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Establishing new bathing sites at the Curonian Lagoon coast: an ecological-social-economic assessment

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Abstract
The large southern Baltic lagoons (Curonian, Vistula and Szczecin Lagoon) face a similar challenge, the need for economic, especially touristic development. This development is hampered by poor water quality, namely eutrophication with regular algae blooms and low water transparency and often insufficient bathing water quality. Therefore, beaches and bathing sites, one precondition for tourist development, are often lacking. Using the Curonian Lagoon as case study, we apply a Systems Approach Framework (SAF) and especially an Ecological-Social-Economic (ESE) assessment to analyse, whether it is reasonable to establish new beaches, against the background of an improved sewage treatment. In this systematic, stepwise and participatory Integrated Coastal Zone Management approach, we guide and support municipalities from the issue identification towards the final implementation by developing alternative scenarios, using model simulations and carrying out tourist surveys as well as supporting socio-economic studies. The present state of bathing water quality does allow opening a new bathing site with a beach at the lagoon and one town decided to do so. The socio-economic analyses did show that lagoon water quality and the possibility to go for a swim is not sufficiently important for tourists on the Curonian Spit, that opening a beach would make sense from an economic point of view. However, high lagoon water temperatures may help to extend the summer bathing season and a beach is regarded as additional attraction for tourists. A systematic involvement of stakeholders was imperative in this case study and we provide lessons learnt for a successful participatory process.

Keywords Integrated coastal zone management · Systems approach framework · Tourist survey · Water quality perception · Bathing water quality · *Escherichia coli* · Enterococci

Introduction

Around the Baltic Sea, tourism plays an important role and is still growing. Based on international arrivals in 2012, the Baltic Sea region accounted for 7% of the world's tourism and 13% of tourism in Europe (Winther and Jensen 2014). Lithuania has a population of 2.8 million and in 2016 recorded 2.75 million tourist overnight stays (1.5 million foreign tourist overnight stays). Tourism industry accounts for 1.6% of GDP and 1.5% of the employment. This is lower compared to other southern and south-eastern Baltic and neighbouring countries, like Latvia, Germany or Poland, but an ongoing increase is forecasted (Blanke and Chiesa 2013). All southern Baltic countries face the problem that bathing tourism is concentrated along the Baltic coast and generates locally limited relatively high economic income. As consequence, steep gradients in living costs, wealth and economic power exist to the rural hinterland. Along the southern Baltic coast, tourism often locally contributes more than 50% to the GDP and is the exclusive economic factor. Further, the climatic conditions restrict the bathing season to a few summer months (Świątek 2014) and cause relatively low occupancy rates of bed-places. Low occupancy rates indicate a non-sustainable tourism with seasonal jobs and income and cause problems to maintain the tourism infrastructure. As a consequence, most countries have the aim of developing and strengthening rural hinterland tourism and of extending the tourism season. This requires a suitable tourism infrastructure. Sandy beaches with bathing sites are among the most important elements and beaches at

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lagoons, which show suitable water temperature for swimming during a longer period in summer, may be useful.

The southern and south-eastern Baltic coasts of Lithuania, Latvia, Poland and Germany are formed by glacial sediments and sandy strips are common. Further, all countries have in common large inner coastal waters (bays and lagoons) connected to the Baltic Sea. At these inner coastal waters, tourism usually is still very limited (Bielecka and Różyński 2014), but shall be developed to increase the economic power. In the past, heavy eutrophication and insufficient bathing water quality (Schernewski et al. 2014) restricted the development of tourism. However, recent nutrient load reductions and improved sewage treatment in most cases improved water quality and this offers new possibilities.

The overall objective of this study was to carry out an analysis whether it is reasonable to establish beaches and bathing sites at the Curonian Lagoon in Lithuania. For this purpose, we applied the Systems Approach Framework (SAF) and tested if it is a suitable methodology to support and implement the ideas of an Integrated Coastal Zone Management (ICZM) in this concrete case. The SAF is a stepwise, user-friendly methodology with high practical relevance that allows addressing problems and challenges in the coastal zone in a systematic way (Hopkins et al. 2011; Støttrup et al. 2017). It includes an integrated Ecological-Social-Economic (ESE) assessment in close cooperation with stakeholders.

Study site & methods

Curonian lagoon and spit

The Curonian Lagoon (Fig. 1) is a transboundary water shared between Russia and Lithuania and separated from the Baltic Sea by the Curonian Spit. The total lagoon surface area is about 1584 km^2 with 413 km^2 in Lithuania, the maximum length 93 km and the mean water depth 3.8 m. The lagoon can be regarded as a freshwater system, with a salinity below 0.1%. Only at the opening to the Baltic Sea, in the Klaipeda Strait, salinity on average reaches 0.2–0.3%. The Lithuanian part of the lagoon is strongly influenced by nutrient loads from Nemunas river. The Nemunas has a catchment area of 97,920 km^2, an average flow of 692 m^3/s (Jakimavičius and Kovalenkovienė 2010) and discharges about 44,000 t total nitrogen and about 1800 t total phosphorus into the lagoon (Helcom 2015). With respect to nutrient loads, it is one of the four most important rivers in the Baltic Sea region. The consequence is a heavily eutrophicated lagoon with frequent, potentially toxic, cynaobacteria blooms in late summer. The average water transparency (Secchi depth) is only about 0.7 m.

The Curonian Spit (mainly covered by Neringa municipality) is one of the most popular local and foreign tourist destinations in Lithuania and hosts 400,000 guests per year (Povilanskas and Armaitienė 2010). Tourism is the major source of income in Neringa, but it is concentrated in the summer months, with 72% of overnight stays between June and August. With about 1200 inhabitants, Nida is the largest and most famous seaside resort on the Curonian Spit. The second largest resort is Juodkrante with 720 inhabitants. About 12 km out of nearly 50 km of Baltic Sea beaches along the Curonian Spit are used for recreational purposes and the beaches are awarded with the Blue Flag label. The Baltic Sea possesses excellent bathing water quality according to the Bathing Water Directive 2006/7/EC. At the Curonian Lagoon coast, only one regulary monitored bathing site exists, located near Kintai on the eastern lagoon coast. Here, between 2013 and 2016, the threshold for a sufficient water quality in coastal and transitional waters was exceeded during two years on single dates for Enterococci and during 3 years on altogether 4 dates for *E.coli*. On 16.08.2016, extremely high concentrations of 2500 cfu/100 ml and 9400 cfu/100 ml Enterococci were observed. More than 200 cfu/100 ml Enterococci concentrations already indicate insufficient bathing water quality according to Directive (2006/7/EC). On the Curonian Spit lagoon coast no official bathing sites exist, despite the fact that all seaside resorts (Smiltyne, Juodkrante, Pervalka Preila and Nida,) are located at the lagoon (Fig. 1).

