Ocean & Coastal Management 101 (2014) 2–13

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Application and evaluation of an indicator set to measure and promote sustainable development in coastal areas

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ARTICLE INFO

Article history:
Available online 10 May 2014

ABSTRACT

Increasing problems in and pressures on coastal zones and subsequent high-ranking political initiatives to deal with these problems have resulted in several efforts to measure state of and progress towards sustainability in coastal zones. The project SUSTAIN developed an indicator-based methodology and scoring system which allows municipalities as well as district and regional authorities to evaluate their sustainability performance. The results shall serve as a policy and strategic planning tool and improve the management of coastal zones. Ten groups applied the indicator set in two contrasting Baltic coastal municipalities, Neringa in Lithuania and Warnemünde in Germany. Nine groups were composed of five students, and the tenth group had a single expert. The variability of results from different groups is high for both study sites and on every data aggregation level. The data's limited reliability and reproducibility hinders regional, national and European inter-comparisons between sites. Indicator applications for time series are also problematic due to limited data availability, quality, and spatial resolution, as well as shortcomings in the indicator set and the human factor. The role of evaluators and their background and spatial heterogeneity are discussed, and recommendations are given. Overall, the interactive application process supports a learning-focused process for building awareness of sustainability and favours strategic planning. In combination with the QualityCoast labelling system, the SUSTAIN methodology can provide convincing practical benefits for municipalities.

1. Introduction

In 2006, the European Council adopted the EU Sustainable Development Strategy. It defines a vision of sustainability in which economic growth, social cohesion and environmental protection are integrated and the needs of the present generation are met without compromising the ability of future generations to meet their own needs (European Council, 2006). European coastal zones can be subjected to intense levels of activities, and many of them face problems of deteriorating natural, socio-economic, and cultural resources. To solve these problems, the European Parliament and the European Council adopted a Recommendation on Integrated Coastal Zone Management (ICZM) in 2002 (CEC, 2002). The European Commission defines ICZM as a dynamic, multidisciplinary and iterative process designed to promote sustainable development of coastal zones. Increasing problems in coastal zones and high-ranking political initiatives promoting ICZM have resulted in indicator-based efforts to measure the state of and the progress towards sustainability in coastal zones (Olsen, 2003; Pickaver et al., 2004). Indicators are popular because they provide a simplified view of complex phenomena, quantify information, and make it comparable. Indicators are regarded as important tools in European coastal and maritime policy (Meiner, 2010) and have been used for years to monitor the EU Sustainable Development Strategy.

Given their political usefulness, many coastal indicator sets have been developed on a national (Henocque, 2003; Sarda et al., 2005; Hoffmann, 2009), European (Burbridge, 1997; Van Buuren et al., 2002; Pickaver et al., 2004) and world-wide scale (Ehler, 2003; Olsen, 2003; Belfiore et al., 2006). Many exercises in applying indicator sets (Lescrauwaet et al., 2006; Schernewski et al., 2006; Pickaver, 2009; O'Mahony et al., 2009) and critical evaluations of indicator sets (Breton, 2006; Wallis, 2006; Bell and Morse, 2008) have also taken place. Despite improvements, they revealed several weaknesses, e.g. inadequate recognition and awareness of the indicators' functions, being overly technical and insufficiently oriented towards policy assessment and

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http://dx.doi.org/10.1016/j.ocecoaman.2014.03.028

evaluation and the decision making process (Breton, 2006; Lyytimäki, 2011).

The Guiding Principles for Sustainable Development (CEC, 2005a) mention the coherence between local, regional, national, and global actions, and the review of the EU Sustainable Development Strategy (CEC, 2005b) points out the importance of the local and regional levels. According to the EU, integrated management of the coastal zone requires strategic, coordinated, and concerted action at the local and regional levels (CEC, 2002). Thus, coastal municipalities and districts play an important role in sustainable development, and measuring their current state of sustainability and effort is a major task. However, the acceptance of existing indicator sets at these administrative levels is very poor. Some reasons include complexity, a lack of necessary expertise, data requirements, time costs, results which require interpretation, an uncertain benefit, and a lack of motivation.

Within the project SUSTAIN, a set of indicators has been designed to measure sustainable development in coastal areas on a local and regional level (SUSTAIN partnership, 2012a). The indicator set is linked to a scoring and preference methodology, the DeCyDe tool developed by Isotech Ltd, Cyprus (SUSTAIN partnership, 2012b, Loizidou and Loizides, 2012). The entire methodology can be adjusted to the needs of municipalities and will serve as a decision support and strategic planning tool.

Altogether, we employed nine student groups and one professional expert to apply this indicator set in two Baltic case studies, the German seaside resort Warnemünde and the Lithuanian coastal municipality Neringa. Objectives were to evaluate a) if the indicator set suitably reflects the state of or progress towards sustainability, b) if it delivers reliable, reproducible results, and c) if it allows for comparisons between different time periods and between different regions. The role of important controlling factors for and the practical relevance of indicator results for planning and management, as well as future perspectives, will be discussed.

2. Study sites and methods

2.1. Study sites Warnemünde and Neringa

The SUSTAIN indicator set was tested in two contrasting coastal study sites in the Baltic Region, the seaside resort Warnemünde in Germany and the coastal municipality of Neringa in Lithuania (Fig. 1).

Warnemünde is part of the city of Rostock, and with 6670 inhabitants (2011) covers an area of 5.9 km^2 and has about 6 km of coastline. It was founded in the 12th century and remained a small coastal fishery town until the 19th century, when the town was discovered by tourists and seaside holidays at the German Baltic coast became popular. Today, tourism is the major source of income, and Warnemünde belongs to the most important of German seaside resorts. The town provides over 10 000 tourist beds and recorded 313 000 guest arrivals in 2012 and more than 1 000 000 tourist overnight stays (Statistisches Amt Mecklenburg-Vorpommern, 2012). The annual degree of bed capacity utilisation is only 27.9%, which reflects the dependency on summer bathing tourism and a relatively short season. A solid pier in Warnemünde protects the entrance of Rostock harbour and causes ongoing accumulation of sand. As a result, the town has a broad sandy beach about 3 km long, and a growing dune belt protects against storm surges. The beach, which has been awarded the Blue Flag, attracts additional visitors from the city of Rostock (204 000 inhabitants in 2011) as well as day visitors from Northern Germany, especially from Berlin. Consequently, the beach is crowded during the summer season.

