	Biodiversity & Nature Protection
17. MO increases number of beaches and marinas awarded with a Blue Flag	Tourism & Recreation
18. MO improves status of marine fish stocks	Biodiversity & Nature Protection
19. MO supports wildlife protection	Biodiversity & Nature Protection
20. MO increases energy efficiency	Energy & Climate Mitigation

ECONOMICS

CORE INDICATORS (MO - Management Option)	**Categories**
1. MO effects financial policies and instruments to support economic stability and resilience	Accounting & Regulation
2. MO ensures an acceptable employment and training opportunities for local residents	Labour & Welfare
3. MO increases economic diversification (the diversification of income sources away from domestic economic activities (i.e. income from overseas investment))	Accounting & Regulation
4. MO increases payments and investments in coastal management	Accounting & Regulation
5. MO promotes infrastructure development and increases environmental friendly transport	Technology & Infrastructure
6. MO increases investment in innovation for green economy (an economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment)	Production & Resourcing
7. MO increases investments on climate change adaptation and flood risk management	Accounting & Regulation
8. MO supports local entrepreneurs and fair trade	Production & Resourcing
9. MO effects direct investment (government, private sector, foreign direct investment)	Accounting & Regulation
10. MO effects tourism management and its strategy	Tourism

11. MO increases culturally and environmentally friendly, low-impact tourism	Technology & Infrastructure
12. MO increases total economic value (the value derived by people from a natural resource, a man-made heritage resource or an infrastructure system, compared to not having it)	Technology & Infrastructure
OPTIONAL INDICATORS	**Categories**
1. MO increases volume of port traffic (e.g. incoming and outgoing passengers, volume of goods handled per port)	Exchange & Transfer
2. MO financially effects of setting up and managing a MPA	Accounting & Regulation
3. MO ensures beaches with eco-labels	Tourism
4. MO increases recreational boating	Tourism
5. MO increases bed occupancy rate	Tourism
6. MO increases vehicle ownership	Consumption & Use
7. MO supports accessibility in island territories	Technology & Infrastructure
8. MO effects aquaculture and fisheries production	Production & Resourcing
9. MO supports construction, modernization of fishing boats (including scraping)	Production & Resourcing (Consumption & Use)
10. MO increases tourism seasonal pressure (intensity of tourism)	Tourism
11. MO effects patterns of sectoral employment (full time, part time and seasonal employment)	Labour & Welfare
12. MO increases productivity and use of sustainable agriculture and fisheries	Production & Resourcing

SOCIAL WELL-BEING

CORE INDICATORS (MO - Management Option)	Categories
1. MO promotes social justice and equal opportunities for all members of society	Freedom & Justice
2. MO improves quality of life (all people have a home and access to basic infrastructure and services)	Public Health & Wellbeing
3. MO provides educational opportunities, supports life-long learning and increases awareness about sustainability	Learning
4. MO protects, monitors, and safeguards local resident access to natural, historical, archaeological, religious, spiritual, and cultural sites	Local Identity & Tradition
5. MO supports the conservation of cultural heritage (includes rural heritage)	Local Identity & Tradition
6. MO increases production of local and fair trade goods and services	Local Identity & Tradition
7. MO promotes communication, cooperation between citizens and local authorities	Freedom & Justice
8. MO reduces vulnerability of people to climate change and promotes comprehensive risk based assessment and prioritised action in an area	Public Health & Wellbeing

OPTIONAL INDICATORS	Categories
1. MO increases public events, concerts and festivals, organised to strengthen the area's local identity	Local Identity & Tradition
2. MO encourages visitors to volunteer or contribute to community development, cultural heritage, and biodiversity conservation	Local Identity & Tradition
3. MO supports providing interpretive information at key natural, historical, archaeological, religious, spiritual, and cultural sites (the information is communicated in relevant languages)	Local Identity & Tradition
4. MO supports community and promotes to enable tourism-related enterprises to support community and development initiatives	Local Identity & Tradition
5. MO supports cultural heritage actions (relevant cultural projects the local authority or municipality is involved with: staff time or funding)	Local Identity & Tradition
6. MO increases consumption of goods that are locally produced (local products)	Local Identity & Tradition
7. MO effects provision of health care services	Public Health & Wellbeing

PROCESS INDICATORS

MANAGEMENT PROCESS INDICATORS
1. A management team with broad competences and sufficient representation was built to lead the planning process
2. Human activities and associated stakeholder groups were determined
3. The issue was chosen driven by ecological, social or economic needs and targets were set
4. All possible measures were identified and compiled into alternative hypothetical scenarios
5. A strategy was developed how to assess the effect and ESE (Economic, Social, Ecologic) consequences of different scenarios (e.g. modelling)
6. Different alternative scenarios were simulated and results discussed with stakeholders
7. Assessments were made of impacts on different stakeholders
8. Costs were calculated for different optional measures considered in the scenarios
9. There was a strategy for the issues of missing data and uncertainty in implementation process
10. The feasibility, costs end efficiency of scenarios were reviewed and evaluated
11. The entire process was documented and publicly available
12. The concept was implemented and accepted by the public
13. Effects of implemented measure are monitored on regular basis with respect to identified targets
14. The success of measure was evaluated

Klaipėdos universiteto leidykla

Donalda Karnauskaitė
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Doctoral dissertation

KRANTO ZONOS DARNAUS VYSTYMOSI VERTINIMAS
Daktaro disertacija

Klaipėda, 2019

SL 1335. 2019 07 15. Apimtis 13,37 sąl. sp. l. Tiražas 20 egz.
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