In the central lagoon water temperatures can reach up to 25 °C and between 2010 and 2016 on 10 (July) resp. 13 (August) days per month the water temperatures were 20 °C or higher. As a comparison, in the nearby resort Palanga, only on 7–8 days/month in July and August, Baltic Sea temperatures of 20 °C or more were recorded in this period. In June and September, even in the lagoon, 20 °C are the exception. However, with in average 16 °C in June (2010–2016) the water temperatures in the lagoon were two degrees higher than in the Baltic Sea.

Socio-economic data collections, surveys and model

Visitor survey 2015 Between June and September 2015, a survey among visitors was conducted in Neringa Municipality. Altogether 318 visitors participated. The questionnaire was provided in 4 languages, Lithuanian, English, Russian and German and distributed to visitors. The intention of the survey was to get an overview about purpose of the visit and how visitors perceive Neringa, especially with respect to bathing and beaches. Basic questions included the main purpose of the visit to Neringa, gender, age, country of origin, travel companionship, type of accommodation. More specific questions about the settlements they visited in Neringa; whether they have visited Neringa before; activities during their stay; importance of water quality and beaches for choosing a holiday destination; important factors for choosing a beach, how they define a good bathing water quality, how they perceive bathing water quality of the Baltic Sea and the Curonian lagoon; if they experienced bathing water quality changes over the last 10 years; the level of information with respect to the condition of the Baltic Sea

Fig. 1 Location of the Curonian Lagoon (**a**) and the seaside resort Nida (**b**). The seaside resorts on the Curonian spit form Neringa Municipality. Pictures of the Baltic Sea and the Curonian Lagoon coast on the Curonian Spit near Nida

and the Curonian Lagoon; sources of information about bathing water quality of a leisure destination; intention to visit/use sandy spots (unofficial beaches) at the Curonian Lagoon; the best location for a new beach at the Curonian Lagoon in Neringa, advantages in comparison to Baltic Sea beaches; acceptable travel distance from accommodation to visit a beach; view on Neringa as a sustainable tourism destination.

Visitor survey 2016 Between 15th of June and 15th of August 2016 a survey among 220 visitors was conducted in Nida. The intention was to get a better impression about costs and benefits of beaches at the Curonian Lagoon. The questionnaire was given to the visitors in form of a paper in one of the 4 languages, Lithuanian, English, Russian and German. Questions were: Please estimate your costs (Euros) per person per day while staying in Nida? What means of transportation have you used to travel to Nida on this trip? Are you travelling alone or with company? What is your definition of leisure time on the beach? Do you think that a beach needs additional services/infrastructure? What additional services would make a beach at the Curonian Lagoon more attractive? How much would you be willing to pay for these services? Would you require a financial compensation in Nida, if access to the Curonian Lagoon beach would be no longer available? How much should the compensation be?

The socio-economic model The socio-economic model is based on two pillars: a) the public need for a beach in Curonian Lagoon, expectations of services provided if one to be opened, and willingness to pay for the services and b) the costs for beach establishment, infrastructure and maintenance (toilets, sand nourishment, beach cleaning, force majeure costs), publicity and advertisement campaigns as well as costs for regular bathing water quality monitoring and the Blue Flag award.

For the socio-economic assessment, the following initial conditions were defined: the beach is open only when the Curonian Lagoon water temperature is above 18 °C. When the Curonian Lagoon beach is open, it is assumed to be peak season and all the tourist accommodation places are occupied. The socio-economic assessment represents not only the expenses and possible revenue of an open beach at Curonian Lagoon, but also allows to predict payback periods for different alternative scenarios. The annual profit for each scenario was calculated with the formula:

$$P_{scenario} = ((€_{tourist} + €_{extra}) - (E_{closed\ b.} + E_{beach\ m.}))^{*} t_{b.operation},$$

$€_{tourist}$: average earnings from tourists (accommodation and expenses); $€_{extra}$: earnings from services provided at the beach; $E_{closed\ b.}$: loss of prestige expenses (compensation for beach being closed); $E_{beach\ m.}$: expenses for beach maintenance; $t_{b.\ operation}$ –number of beach operation day.

Microbiological methods, survey and model simulations

In the European Bathing Water Directive (2006/7/EC), *Escherichia coli* (*E. coli*) and Enterococci serve as indicators for bathing water quality and are determined in water samples in front of beaches during the bathing season. With respect to

E. coli, the threshold in coastal and transitional waters is 500 cfu/100 ml (based upon a 90 percentile evaluation). If this threshold is exceeded, the bathing water is classified as poor and bathing is prohibited. Frequent threshold violations result in a permanent closure of a beach.

To restrict the effort, we largely focussed on *E. coli* and carried out monthly sampling in 2015 and 2016 from May to August (up to 6 samples at each site). Samples were taken around the Lithuanian part of the lagoon at potential pollution sources (sewage outlet, river entering lagoon, agriculture, cormorant resting places), at the only official bathing site in Kintai, in areas with known recreational activities (boating, kitesurfing) and at potential new beach locations. We took samples in 0.3 m and 1 m below the water surface in 250 ml sterile polypropylene bottles, protected the samples from light, and kept them cool. Additionally, we measured in situ temperature, salinity and dissolved oxygen (DO) using a YSI 460 multiple probe. The water sample analysis took place on the same day. According to the Bathing Water Directive (2006/7/EC), the number of colony forming units (cfu) of total coliforms and *E. coli* in 100 ml of water was determined by the membrane filtration method (ISO 9308–1:2014). For all the analysed samples, three volumes of 100 ml were filtered through 0.45 μm pore size mixed esters cellulose membranes (Millipore). The number of Enterococci (mpns) were assed using IDEXX Enterolert® indicator and the and IDEXX Quanti-Tray®. The filters placed on the agar plates were incubated at 37 °C for 24 h. Additional data was available from the Šilutė municipality bathing sites monitoring data of *E. coli* and Enterococci (year 2011–2016) for Kintai and the river Atmata (Nemunas). The data served as input for particle tracking scenario simulations, with the hydrodynamic model SHYFEM. Details about model, data input and scenarios are documented in (Umgiesser et al. 2017). The decay of *E. coli* was studied during an outdoor microcosm experiment in August 2015 during light exposure and during darkness and used for modelling data.

Systems approach framework (SAF)

The core of the SAF is the Ecological-Social-Economic (ESE) assessment (Hopkins et al. 2011). In this study, a modified ESE assessment with 6 steps and defined tasks was applied (Table 1). These steps largely guide the presentation of the results, because testing the suitability and applicability of the SAF for a concrete problem was a major objective.