Located at the entrance of Rostock harbour and Breitling bay, Warnemünde became an important ship-building location during the 20th century, but the industry has faced a serious decline during the last two decades. After German reunification in 1990 and the resulting political changes in the entire Baltic region, sport-

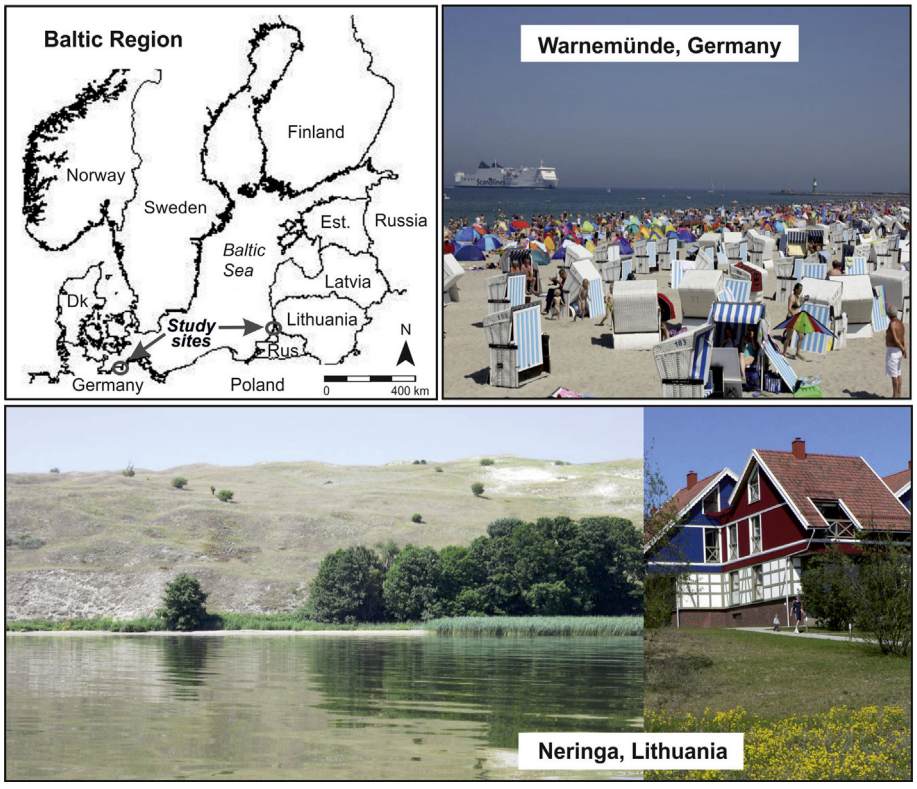

Fig. 1. Location and impressions of the Baltic study sites Warnemünde, Germany and Neringa, Lithuania.

boat and cruise tourism started to grow quickly. In 2012, 181 cruise ships (or 300 000 passengers) visited Warnemünde, making it the most important cruise ship port in Germany. Close to 1 000 sport boats berths are available. Today, fisheries and the small local fish market have only limited economic importance, but are maintained as a cultural heritage and tourist attraction. Parts of the dune belt, the coastal cliffs, and the coastal forests are under nature protection programs.

Neringa municipality is located on the Curonian (Kuršių) Spit – a narrow peninsula, separating the Curonian (Kuršių) Lagoon from the Baltic Sea. It is the longest (about 50 km) municipality of Lithuania at the border to Russia. Neringa was founded in 1961, when the five settlements Nida, Juodkrante, Preila, Pervalka and Alksnyne were joined into one administrative unit. Neringa is part of Kursiu Nerija National Park, a designated HELCOM Baltic Sea Protected Area and a Natura 2000 site. The area is protected as one of the largest and most complex dune habitats in Europe. Moreover, it is an important migratory bird convergence space and known for rare breeding bird species. Forests cover about 83% of total area, but most are protected and used only for recreational purposes (Statistics Lithuania, 2012a). The shoreline between Nida and Juodkrante is relatively stable. Artificial fore-dunes along the Baltic coast protect coastal villages from destructive sand drift.

In 2011, Neringa had 2 570 inhabitants (28.6 inhabitants per km^2) and the population increased by 7.7% during the last decade (Statistics Lithuania, 2012b). Tourism is the major source of income. In 2012, 69 accommodations hosted 49 456 tourists with 134 786 tourist overnight stays. About 47.4% of the tourists were foreigners. Tourism is concentrated in the summer months, with roughly 72% of overnight stays between June and August (Statistics Lithuania, 2012a). About 12 km out of nearly 50 km of Baltic Sea beaches are used for recreational purposes, have been awarded with the Blue Flag, and possess excellent bathing water quality according the Water Bathing Directive 2006/7/EB. A 53 km bicycle path has been developed, and Nida possesses the only sport boat harbour on the spit.

All land belongs to the state and is only rented to the local population. Agriculture is not allowed in Neringa, and forestry and fisheries account for only about 1% of the total economic turnover. Neringa has a long commercial and cultural tradition in fisheries, but changes during recent years (fish species composition and stock in the Curonian lagoon, fishery restrictions and high real estate prices) caused a decline which is considered to be negative for tourism development. Increasing numbers of motorised visitors and infrastructure and urban development coupled with nature protection restrictions have caused ongoing debates in the municipality.

2.2. The indicator set

12 partner organisations from across the European Union were involved in SUSTAIN, a 3-year INTERREG IVC programme project partially funded by the European Regional Development Fund. The objective was to create an indicator-based methodology and scoring system which enables local and regional authorities to self-evaluate their sustainability performance for the purpose of improving coastal zone management (SUSTAIN partnership, 2012b). The project followed a bottom-up approach and involved end-users already in the development phase. SUSTAIN provides an indicator set to measure sustainability, with a total of 58 core indicators (84 indicators altogether) grouped according to 24 issues, which are then allocated to the four pillars of sustainability: governance, economics, social-wellbeing, and the environment. The first three are represented by five issues, while the last is measured by nine issues. The system is based on indicators that are commonly used and regularly monitored, according to EU legislation. The set of 58 core indicators should always be applied in study sites, while additional 26 optional indicators allow experts to adapt the set to local and regional s needs (SUSTAIN partnership, 2012b).