Table 1 Steps and tasks in the Ecological-Social-Economic (ESE) assessment

1. **Issue Identification** - list human activities; map institutions and stakeholders; map ecosystem services; engage stakeholders and conduct consultations; map stakeholder preferences; prioritise and identify/select issues; identify relevant social, economic, environmental components and dependencies.
2. **System Design** - develop a conceptual model; assess data availability and model resources; re-visit selected issue; define administrative and virtual system boundaries and ESE linkages; define success criteria and indicators; assess the system state (sustainability & ecosystem services); discuss and select potential scenarios with stakeholders; identify external hazards.
3. **System Formulation** - identify and assemble data inputs and variables; formulate, document, calibrate and validate each of the individual ESE model components (environmental, social, economic) and auxiliary models; link ESE model components into one system model; test sensitivity; run scenario simulations.
4. **System Assessment** - prepare scenario results for stakeholders; visualize consequences of ESE model scenarios and/or ecosystem services and sustainability; conduct stakeholder meetings and discuss results; potential impacts and management options.
5. **Implementation** - specify regulatory and financial requirements; obtain legal permits; identify mitigation measures to reduce; offset, or eliminate negative impacts; ensure pro-active public information and consultation.
6. **Monitoring & Evaluation** - Ensure that required mitigation measures are implemented; evaluate whether mitigation measures are effective; assess if the objectives were reached (indicators); inform stakeholders regularly on progress, evaluate needs for re-iteration of the SAF process.

Results

Issue identification & scenarios

At the beginning, we carried out a review and personal discussions about relevant problems, issues and plannings. The first step was to establish an interdisciplinary research team and to carry out a systematic stakeholder mapping, where we identified key-persons (federal state ministry, state agency, authority, district representatives, tourism association and local mayor, fisheries, nature protection NGO's), that were required for the process. The Klaipeda region tourism association turned out to be a key-player with respect to local knowledge and contacts and we added the vice-director to the research team.

Already early in the discussions, the opening of new bathing sites/beaches at the Curonian Lagoon coast turned out to be a potentially relevant local issue. In preparation of stakeholder involvement activities and to obtain a better understanding of relevant social, economic, environmental components and dependencies in the region we carried out a DPSIR (Driver-Pressure-State-Impact-Response) and CATWOE (Customers-Actors- Transformational process-Worldview-Owners-Environmental constraints) for this issue and visualized the results (Fig. 2).

During the first stakeholder workshop on 11th of June 2015 in Nida, where 6 stakeholders and 8 scientists took part, the potential issue of a beach opening was confirmed as relevant. During the workshop, we discussed DPSIR and CATWOE as well as compiled the main expectations and concerns. In

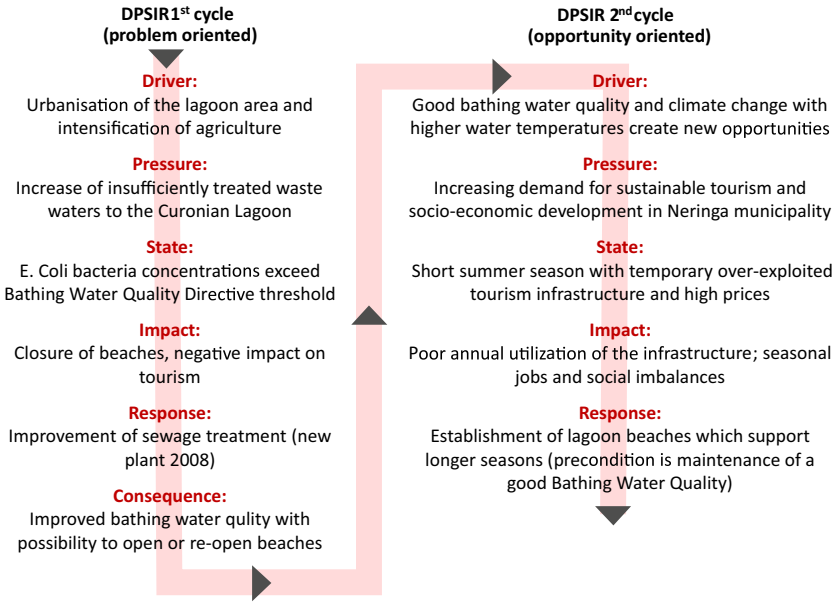

Fig. 2 Results of the Driver-Pressure-State-Impact-Response (DPSIR) analysis with respect to opening new beaches at the Curonian Lagoon coast

general, new bathing sites/beaches at the lagoon were perceived as a potential for local development. Compared to the Baltic Sea, they could be established close to the towns, are less exposed and sheltered from dominating westerly winds. The shallow lagoon does not allow high waves and could be beneficial and more safe especially for elderly people and children. Further, higher water temperatures could allow a prolongation of the bathing season. On the other hand, the lagoon suffers from eutrophication with low water transparency and blooms of potentially toxic blue-green algae are common and often last over weeks in late summer (Paldaviciene et al. 2009). However, a major concern was the unknown situation with respect to bathing water quality. In case the newly established beaches have to be temporarily closed because of insufficient bathing water quality, Neringa community might face a loss of reputation with negative effects on tourism and economy. The stakeholders saw a need to avoid spatial conflicts between bathers and water sports and uses by applying spatial separations. Further, the stakeholders expressed their interest to be involved in the process and to be informed about results on a regular basis. The workshop revealed that the ideas of ICZM (and especially the SAF) as well as several scientific terms were new for the stakeholders. A joint terminology and a common understanding had to be developed in the beginning.

As consequence of the first stakeholder meeting, the research team agreed to establish a bathing water quality monitoring and to allocate and quantify potential microbial pollution sources. To assess the spatial-temporal state of microbial pollution, to allocate suitable locations for new bathing sites and to allow a risk analysis of a beach closure under different environmental conditions, the team agreed to apply a hydrodynamic model including particle tracking. Further, a need to assess the tourists' view about lagoon beaches became obvious (Fig. 3).

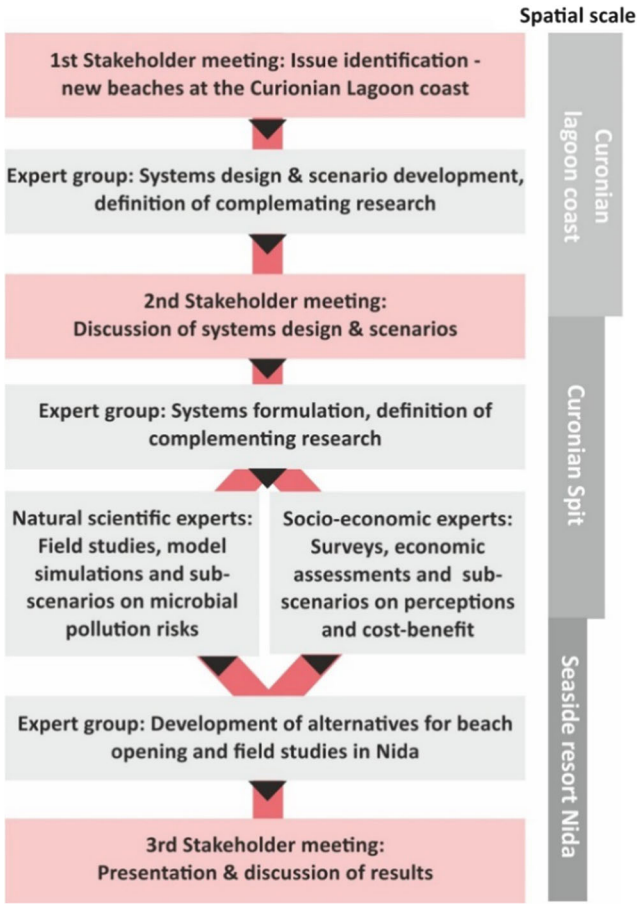

Fig. 3 Overview about the stakeholder involvement and the application of the Ecological-Social-Economic (ESE) assessment within the Systems Approach Framework as well as the spatial scale of the process

System Design & Formulation

In the System Design step, we developed a conceptual model that visualised the dependencies within and between the economic and the natural scientific models (Fig. 4). In the second stakeholder meeting on 16 October 2015 in Nida (11 stakeholders and 5 scientists), possible alternative scenarios and the pre-conditions were discussed. The scenarios only differed in the location of new bathing sites/beaches. Criteria were that a location should show no risk of microbial pollution and bathing prohibition, should show low phytoplankton concentrations and a low risk of potential toxic algal blooms and has to be close to a village. The conceptual model (Fig. 4) was discussed during the meeting and was considered as suitable to address the issue of bating water quality and beach establishment. Because of stakeholders involved and the location of major tourist resorts, we agreed to reduce the virtual system boundaries to the Curonian Spit and especially the administrative boundaries of Neringa Municipality. Further, the need for more detailed social-economic studies became obvious. The models are described in the methodology.

System assessment - bathing water quality

Figure 5 shows the spatial bathing water quality in the Curonian Lagoon based on *E. coli* samples of 2015 and 2016. Generally, *E. coli* was found in all sites and the concentrations were between 1 and 6000 cfu/100 ml. The most frequent pollution with *E. coli* concentrations above 500 cfu/100 ml were observed in Kintai and Pervalka. In Nida and Preila the data always indicated an excellent bathing water quality. A detailed correlation analysis showed that high *E.coli* concentrations occurred together with high concentrations of suspended particulated matter and high turbidity and lower concentrations of pH and oxygen The distance from the river and the sewage were also important.

A problem was that the spatial pollution pattern (Fig. 5) was based on a few sampling dates and its temporal representativeness was limited. Therefore, a 3D hydrodynamic model was applied to provide a complete spatio-temporal *E. coli* pollution pattern in the lagoon (Umgiesser et al. 2017). The *E. coli* laboratory decay experiments in light and darkness were used as input for the numerical model. A reference model simulation included all data available for 2015 and confirmed the low concentrations in Preila and Nida results. To receive an insight into potential spatio-temporal pollution events, several scenario-simulations were carried out: high touristic pressure on the spit, enhanced river loads, a sewage system breakdown, severe meteorological conditions and an additional *E. coli* input from the Russian side of the spit. Because of fast decay of *E. coli* (0.55 and 2.3 days), distant pollution sources did not play a role for beaches at the spit. Only a breakdown of the sewage system on the Curonian Spit could cause temporary bathing prohibitions (Umgiesser et al. 2017).

E. coli compared to Enterococci has a faster die-off rate. As consequence the *E. coli*/ Enterococci ratio decreases with increasing distance to a pollution source or with time after an emission. A ratio of 2.5 results from the thresholds for both organisms in the Bathing Water Directive (Fig. 6). Simplified, a ratio above 2.5 indicates a local or fresh pollution. The

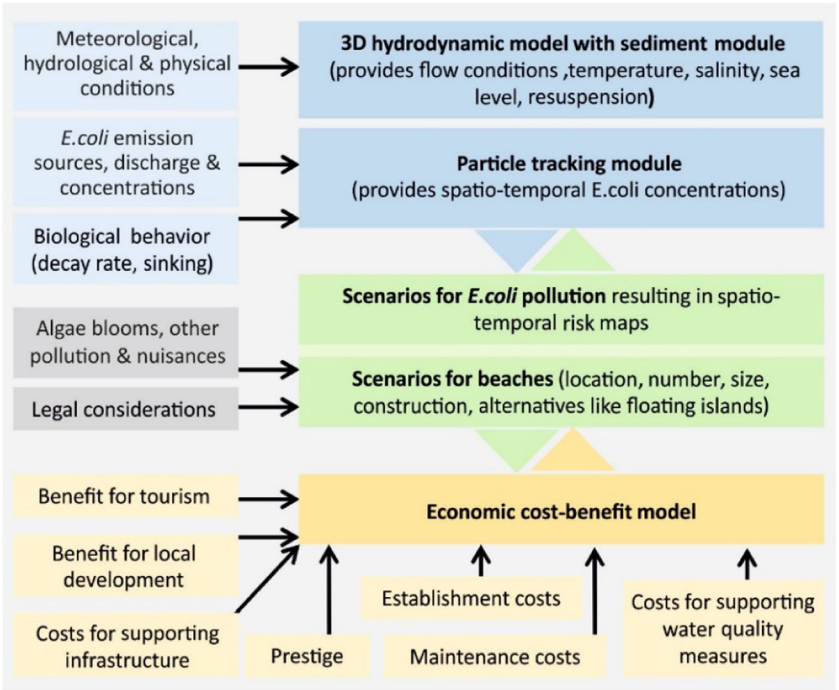

Fig. 4 Economic and ecological conceptual models

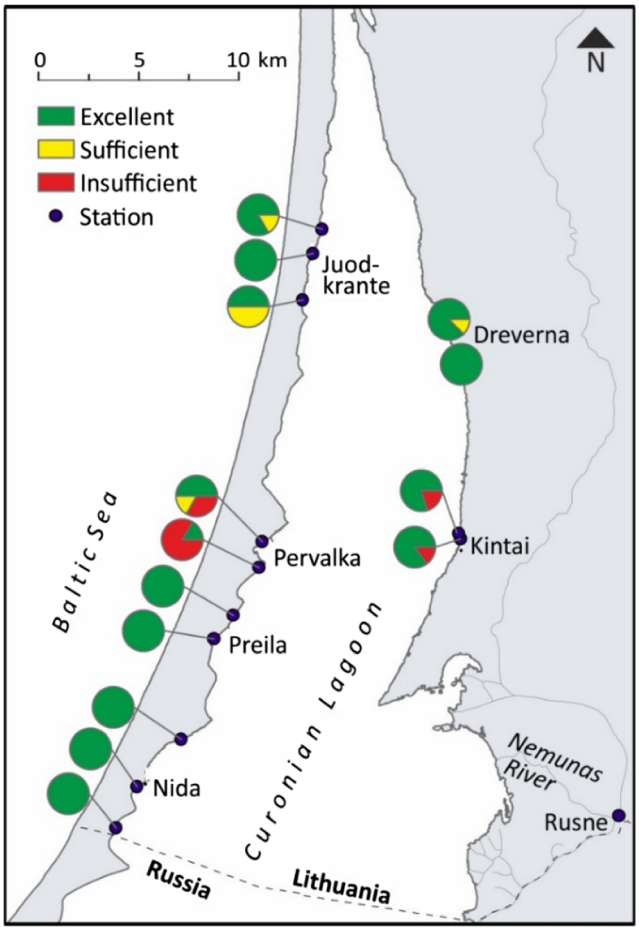

Fig. 5 Bathing water quality in the Curonian Lagoon based on of samples for *E. coli* between 2015 and 2016. Thresholds according to the European Bathing Water Directive for coastal and transitional waters: excellent <250, good (sufficient) 250–500, insufficient >500 cfu/100 ml