The governance issues and indicators are used to measure the consistent management, cohesive policies, guidance, processes, and decisions for good coastal management. Traditionally, indicators to measure governance have proven to be very difficult to define (Bouckaert and Van de Walle, 2003; Ehler, 2003). Therefore, for this pillar SUSTAIN provides a series of grouped yes – no – don't know questions, with each question regarded as an indicator. Economic performance issues and indicators show whether a strong and sustainable coastal economy is being promoted and supported. Environmental quality performance issues and indicators demonstrate the availability of sustainable environmental practices and the way they are promoted. Social performance issues and indicators measure social unity and resiliance (SUSTAIN partnership, 2012b). Table 1 gives an overview of the core indicators and their allocation to issues and pillars. More detailed descriptions for each indicator and its units are provided in the SUSTAIN partnership (2012a).

After the relevant data is collected and indicator values assigned during the 'indicator application' phase, a moderated stakeholder exercise takes place, which uses matrices to determine the relative importance of the issues and pillars (weighting), which is then combined with the indicator values. Together, both the indicator application and the weighting exercise form the full SUSTAIN methodology, and are included in the DeCyDe tool by Isotech Ltd, Cyprus (Loizidou and Loizides, 2012). We focus on the first part of this methodology, the indicator application.

2.3. Indicator application process

The core indicators are mandatory and were used in both study sites, Neringa and Warnemünde. We largely followed the stepwise approach described in SUSTAIN partnership (2012b). First, the relevant data for each core indicator were collected. Second, each indicator was scored using the assessment protocols. The data was then attributed to one of six appropriate classes and converted into class values from 0 to 10 based on predefined ranges. These class values were averaged for each issue and summed to receive a total score for the pillar. If data was imprecise or unavailable, the data was approximated. SUSTAIN provides EXCEL spread-sheets, which use entered scores to automatically calculate aggregated results for issues and pillars. In a third step, the results would be presented to and discussed with local and regional stakeholders during workshops. The purpose of this interactive discussion is to evaluate whether the set of indicators both meets local demand and is sufficient to provide a realistic picture of the state of sustainability. If not, additional optional indicators can be added to tailor the set to those specific needs. We left this step out of our case study and focused exclusively on scoring core indicators in order to keep the results comparable.

In both study sites, the application exercise was carried out by local postgraduate students (Klaipeda University resp. Rostock University) with varying scientific background. Five groups worked in Neringa in September 2012 (25 students) and four groups in Warnemünde in January 2013 (20 students). Each group had five members: two assessed the environmental indicators, and one person each assessed the social, economic, and governance indicators. Each group had several members with good local knowledge. The students received the guidance manuals (SUSTAIN partnership 2012a, 2012b) several days before the application. After an introduction and practical exercises, the groups had about one full day to carry out the indicator application. The exercise was

Table 1
The SUSTAIN indicator set: pillars, issues and indicators (modified after SUSTAIN partnership, 2012a).

The SUSTAIN core indicator set: 4 pillars, 22 issues and 58 indicators	
Economics (with 4 Issues)	**Indicators** (scoring: 6 classes and 'no data')
1. Economic Opportunity	1. Employment by sector 2. Unemployment rate 3. Gross Value Added
2. Land Use	4. People and assets at risk in in coastal areas
3. Tourism	5. Tourism Intensity 6. Beaches with eco-label awards 7. Recreational boating
4. Transportation	8. Transport usage 9. Volume of port traffic
Environmental Quality (8 Issues)	**Indicators** (scoring: 6 classes and 'no data')
1. Air Pollution	1. Air quality
2. Biodiversity & natural resources management	2. Area of land and sea protected by statutory designations 3. Change of condition of coastal and marine habitats and species that have been identified as priorities for conservation
3. Change at the coast	4. Coastal erosion 5. Length of artificially defended coastline
4. Energy & climate change	6. Energy consumption 7. Greenhouse gas emissions 8. Share of renewable energies
5. Land use	9. Area of built-up land
6. Public health and safety	10. Human exposure to harmful noise levels
7. Waste Management	11 Waste production and disposal method 12. Amount of beach litter
8. Water resources and Pollution	13. Quality of bathing water 14. Wastewater treatment 15. Chemical status of coastal waters 16. Ecological status of coastal 17. Hydrocarbon spills
Social well-being (with 5 Issues)	**Indicators** (scoring: 6 classes and 'no data')
1. Demography	1. Demographic dependency
2. Equity	2. Poverty
3. Education and training	3. Educational attainment of the population
4. Local and cultural identity	4. Visits to cultural and natural sites 5. Attendance to festivals and public events, organised to strengthen the area's local identity
5 Public Health and Safety	6. Provision of health care services 7. Crime 8. Safety provision
Governance (with 5 Issues)	**Indicators** (scoring: 'yes'; 'no'; 'do not know')
1. Policies/strategies for sustainability	1 A sustainable development strategy which includes specific references to the coast and adjacent marine is in place? 2. There is effective political support for the sustainability process? 3. There are integrated, sustainability development plans? 4. The SUSTAIN Issues are covered by relevant policies at the local/regional level? 5. The SUSTAIN Issues are covered by relevant legal instruments at the local/regional level? 6. Guidelines have been produced by national, regional or local governments which advise planning authorities on appropriate sustainable uses of the coastal zone? 7. Strategic Environmental Assessments are used to regularly examine policies, strategies and plans for integration of sustainable activities?
2. Monitoring tools for sustainability	8. Sustainability targets have been set? 9. The sustainability targets are regularly reviewed? 10. There is regular monitoring of the coastal area with respect to the sustainability issues? 11. A report on the State of the Coast has been written with the intention of repeating the exercise every five or ten years? 12. Reviewing and evaluating progress in implementing sustainability criteria is regularly conducted? 13. Assessment of sustainability issues shows a demonstrable trend towards a more sustainable use of coastal and marine resources?
3. Human resources capacity building	14. Local/regional administrations have adequate capacity of staff to deal with sustainability matters? 15. Local/regional administrations have adequate expertise available to deal with sustainability matters? 16. Staff is trained on coastal sustainability matters? 17. All the relevant administrative levels and departments are collectively working on sustainability matters?
4. Implementation of good management practices	18. There is an identifiable point of contact for coastal sustainability matters? 19. Existing instruments are being adapted to deal with sustainability management matters 20. A long-term financial commitment is in place for undertaking initiatives which aim towards sustainability? 21. Integrated programmes on the coast are being carried out that improve the sustainability of the area?
5. Stakeholder involvement/public participation	22. All stakeholders involved in sustainability performance have been identified and are both informed and involved? 23. Partnerships have been established between local authorities and communities for sustainability matters? 24. There is a public participation process involving all necessary stakeholders, including business?

conducted with information publicly available on the Internet complemented by a few telephone interviews with local experts. The students decided by themselves whom to contact and which additional sources to use.