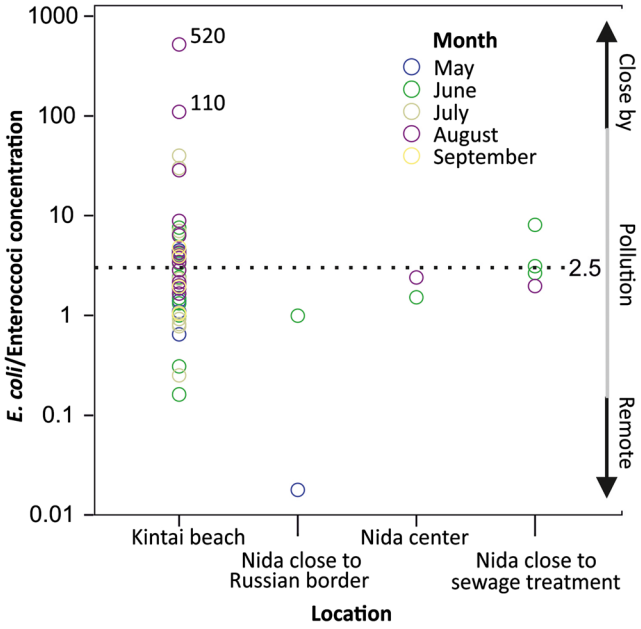

Fig. 6 *E. coli*/Enterococci concentration ratio. A ratio of 2.5 results from the thresholds for both organisms in the European Bathing Water Directive

further the ratio is below 2.5, the more likely is a distant (old) emission. Figure 6 shows ratios for Nida and Kintai. In general, both sites showed a dominating local pollution. Only one sample in Nida in May indicated relatively high Enterococci concentrations, but the absolute values were low.

Both, model simulations and data confirm that in Nida and Preila (and to a minor degree in Juodkrante) new bathing sites would very likely not face the risk of insufficient bathing water. In these places, the microbial conditions are favourable for opening beaches.

System assessment - tourist perception & acceptance

Tourists were the target group for possible new beaches/bathing sites at the lagoon. Therefore, their views were of outstanding importance for decision-making. The visitor survey revealed the following results: 41% of the interviewees stayed for longer than 5 days on the spit, 32% less than 5 days and 16% were day-visitors. 11% indicated 'other' and include e.g. traveling locals. On average, the total duration of the current travel (including other destinations) was 8.3 days. 67% of the visitors were from Lithuania, followed by 11% Germans, 4% Russians and 3% Polish. The age spectrum of the interviewees between 20 and 50 was balanced, but only 15% were older than 50 years. Most visitors were traveling with a partner. Only about one third were families.

When asked about major activities on Neringa, walks were mentioned most often followed by visiting places of interest, visiting exhibitions and cultural events and bathing in the Baltic Sea (Fig. 7a). Altogether, nature related activities on the spit and culture related activities were more important than water activities. Bathing in the lagoon was mentioned only 6 times. These results clearly indicate that even in summer, Neringa is not a classical beach and bathing destination. When asked about important factors for choosing a beach the visitors mention a wide spectrum. Access to the sea, the lack of pollution and nuisances, existing beach infrastructure and low visitor densities, were most often mentioned as important or very important (Fig. 7b). Water clarity was important for many, but high water temperatures played only a minor role. The same is true for access to the lagoon. However, the vast majority mentioned water quality and beach quality as important or very important factors for choosing a holiday destination.

The question about visitor's perception of water quality of the Baltic Sea and of the Curonian Lagoon showed differences (Fig. 8a). 51% consider Baltic Sea water quality as excellent or above the average, and only 27% judged water quality in the lagoon as excellent or above the average. 13% considered the Baltic Sea and 16% the

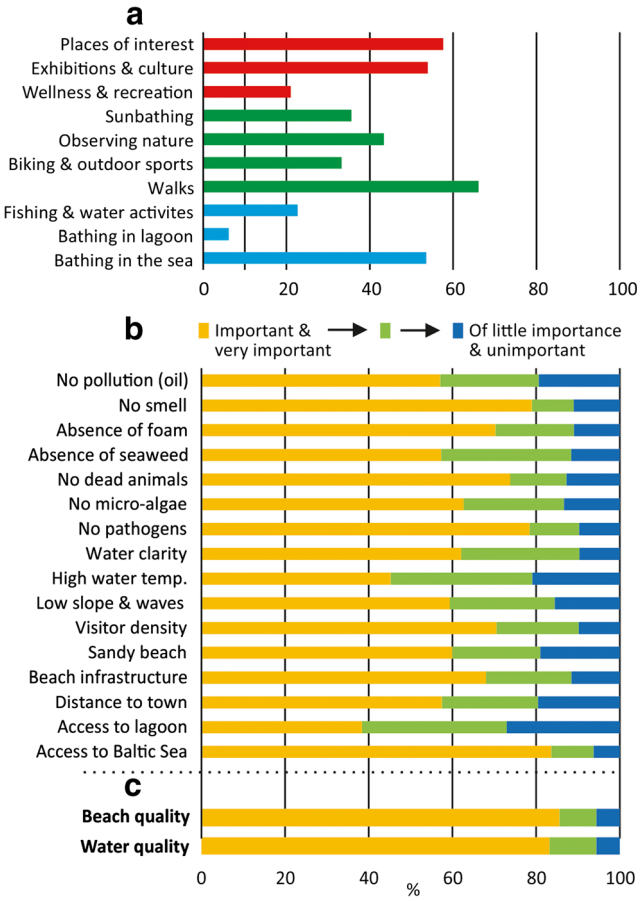

Fig. 7 Visitor survey 2015: a) Visitor activities during their stay in Neringa. It was allowed to mention several major activities. The bar-colours refer to the type of activity (blue: water and green: nature related). b) Factors for choosing a beach. c) Factors for choosing a holiday destination

lagoon water quality as extremely poor. 44% of the visitors support the view that bathing water quality in the lagoon had improved during the last decade while 9% had the opposite opinion (Fig. 8b). The majority was uncertain about this issue. 61% of the visitors were not interested or had no or little knowledge about water quality (Fig. 8c). Only 3% stated that they felt well informed. The Baltic Sea beaches in Neringa were awarded with the Blue Flag and bathing water information was displayed on major entrances. However, the beach information boards were not the dominating source of information. Media, the Internet, friends and the tourist information office were of comparable or higher importance. About 25% do not search for this kind of information. The majority of visitors had only little knowledge about water quality. Reason can be that bathing does not play a dominating role as holiday activity. To some degree, the relatively high number of foreign tourists might serve as an explanation. On the other hand, 90% of the visitors stated that they visited the area not for the first time.