The following day, the groups discussed the scores internally, presented the results to the other students, and provided detailed feedback. The total available time for the application was roughly one working week for one person. The idea was not to apply the most scientifically sound application methodology, but to the test the indicators under the most realistic conditions. The indicators are meant for a self-assessment in municipalities. The educational level and local knowledge of the students, as well as the available time all represent realistic application conditions for typical municipalities. The allocated time was determined from responses from representatives of municipalities and the local tourism sector at a workshop on indicators of sustainability in Warnemünde.

For Warnemünde, a more detailed application also took place. A junior scientist involved in the SUSTAIN project work spent two full working weeks over a period of two months to carry out the application, using Internet, official statistics, literature, and additional phone interviews with local experts.

3. Results and discussion

3.1. The indicator application and scoring process

The SUSTAIN indicator set has been selected based on three criteria: relevance to sustainability, data availability, and its readiness for field use. The challenges linked with collecting the relevant data for each indicator are indicated in SUSTAIN partnership (2012b) and our experiences confirm several problems, e.g. that the data often is not available from one year, so data from different years has to be used. The consequence is that the indicator application result does not reflect conditions in municipalities for one reference year, but rather describes the situation during a period of several years. Usually a recent and full data set from only one year was not accessible, and we had to choose a period a few years in the past instead of only one specific year. Therefore, the results are not current. Another problem encountered at both sites was finding data that was specific to the assessed spatial unit. To carry out an indicator application for a traditional and well-defined administrative unit, like a municipality or a district, helps to overcome this problem because the data often is already aggregated with respect to these units. However, in some cases data privacy laws requiring aggregation of data did not allow us to resolve municipal data to a sufficient degree. For Warnemünde, which is a part of the city of Rostock and not a self-governed municipality, suitable aggregated data was often lacking. In our case studies the availability of data was an important problem. Even if data existed, it took effort to find out how and where to access it. The problem of data availability was indicated in other studies as well, e.g. dealing with environmental indicators (Stein et al., 2001), evaluating tourism sustainability (O'Mahony et al., 2009), or discovering information about the local community (Ballinger et al., 2010). One method for to overcome the data availability gap is standard, repeatable, and cost effective information gathering surveys (O'Mahony et al., 2009).

According to SUSTAIN partnership (2012b), 'the approach to score through ranges instead of using precise values, provides the method with flexibility: even data which could not be specifically identified or might be considered imprecise or give just an approximation can be used if identified within a range.' Table 2 shows an example spread-sheet for the issue 'Economic opportunity.' In detail, the approach includes several subjective predefinitions that have significant influence on the results: the definition (boundaries) of the classes, the choice of non-equidistant classes, the definitions of the minimum and maximum of the total range, and the allocation of scores from 0 to 10 to each class. Further, the approach has mathematical weaknesses. If no data is available, the score for an indicator is zero. It is not removed from the calculation but included in the average calculation, reducing the result. Further, indicators that are dependent on each other, like the percentage of employment in primary, secondary and tertiary sectors of the economy (Table 2), are treated as independent indicators in the average calculations, causing an overestimate of the indicator 'employment by sector'. Scoring through classes is a simple approach which is easy to understand and allows for the combination of different data (e.g. relative, classified, and numerical data), but includes a problematic loss of information and reduces the overall quality of the indicator performance. It can hardly be regarded as an advantage in cases where data is uncertain or has to be estimated. Due to these experiences, we thoroughly revised several parts of the scoring spread-sheet.

Table 2
Example of the SUSTAIN indicator scoring spread-sheet. Shown are the 3 indicators defining the issue 'Economic Opportunity' as part of the sustainability pillar 'Economic', the scoring units and ranges. Gross Value Added is calculated per sector of economy, explicitly focussing on coastal-dependent activities like fishing, aquaculture, tourism and port activities. The table is modified after SUSTAIN partnership (2012b).

Pillar: Economy								
Issue: Economic Opportunity	**Units**	**Scoring Ranges**						
1. Employment by sector	% Primary sector	<10%	10-20%	20-40%	40-60%	60-80%	>80%	No data
		2	4	10	6	4	2	0
	% Secondary sector	<10%	10-20%	20-40%	40-60%	60-80%	>80%	No data
		2	4	10	6	4	2	0
	% Tertiary sector	<10%	10-20%	20-40%	40-60%	60-80%	>80%	No data
		2	4	10	6	4	2	0
2. Unemployment rate	%	>20%	15-20%	10-15%	5-10%	2-5%	<2%	No data
		1	2	4	6	8	10	0
3. Gross Value Added	% of budget for coastal sectors	<5%	5-10%	10-15%	15-20%	20-25%	>25%	No data
		1	2	4	6	8	10	0

3.2. Reproducibility and reliability of results

Indicator scores are averaged to calculate issue scores, and these are further aggregated into pillar scores. Does aggregation stabilise the results and improve reliability? The average scores for every issue are shown for Warnemünde (Fig. 2) and for Neringa (Fig. 3). For every issue the results between the 4 (5) groups of evaluators differ strongly. The total average over all issues in Warnemünde is five. The averaged minimum scores are two scores lower and the averaged maximum two scores higher than the average. The same is true for Neringa (Fig. 3). The differences between aggregated results at both issue and pillar levels are very high.