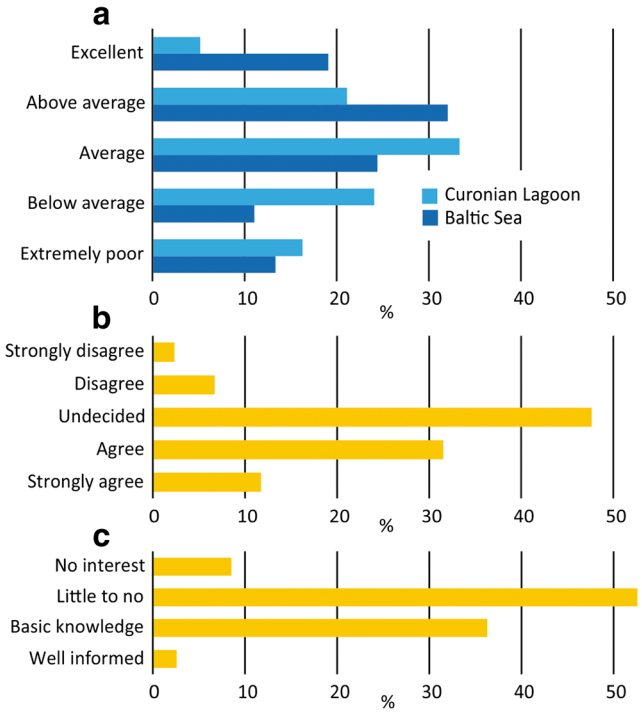

Fig. 8 Visitor survey 2015: **a** Water quality perception by visitors, **b** improvement of water quality in the Curonian Lagoon and c) level of information about the conditions of the Baltic Sea and the Curonian Lagoon

Higher water temperature and a longer bathing season together, were mentioned by 49% of the visitors as advantage of a beach at the lagoon. Compared to that a better and faster accessibility, shallower water with less waves and fresh water were of minor relevance (Fig. 9a). On the Curonian Spit the shortest way from a town to the Baltic Sea beach was between 1 km and 2 km. This was an acceptable distance for most visitors (Fig. 9b). Only 13% preferred to have a distance to the nearest beach of less than 300 m. Lagoon beaches, located in towns could be reached within a few 100 m, but visitors did not perceive this as a major advantage.

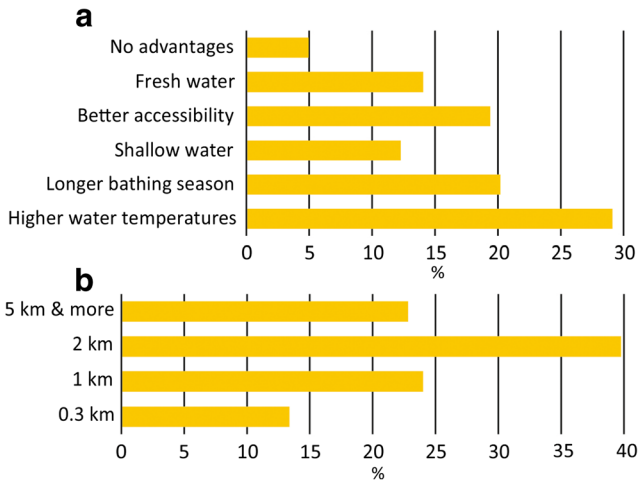

Fig. 9 Visitor survey 2015: **a** Advantages of a potential beach at the Curonian Lagoon and **b** acceptable travel distance to a beach

System assessment – Socio-economic survey and model

The visitor survey 2015 revealed that with 52%, Nida is the most visited place followed by Juodkrante and Preila with 20% each. Further, Nida is the largest resort with the highest bed capacity. The survey in summer 2016 complemented the 2015 survey and gathered more socio-economic data with focus on Nida. The results with respect to major activities in Nida did not differ much from the previous survey covering the entire Neringa Municipality. Bathing in the Curonian Lagoon had a share of only about 2% in all activities mentioned by visitors.

The visitors were asked, which additional services should be provided to increase the attractiveness of Curonian Lagoon beaches. 80% mentioned showers, followed by an SMS alert service (75%) (providing information about water temperature, wave height, pollution etc.), personal items lockers (49%), open air movies (45%), solarium (44%), water tourism (33%) and snack places (33%). Of less relevance were beach chair rental, a children playground, water quality signs and scuba diving/snorkelling. The next question addressed how much visitors are willing to pay for each service. For SMS alerts, showers and water quality signs they were ready to pay less than 1 Euro. For all other services, a fee between 1 and 5 Euro was considered as acceptable by those who generally would use this service. The amount of money a visitor was ready to pay, was multiplied with the number of respondents who would use the service and are willing to pay for it. As a result, the maximum potential annual income from each service was calculated. For open air movies, scuba diving, water tourism, a children playground and beach chair rental and a snack area, a potential annual income of around 20,000 Euro each could be generated. Much less for the other services.

The lagoon is heavily eutrophied and potentially toxic algae blooms, especially in August might make it necessary to restrict bathing in the lagoon. Therefore, tourists were asked, if they would find it necessary to get a compensation if the Curonian Lagoon beach would be temporary closed for bathing. 30% replied that they would like a financial compensation. Preferably, they wanted a 25%–50% reduction of the entrance fee to the National park, a 50% reduction of the beach equipment fee or a 25%–50% reduction of parking costs.

In five different scenarios, establishing and maintenance costs for the beach and its infrastructure were combined with possible revenues from services. Theoretically and considering a time-period of several years, costs might be compensated by revenue. However, more realistic is that beach establishment and bathing site maintenance would create additional annual costs for Nida, since none of the services would generate a turnover that would allow establishing a profitable business.

Implementation

The results can be summarized as follows: Curonian Lagoon beaches in Nida, Preila (and possibly Juodkrante) would very likely provide an excellent bathing water quality according to the Directive (2006/7/EC). However, the lagoon is heavily eutrophied and potentially toxic algae blooms, especially in August might make it necessary to temporary restrict bathing in the lagoon. Nida is the largest resort has the highest bed capacity and number of visitor. In case a beach with bathing site shall be opened it should preferably take place in Nida. Baltic Sea beaches only require maintenance costs (e.g. cleaning, life guard) and already have an established infrastructure and services. Further, Baltic Sea and Curonian Lagoon beaches would largely become competitors for the same clients, since Nida is too remote to be able to attract additional day-visitors and fully booked out during peak season. However, a lagoon beach can be considered as an additional attraction for the resort and higher water temperatures would allow bathing already in June and possibly help to extend the bathing season. On the other hand, the tourist survey in 2015 showed that bathing in general was not a major reason for visiting the Curonian Spit and the possibility to go for a swim in the lagoon was mentioned as activity by only very few visitors. Further, it is very likely that a lagoon beach/bathing site in Nida would cause lasting annual costs for the town.