What are the consequences of these uncertainties in the indicator application methodology? According to the SUSTAIN partnership (2012b), the methodology shall enable municipalities to repeat the exercise at different time intervals in the future, to determine whether or not they are moving towards greater sustainability. This repetition is important for a long term assessment (Mc Cool and Stankey, 2004; Breton, 2006; Ballinger et al., 2010). To assess whether repetitions make sense, we compared the present result of the in-depth application in Warnemünde with an application based on data of the late 1990s. Only a few indicators had different scores for 1990 and today. The systematic changes as reflected in the aggregated scores are minor when compared to the multiple major methodological uncertainties. First, the SUSTAIN 'scoring through ranges' approach hides small to medium changes, as most data stays in the same class and therefore receives the same score in the present and in the past. For example, the employment in primary, secondary and tertiary sector in a traditional seaside resort like Warnemünde changed only to a very limited degree during the last decade, with the scores remaining in the same classes. It is unlikely that in the future the changes between these three sectors of employment will cause differences in scores, because the classes are relatively broad.

Second, due to data availability, the score always reflects a longer time period rather than a single year, and this reduces differences between results from two spaces in time. Our experience shows that the indicator set does not allow a reliable comparison of different decades at one study site. Over a long period of several decades, systematic changes might become visible, but only if the quality of data remains stable and the same person carries out the evaluation.

There are several reasons for differences in the results between the groups, including misinterpretations due to insufficient or imprecise indicator descriptions, misunderstandings due to language barriers (the German and Lithuanian groups used the English indicator description and application manual), and the lack of suitable and sufficiently resolved data combined with the need to estimate certain values. However, subjectivity, perception, and the cultural background of the evaluator also play an important role. This is a known phenomenon even within one country (Ballinger et al., 2010), but become very obvious when groups with very different backgrounds from different countries are involved. Comparative indicator applications between countries involving local evaluators seem hardly reasonable.

The SUSTAIN indicator set has been developed for local municipalities as well as for district and regional authorities, to allow a self-assessment. Local evaluators have the advantage of often bringing good knowledge of the site being assessed and good access to available local data. However, the lack of experience in indicator applications, varying educational levels, and a lack of access to experts all pose problems for the accuracy of the indicator assessment.

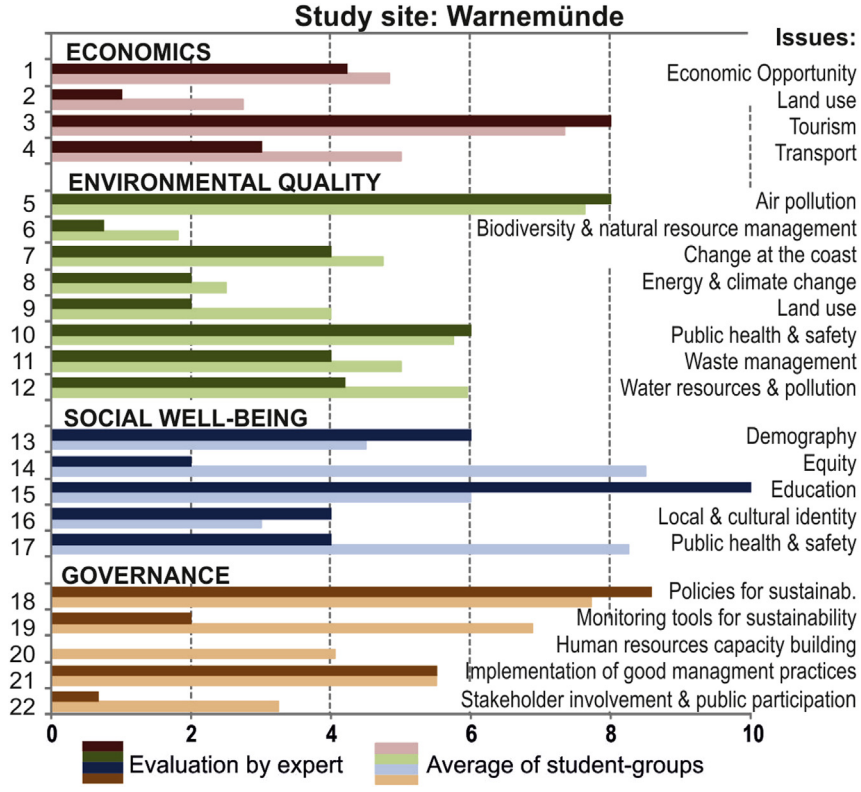

Fig. 2. Comparative application of the SUSTAIN core indicator set in the seaside resort Warnemünde. Shown are indicator scores that are aggregated to the level of issues. The issues describe the four pillars of sustainability, namely economics, environmental quality, social well-being and governance. Compared are applications carried out by an expert with average results of 4 student groups.

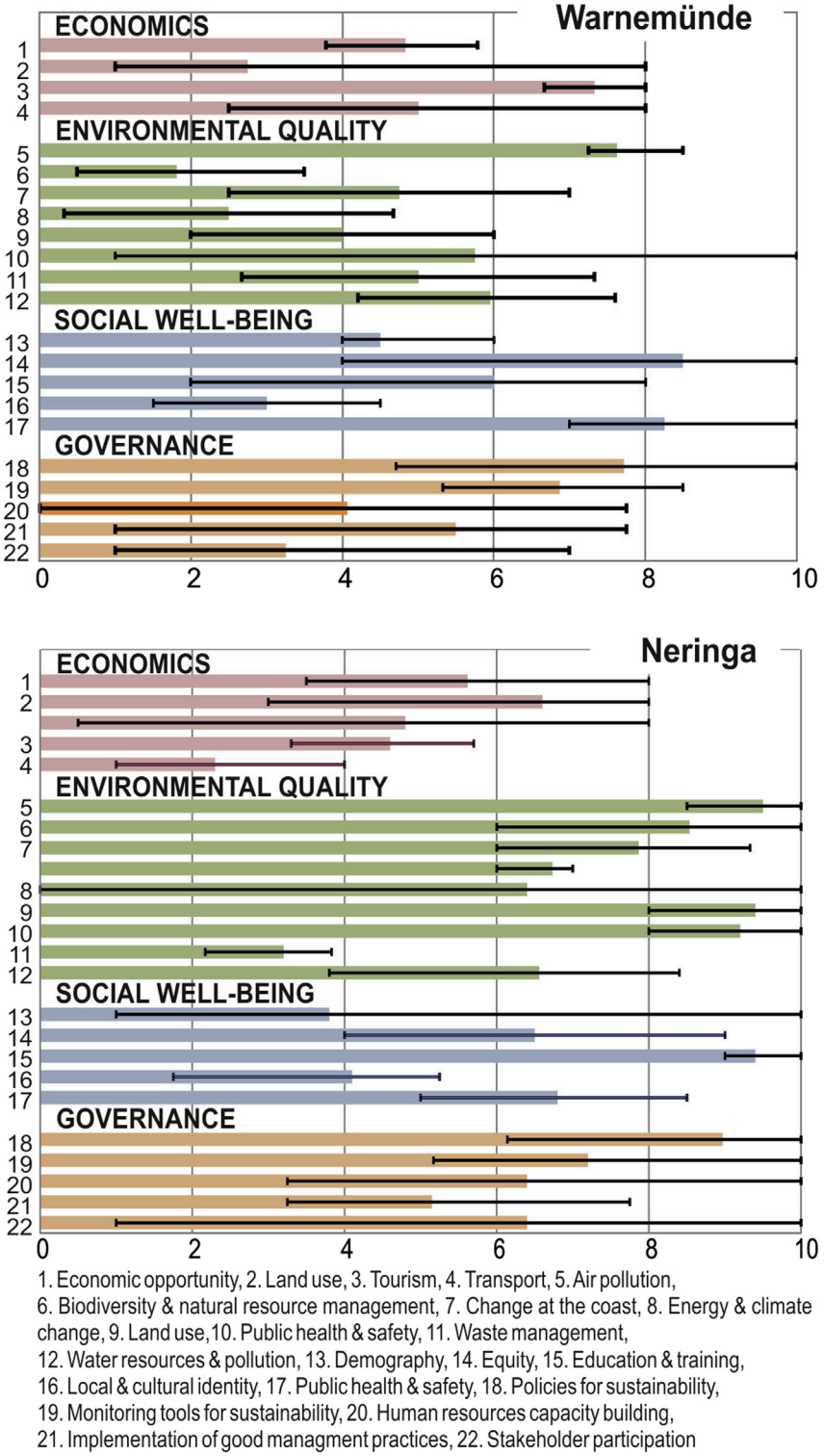

Fig. 3. Application of the SUSTAIN core indicator set in the seaside resort Warnemünde, Germany and in the municipality of Neringa, Lithuania. Shown are average, minimum and maximum indicator scores that are aggregated to the level of issues. The issues describe the four pillars of sustainability, namely economics, environmental quality, social well-being and governance. The applications were carried out by 4 (5) student-groups in Germany (Lithuania). During the exercise in Lithuania, the issue 'fisheries and aquaculture' was still part of the pillars economics and environmental quality and were later removed.

Our groups included young scientists with local knowledge who were introduced to the indicators and had the possibility to discuss problems in the group. Discussions within the group very likely stabilised the results and reduced subjectivity. Therefore, it is unlikely that one local person alone and without access to group feedback will produce a more stable, reproducible, and reliable result than our test groups.

To what extent does the time available for indicator application affects the quality of the result? Our groups had to base the indicator scoring mainly on information and statistics available through

the Internet. Official statistics and long-term monitoring programs are considered as the most reliable data sources and therefore very suitable for indicator applications (Hoffmann, 2009). The time available for phone interviews and additional literature search was limited and done only for a few indicators. Compared to this, our in-depth application carried out by a young scientist utilised much more knowledge from local experts, unpublished literature, and planning documents. We did not observe systematic differences in quality between a fast screening, done by a single person within one week (40 h), compared to an in-depth indicator application taking 80 h (two weeks full-time) stretched out over six weeks (Fig. 2). The benefit of investing more time resources into the application process does not improve the result to a degree that it can be regarded as cost-effective. We recommend a restriction of the indicator application to one working week. As mentioned before, the cultural, educational, and disciplinary background of the person carrying out the application has significant impact on the results. On the other hand, local stakeholders with knowledge of the situation and its history as well as suitable contact networks are extremely important (Hoffmann, 2009). However, we also recommend the involvement of an experienced external expert in the local application process. A neutral expert can beneficial for a critical view on non-desired development and current local practices (Lyytimäki, 2011).

3.3. Spatial, cross-regional comparability

The SUSTAIN indicator sets (core and optional) were developed by a European project involving 12 partners from different European countries. The sets should be suitable for all regions in Europe, and a major criterion for the choice of core indicators was their applicability across Europe and the availability of data collected according to various European Directives (SUSTAIN partnership, 2012b). This approach implies that the results allow a comparison of e.g. different municipalities within one country and between different countries.

Does the core indicator set allow cross-regional comparisons between municipalities? To test this, we compared the results from our two study sites (Fig. 3). Both study sites are very different with respect to their local setting, but both are dominated by tourism.

As expected, Neringa receives higher average issue scores for environmental quality. With respect to the issues describing social well-being and economics, both study sites show similar scores. With respect to governance, Neringa has an average of 6.8 compared to 5.5 in Warnemünde. Knowing the situation in both places, the higher value for governance in Neringa and similar scores for economics are surprising. We had expected similar scores for governance and significantly higher scores for economics in Warnemünde. There are several reasons for this surprising result. First, the titles of the issues are sometimes misleading and led to confusion among stakeholders with regard to the indicators describing the issue. The issue 'land use' in the economics pillar, for example, is exclusively described by the indicator 'people and assets at risk in coastal areas.' In the environmental quality pillar, the issue 'land use' is described by the indicator 'area of built-up land.' However, both indicators are insufficient to estimate 'land use' as understood in the common sense. The choice of indicators and the terminology caused misconceptions and required revision. Another important reason is the cultural background of the evaluators. The group members seem to intuitively compare the situation in the study site with their experiences from other parts of their country. German students and the expert were more critical of the economic situation in Warnemünde because it belongs to eastern Germany, a region which is known for an under-performing economy. In contrast, the Lithuanian students approved highly of the fast tourism development and improvements in infrastructure in Neringa, because this development was perceived as better than the average in Lithuania. Compared to other Lithuanian resorts, like Palanga or Sventoji, Neringa is the most expensive, and attracts Lithuanians with higher income and foreign tourists, especially from Germany. Evaluators might perceive this as an economically sustainable situation and this might influence their evaluation. Possible economic and social risks associated with a short bathing season of only three months and a complete dependency on tourism are perceived as less critical. The cultural and national background seems to play a role for other issues as well, but its effect on the results cannot be quantified based on our data. However, it seems that the indicators and the scoring methodology, which should objectify the evaluation of the state of sustainability, are not able to entirely exclude subjective elements.