These results were presented and discussed during the 3rd stakeholder meeting in Nida on 7th of February, 2017, where 8 persons took part. Since it became obvious that the establishment of a beach/bathing site would be associated to considerable costs and that nature activities are in the focus of visitors, alterative scenarios were developed and discussed. The stakeholders were asked to comment and rank the alternative scenarios according to their relevance: 1) Providing/improving nature trails and environmental information to attract more guests in pre- and post-season. 2) Advertisement to attract nature-lovers in pre- and post-season (including summer and winter (ice) fishing activities and winter sports, like ice skating and cross country skiing). The stakeholders had the opinion that enough nature trails existed in the area, but that the advertisement probably was insufficient. These two scenarios, scenario 1 and 2, were given the highest priority. 3) A linked advertisement campaign with reduced rents in pre- and post-season. The group agreed that this was missing and should take place at high priority. 4) Attracting guest though events in pre- and post-season. The number of events was considered as sufficient, but possibly reduced ferry prices could help to attract more people to attend the events. 5) Developing Nida as base for visiting Russia (tours). 6) Support of a ferry to Klaipeda in pre- and post-season to attract guest. 7) To develop the shut-down airport close to Nida for recreational activities. The last three scenarios were considered as relevant, but had only a low priority. During the discussion, the stakeholders came up with

additional suggestions, like strengthening the medical treatment sector, ship excursions for bird watching, the establishment of camping sites at the lagoon and building a pool in the lagoon for swimming.

The stakeholders agreed that these scenarios were more complementary to opening a beach/bathing site instead of being alternatives. They saw a combination of several scenarios together with a new beach as promising to attract more Lithuanian families and to take steps towards a more sustainable tourism in pre- and post-season. They agreed to utilize a coastal strip near the centre of Nida to open an official bathing site. This site is close to the sport boat harbour and has a narrow sandy strip (Fig. 10). In the beginning, the establishment of a bathing site should be carried out at low costs, to test the acceptance and without additional sand nourishment and new beach infrastructures.

Monitoring & evaluation

During summer season 2016 potential coastal strips at the lagoon were visited several times to assess their general suitability to establish a beach/bathing site. Between May 18th and Octctober 2nd, 14 regular visits to the coastal strip in Nida took place, mainly to get an impression of visual nuisances. In a monitoring sheet the presence of visible algae blooms in the water, water colour, smell, presence, coverage and composition of beach wrack and litter as well as the presence of dead fish were documented. Additionally, water and air temperature as well as wind speed and direction were recorded near the coast. Litter and other anthropogenic remnants were present on all dates, because no cleaning and removal took place On 80% of the visits alluvial dead fishes, up to 18 on an approximately 100 m strip, were observed. On four dates in early summer, alluvial dead beetles caused a disturbing smell and accumulated macrophytes caused a negative visual impression. Dead beetles turned out to be the major nuisance and their removal took two weeks, because of ongoing accumulation. Water colour varied between green, blue-green and muddy green. Already in late May 2016 the water temperature reached up to 18.5 °C and early June up to 24.5 °C. On Sept. 14th the temperature was still up to 20.2 °C. This first initial monitoring indicates that additional cleaning and the removal of beach wrack would be necessary to keep the coastal strip attractive for swimming. Further, it became obvious that the lagoon, especially shallow and sheltered areas, heat up fast and early in the season. In 2016, the lagoon showed water temperatures close to or above 20 °C during a 4 month summer period. This means that the bathing season in the lagoon can be considered as twice as long, compared to the Baltic Sea.

Fig. 10 Potential first new bathing site in Nida at the Curonian Lagoon

The application of an Ecosystem Service Assessment tool (ESAT) and an indicator based assessment of state and progress towards sustainability took place. Since both tools were developed during the SAF application in this case study, the results were not available in the early stage of the SAF. However, they generally allowed a comparative assessment of the situation with an established beach and without. The results will be documented elsewhere.

Discussion

The large southern Baltic lagoons, Curonian, Vistula and Szczecin Lagoon as well as several smaller German lagoons and bays face a similar challenge: the need for economic, especially touristic development. This development is hampered by poor water quality, namely eutrophication with regular algae blooms and low water transparency and in the past insufficient bathing water quality (Schernewski et al. 2012; Schippmann et al. 2013; Bielecka and Różyński 2014). Therefore, beaches and bathing sites, one precondition for tourist development, are often lacking. Our study shows, that improved sewage treatment allows opening new beaches in the Curonian Lagoon, but very likely in other lagoons, as well. Further, the Systems Approach Framework (SAF), especially the Ecological-Social-Economic (ESE) assessment with intensive local stakeholder involvement, turned out to be a suitable approach to support municipalities to implement measures, in this case to establish a new beach. Therefore, our issue and approach can be regarded as transferable and relevant for other southern Baltic countries. Since data is already partly available and models are established, the approach can easily and at low costs be transferred to other municipalities at the Lithuanian eastern coast of the Curonian Lagoon (e.g. Kintai, Dreverna or Svencelė) and Russian parts of the lagoon. Other comparable examples show that a SAF application to this issue is of relevance for other coastal areas, as well, like the coast of Barcelona, Spain, (Tomlinson et al. 2011), the Romanian coast near Varna (Moncheva et al. 2012) or Gdansk Bay in Poland (Hopkins et al. 2012).

An unexpected result was the low interest of tourists in water quality and, compared to the Baltic Sea, a relatively positive impression of water quality in the lagoon. It seems that the lagoon is only of minor interest for tourists and the level of information about the lagoon is low. The visitor survey revealed that the visual impression of lagoon water quality is perceived as acceptable for bathing. However, summer algal blooms remain a potential problem. Studies of other Baltic countries show that the perception of algal blooms can vary widely, ranging from lack of interest to annoyance and avoidance (Nilsson and Gössling 2013). Algal blooms do not seem to be a major problem on the Curonian Spit, since tourists can avoid the situation by choosing a Baltic Sea beach. The municipality regarded the risk of losing reputation in case the lagoon beach has to be closed because of algal blooms, as limited. The advantages of having a lagoon beach dominated. However, it might be useful to provide additional information for tourists, especially for those with a too negative perception of the lagoon.

The present state of bathing water quality does allow opening a new bathing site with a beach at the lagoon and one town, Nida, decided to do so. The socio-economic analyses show that opening a beach does not make sense from an economic point of view, but would provide an additional attraction. In most other towns on the Curonian Spit, new beaches at the lagoon would be possible as well. Because of lower tourist numbers, these beaches would be less beneficial compared to Nida. New bathing sites on the opposite, eastern shore of the lagoon would still face problems with bathing water quality.