Administrative boundaries usually reflect historical or political developments and traditions, which are often similar within one country, for example the criteria how municipalities are defined spatially, but differ between countries. For example, the size and structure of the municipality comprising the study site has immediate consequences on indicator results. While the urban district Warnemünde is delimited by its administrative boundaries from neighbouring largely rural coastal landscape, these boundaries do not reflect the actual functional relationships along the coast. If the area of Warnemünde included its neighbouring areas, the indicator results would look very different. Largely accidental boundaries have a strong influence on results, which is a problem for inter-regional and international comparisons based on indicators.

Municipalities, districts, and regions show a pattern of heterogeneous activities and uses rather than a uniform situation. It seems that a heterogeneous study site is more problematic with respect to the application of indicators and the final result will very likely be fuzzier. Therefore, the indicator set should preferably be applied to homogeneous municipalities rather than to larger districts or regions. Several differences in the issue scores between Neringa and Warnemünde result from different sizes and spatial definitions.

With all these uncertainties, we think that coastal indicators and especially the SUSTAIN core set are not well suited for international comparisons. The strong variability of assessments carried out by different groups for one municipality is present in the end results even for data aggregated to the pillar level (Fig. 4). This high variability would largely conceal differences between different municipalities, especially on an international level.

Comparisons of municipalities within one country will certainly be more reliable, but it has to take into account that the available data for several indicators (e.g. employment rate) do not differentiate on the municipal level but are valid for a region. Municipalities within this region would get the same score for this indicator. Therefore, existing differences between municipalities will not always be sufficiently reflected in the indicator results.

3.4. Benefits for practice and local sustainable development

Are the indicators and especially the issues able to reflect the state of sustainable development in municipalities, and does the methodology enable local actors to measure their sustainability effort? The SUSTAIN partnership (2012b) states that 'within coastal zones, there are many hundreds of indicators which purport to give information about sustainability but, in reality, none of them do so – because that is not their purpose – as they are, in general, state-of-the-coast indicators.' The SUSTAIN indicators cover the four pillars of sustainability and are focused on the coast. They can be considered as a step forward, but going through the indicator and issues lists (Table 1) it becomes obvious that most of them have

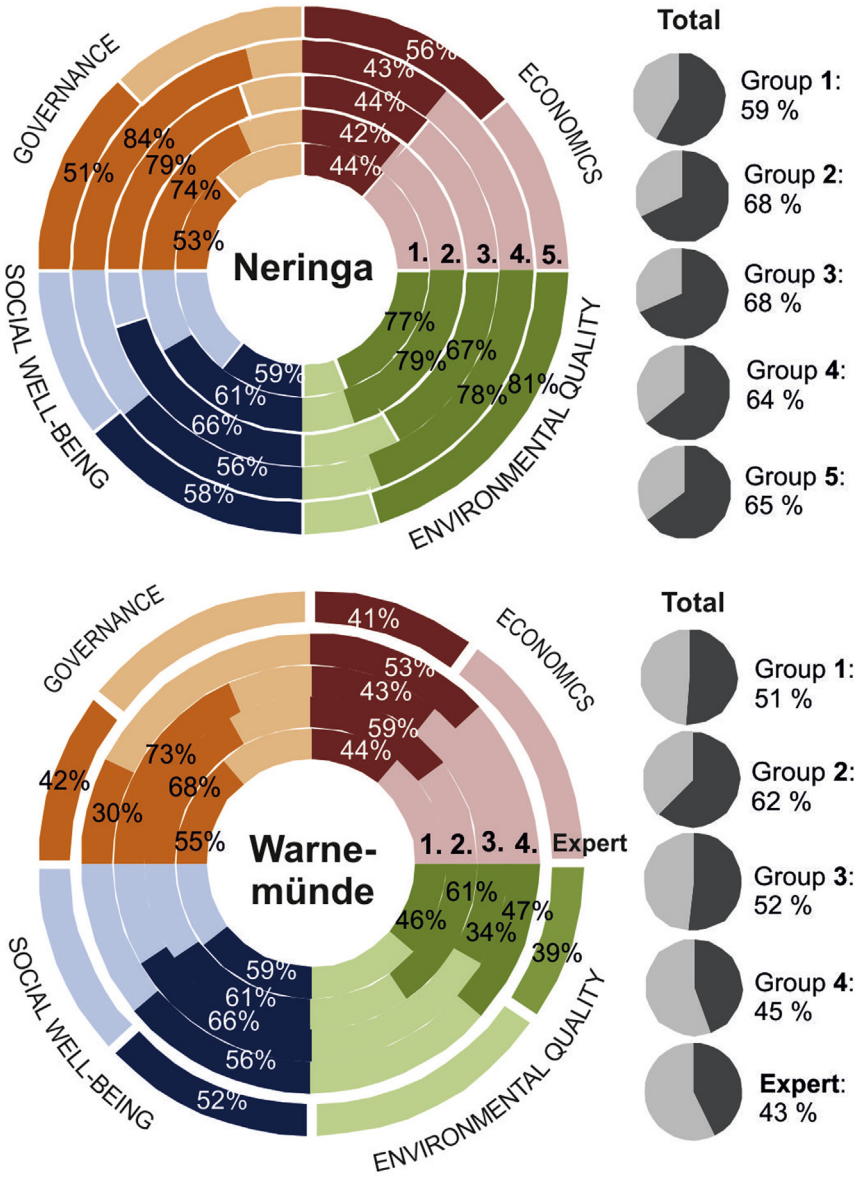

Fig. 4. Application of the SUSTAIN core indicator set in the seaside resort Warnemünde, Germany and in the municipality of Neringa, Lithuania. Shown are aggregated results for the 4 pillars (economics, environmental quality, social well-being and governance) as well as total results. The applications were carried out by 4 (5) student-groups in Germany (Lithuania) and one expert.

only a weak link to sustainability. However, aggregated to a pillar level they provide insights into the present state of municipalities indicate weaknesses and strengths and, if interpreted correctly, can support decision-making for a more sustainable development.