The approach to early and stepwise reduce the spatial scale and the size of the area covered within the ESE assessment to a local scale, simplified choice, number and involvement of stakeholders. Further it avoided problems resulting from many administrative boundaries and different administrative hierarchical levels and responsibilities. From our experience it is important to develop a strategy for spatial down-scaling, as soon as the issue turns out to be too complex to be addressed within the time-frame and/or with the available resources and expertise. The focus on a fast solution at a local scale allowed a rapid process towards implementation. Further, a successful local process later can serve as template for the extension towards larger areas and a more complex structure. This kind of down-scaling and later up-scaling strategy should be part of the ESE process.

History, the cultural background, language, traditions and social structures have an effect on the ESE assessment. Therefore, the ESE assessment needs to be adapted to local conditions and requires tailor-made solutions, taking into account local specifics. The first stakeholder workshop revealed that the concept of an Integrated Coastal Zone Management was new to the stakeholders. It turned out that this common concept in English-speaking countries is not sufficiently reflected in the Lithuanian language. As a consequence, a common terminology and a joint understanding had to be established at the beginning. The educational level of the stakeholders largely determined the readiness to become and remain involved in the process. Stakeholders with a scientific degree were much more supportive, even beyond the joint workshops, and were ready to be actively involved in the ESE application process.

Important aspects for the success of the ESE process were a systematic analysis of possible topics, their local relevance and local interest before starting the process as well as the early analysis of existing gaps in knowledge. As a consequence, three accompanying Master-thesis were initiated to especially provide additional socio-economic data and information. The long-term sustainable development of coastal communities depends upon their coastal ecosystems and the services they provide (Quilliam et al. 2015). Therefore, it is crucial to identify major Ecosystem Services by carrying out an assessment in an early stage of the ESE process and later to analyses potential tradeoffs between different measures and objectives. However, this was not done in this case study but would have been beneficial.

We learned that, after the stakeholder mapping and before the first stakeholder meeting, interviews with major stakeholders could be beneficial. They would help a) to get an overview about the existing knowledge and perceptions, b) to get an awareness of existing conflicts and grown animosities that may become a problem for the ESE process and c) to be able to build upon previous approaches and management experiences. An interesting aspect was that the willingness to get involved in stakeholder meetings was hampered by previous experiences. Several EU funded international projects were carried out in the region. All had to involve local stakeholders, but usually only formally and without really reflecting local needs and interests. A consequence of this was frustration and a loss of interest in stakeholder meetings. Therefore, it was necessary to clearly point out the objectives of the ESE assessment, to address a concrete issue of local relevance and to show the future benefits.

Our successful stakeholder involvement provided some insight into optimal group size and a balanced representation of all stakeholder views. Out of a large number of potential stakeholders, we identified 10 representatives which were important for the process, for whom the issues had highest relevance and who were responsible for the implementation. We assumed that 10 stakeholders would well reflect the views within the municipality and on the other hand allow an active discussion and involvement process. However, this decision was taken subjectively. For our issue and its limited complexity this choice turned out to well suited. It enabled the establishment of personal links between scientists and stakeholder and a balanced and equal discussion during the workshops. There was no need to adapt the stakeholder group in different stages of ESE application process and no need for major consultations between the meetings. To have a stable stakeholder group throughout the process turned out to be important. The stakeholders attended the first meeting unprepared and had a

subjective view on the issue. Their opinions were based on various information sources with very different quality and reliability. An important first step was to give an overview about facts, existing knowledge and data, uncertainties and to develop a joint understanding. Only when the stakeholder group remains the same during the ESE process, this joint knowledge foundation can easily be utilized and extended. The participation of an influential stakeholder with deep local roots and no personal gain from the process was of high value to the SAF as he could take on the role of moderator with wide acceptance from all stakeholders.

Another important aspect for the successful stakeholder process was that all meetings and the entire process took place during only about 1.5 years. This allowed to maintain and to build upon joint knowledge. Further this was positive for the motivation of stakeholders to stay involved. Beneficial in this respect was that we were able to utilize existing models and data. This allowed us to carry out model simulations and to visualize consequences of different scenarios at an early stage.

In other case studies, time lags between stakeholder participation process and implementation of a measure turned out to be a major problem (Støttrup et al., Schernewski et al. 2017). An implementation years after the decision process, can cause a loss of ownership and political support. However, this was no problem in our case study, mainly because limited costs and well defined responsibilities allowed a fast incomplete implementation.

Hopkins et al. (2012) explored the value of a Systems Approach Framework for coastal management based on 18 study sites in Europe. The role of public perception and stakeholder participation for decision-making is stressed. However, the authors conclude that supporting "methods are less well developed at present, but their value was clearly demonstrated". Tett et al. (2012) carried out a comparable SAF case study in Loch Fyne, Scotland, addressing the conflict between shellfish aquaculture and recreational use for yachting. An stakeholder involvement took place, but the lessons learnt from the participation process largely remained abstract and theoretical. There are only few examples documenting successful participatory processes in a SAF context and usually from Scandinavian countries, where a strong tradition exists (e.g. Dinesen et al. 2011; Franzén et al. 2011). In most other examples where a SAF was applied, stakeholder involvement successfully raised awareness about an issue and caused discussions, but was not carried on until the solution of the problem (e.g. Moncheva et al. 2012; Tolun et al. 2012). Against this background we hope that our practical experiences and lessons learnt may help future coastal management case studies to successfully carry out a stakeholder participation.

The integrated and interdisciplinary ESE assessment initiated a broader and more general discussion process in the municipality towards a more ecological tourism development. Further, a spatial up-scaling of issue and approach might provide a concrete starting point for a cross-border discussion and cooperation between Russian and Lithuanian municipalities. Neringa Municipality is on its way to develop a sustainable tourism (Kavaliauskė and Kočytė 2014). Beside governance aspects, like an effective cooperation between Neringa Municipality, the Curonian Spit National Park administration and the National Service of Protected Areas in Lithuania (Neringa Municipality 2013), the transboundary cooperation with Russia plays an important role (Albrecht 2010; Povilanskas et al. 2014).

Conclusion

Result of this study is that it is possible to open new beaches in several places at the lagoon coast, but that the benefit is possibly lower than expected. The stepwise Systems Approach Framework (SAF) and especially the Ecological-Social-Economic (ESE) assessment turned out to be a suitable methodology to identify a problem, to develop possible solutions and to utilize opportunities resulting from an improved situation. It is as an important tool to implement Integrated Coastal Zone Management in practice. Stakeholder involvement plays an outstanding role. Key element for the success of our case study were a) the availability of a spatial down-scaling strategy that allowed to reduce the complexity of the issue; b) taking into account regional history, cultural background, language, traditions, social structures as well as previous approaches and management experiences; c) a stable stakeholder group consisting of 10 representatives that attended 3 meetings and ensured the development of joint knowledge and local ownership of the process; d) the employment of a local stakeholder as permanent research team member to ensure smooth communication between scientists and the stakeholder group as well as e) a stakeholder participation process of a relatively short duration lasting about 1.5 years and rapid implementation of a new beach.

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