Indicators and issues only have practical relevance if e.g. municipalities can make improvements to improve their scores. An improved and more sustainable management has to be reflected in the result, otherwise it is a mere descriptor of the state of the coast indicator. The SUSTAIN optional and core sets include several indicators which are beyond local control. Therefore, a revision is necessary to improve their practical relevance.

The aggregated values for pillars and the end results of an application exercise include many uncertainties, and in and of themselves have only very limited practical relevance. The result is less important, than the application process itself. The application process can initiate and guide municipal discussions about sustainability. Therefore, the major challenge is the organization, guidance, and maintenance of this process to ensure the participation of relevant decision-makers as well as to involve the public (Mc Cool and Stankey, 2004). Stakeholder engagement and public participation is generally much higher during the early stages of development, particularly during issue identification, yet lacking in long term commitment (Ballinger et al., 2010). Important objectives include raising awareness about what sustainability means and identifying a path towards the creation of a future development vision. The question of how to adapt to climate change challenges is an excellent example of a discussion that could be guided by an indicator application exercise.

The SUSTAIN partnership (2012a) created a core indicator set, which was applied in Warnemünde and Neringa, and additional optional indicators. Optional indicators can be used by municipalities if they are relevant and access to the required data is possible. To tailor the indicator set to specific local needs is imperative to ensure a practical value. This approach has to go beyond the SUSTAIN sets, as municipalities need the freedom to contribute their own, specific additional indicators (Mc Cool and Stankey, 2004). Of

Fig. 5. Comparison between two indicator systems: the SUSTAIN pillars and issues and the QualityCoast criteria. The colours indicate which issues/criteria could be merged under a joint title. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

course, this approach reduces the regional trans-comparability of the issue and pillar aggregated results even further, and might lead to imbalances in the representation of the four pillars of sustainability within one municipality. The wish to compare the status of and progress towards sustainability between regions within one country (Sardã et al., 2005) or even across Europe is a major driver for the development of indicator sets (e.g. Breton, 2006; Lyytimäki, 2011). The indicator set to measure the progress in integrated coastal management (Pickaver et al., 2004), for example, was initiated by EU DG Environment to get an insight to what extent sustainable management is implemented in different European regions countries and where deficits exist. Comparisons across Europe allow identifying deficits in monitoring and data availability (Breton, 2006). They also include the possibility of learning from other experiences (Moreno-Pires and Fidélis, 2012).

3.5. *Future perspectives*

Indicator sets are hardly used by practitioners on a local level, and there is a risk that this will happen to the SUSTAIN set as well. The practical value of indicator results are hardly visible for municipalities, and using the application process to raise awareness and develop strategies might sound too theoretical for municipalities to be willing to allocate time and money. Enabling comparisons with other municipalities of the region, country, or world, or the idea of a ranking list or a performance map will very likely attract only very few municipalities. This is especially true when the results will be used for promotion and advertisement purposes. Warnemünde, for example, is in keen competition with neighbouring seaside resorts, which hampers joint regional advertisement programs. It is hard to believe that a publication of indicator results pointing out the strengths and weaknesses of a resort will be welcomed. If indicators are used for internal purposes only, funding will generally be a problem and municipalities will call for external funding schemes (Lyytimäki et al., 2011; Moreno-Pires and Fidélis, 2012).

Our impression is that indicator sets are only attractive and accepted if they ensure an immediate and visible benefit for municipalities. An existing eco-label, like QualityCoast, could be useful in this respect.

QualityCoast is an international certification programme for sustainable tourism destinations. Since 2007, 125 tourism destinations in 23 countries have already been selected for a QualityCoast award. This award includes coastal towns, resorts, and

islands (QualityCoast, 2013). The program promises improved awareness of sustainability issues, monitoring strengths and weaknesses, guidance for improvement, transparent information, local publicity, marketing, and promotion (QualityCoast, 2013). QualityCoast offers clear benefits for coastal destinations, and despite focussing on tourism, it uses an indicator system that covers many aspects of sustainability (O'Mahony et al., 2009) and shows many similarities with the SUSTAIN set (Fig. 5). The idea is to technically merge both systems by using the SUSTAIN scoring sheets to increase the motivation to apply the system due to its clear benefits. Municipalities have the short-term benefit that they can directly apply for the QualityCoast label and have the advantage of being able to use the SUSTAIN results to evaluate their state of sustainability and can use it as a policy tool to develop e.g. a sustainability strategy.

4. Conclusions

The SUSTAIN partnership, (2012a,b) provides sets of core and optional indicators to measure sustainable development in coastal areas on local and regional levels. The indicator set is linked to a scoring and preference methodology and shall serve as a decision support and strategic planning tool. The methodology is innovative, well documented and, easy to use given the supplementary templates provided for the implementation of the SUSTAIN indicator set. The indicator scores are aggregated into issues and further into the sustainability pillars. Our systematic indicator set applications at two study sites, show that the results have a high variability on all aggregation levels. Reliable spatial comparisons of the state of sustainability in different regions and countries are highly impractical, as are time series applications for single sites. This is a result of shortcomings in the availability, quality, and spatial resolution of data, the indicator set and methodology itself, and factors such as human subjectivity. The cultural, national educational and disciplinary background of the evaluator plays an important role as well. For these reasons, the indicator set and the calculation methodology require a thorough revision. However, to our mind, the numerical result of an indicator application is less important than the application process itself. The application process can initiate and guide a discussion about sustainability at the municipal level.

To improve the reproducibility and reliability of indicator results, a homogenous, well defined administrative unit should be selected; municipalities seem most suitable for this. An experienced person who is familiar with indicator sets and methodologies should carry out the application in close interaction with local representatives and should serve as a moderator in the discussion workshops. A stepwise process with workshops is necessary to adjust the indicator set to local needs and to discuss the results. 40 work hours (one week) seems sufficient to carry out the basic core-indicator application exercise.

To stimulate the adaptation of this methodology, it must provide clear benefits for municipalities. The initiation of a learning- and awareness-building process and the desire to support strategic planning towards sustainability alone might not be sufficient as motivations.

We recommended the combination of the SUSTAIN methodology with the QualityCoast labelling system. This could ensure a concrete economic and promotional benefit for municipalities.

Acknowledgements

The work has been part-funded by the European Regional Development Fund INTERREG IVC programme project SUSTAIN and by the German Federal Ministry for Education and Research within the project RADOST (01LR0807B).

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