Mapping and Assessment of Ecosystem Services in Jaunkemeri and Saulkrasti Pilot Areas within the "LIFE EcosystemServices" (LIFE13 ENV/LV/000839) project

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SUMMARY

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Table of Contents

Introduction

Latvia has about 500km long coastline which represents a wide range of ecosystems, landscapes and habitats. Coastal ecosystems have been recognised as unique value for the biodiversity maintenance in the country. About 34% of the coastal areas in the 5km coastal zone are protected as Natura 2000 or specially protected area. The protection has been granted to ensure that degradation of the nature values are prevented or reduced.

An approach of the ecosystem services (ES) is targeted to identify and assess benefits that ecosystems provide to people. The approach is new for Latvia, thus the contract had a research character when implementing the assigned tasks. Few projects have been launched in previous years to enhance the ES approach in Latvian conditions. However, they have not yet addressed the coastal terrestrial ecosystems and their services.

The objective of the contract is to promote sustainable decision-making in policy development and planning process based on the results of mapping and assessment of coastal ecosystems. Thus the contract shall contribute to application of ecosystem approach in planning of coastal development by respecting the possible benefits and impacts related to ES. Two pilot areas in the coastal zone - Jaunkemeri and Saulkrasti - have been selected to test the approach of mapping and assessing the ES for the Latvian coastal conditions.

The following key tasks were implemented in two coastal pilot areas:

- Mapping of the ecosystem services using biophysical data and expert judgement and assessing the ecosystem services supply and demand;
- Testing and assessing the criteria and indicators for the ecosystem service assessment;
- Gathering necessary information on causal-effect relationship among ecosystem services to support development of the planning tool;
- Building-up scenario - one per each site - to assess a change in provisioning ES.

The work has been implemented within the frame of the contract signed between the Nature Conservation Agency and the association “Baltic Environmental Forum - Latvia” in the period November 2015 – May 2016. The contract has been signed within the LIFE project “LIFE EcosystemServices” (LIFE13 ENV/LV/000839) (further in the text - the Project). The Baltic Environmental Forum - Latvia engaged key experts of various environmental fields to assess the ecosystem services based on the indicator approach.

The Summary presents major results achieved during the implementation of the contract. The full set of the outcomes and results are included in the Final Report (in Latvian).

1. Characteristics of the pilot areas

1.1. Identification of ecosystems in the pilot areas

The project has already defined boundaries of the pilot areas in the project proposal. Both territories are located in the coastal zone of Latvia. Jaunkemeri pilot area is located to the west from the capital Riga and at the western part of the Jurmala city. The area is located within the Kemeri National Park. Saulkrasti pilot area is located to the east from Riga, the capital of Latvia, in the middle part of the Saulkrasti town, in the vicinity of the nature park "Piejura", between the coastal rivers Incupe and Peterupe.

In September 2015 the Nature Conservation Agency got a contract to investigate and assess both pilot areas according to the national methodology on species and habitat mapping. As the result the habitat and ecosystem distribution was mapped and the quality of ecosystems assessed. The areas are dominated by coniferous forest ecosystem followed by dunes. Additionally, river down streams were identified as another habitat of EU importance in Saulkrasti. The area covered by ecosystems and habitats were calculated by using GIS tool. The calculation presented in the project proposal on total area of the pilot areas was adjusted accordingly.

Table 1.1. Overview on the identified ecosystems and habitats and their areas (ha)

Ecosystem	Habitats *	Jaunkemeri	Saulkrasti
Beach	Sandy beach	5.55	16.4
Dunes	Embryonic shifting dunes (2110)	0.82	0.85
	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (2120)	3.85	8.38
Forests	Wooded dunes (2180)	3.92	36.24
	Wooded dunes (2180) including natural old pine forests (Western Taïga) (9010)	68.92	24.48
Rivers	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation (3260)	n.a.	7.42
Built-up	Public buildings, residential areas, transport infrastructure, etc.	10.54	39.08
	Total area	93.6	132.85

* the code in brackets refers to the habitat classification defined by the EC Directive 92/43/EEC.

1.2. Assessment of the ecosystem quality

When identifying habitats in the area, the contracted expert also had to provide quality assessment of the status of terrestrial habitats. In Saulkrasti the river habitat was investigated in December 2015, thus the habitat quality assessment was not performed. The habitat quality assessment is made according to four quality classes – poor, moderate, good and high. The overall conclusion was that the highest concern is about the status of the dunes in both pilot areas.

In Jaunkemeri, embryonic shifting dunes are in moderate status while the status of shifting dunes is even poor due to mechanical degradation by reallocation of the beach wrack towards inland when performing beach clean-up action. The forest ecosystems are assessed either at good or high status.

In Saulkrasti, embryonic shifting dunes are also in moderate status while the status of shifting dunes is good as there is no relevant human pressure causing habitat degradation. The forest ecosystems are assessed in moderate or good status due to the pressure caused by a network of footpaths, littering, and presence of the invasive species - dwarf Serviceberry *Amelanchier spicata.*

The river Peterupe and the river Incupe have been assessed according to the Water Framework Directive which is transposed into the national legislation. The directive requires to assess the river water quality according to five quality classes. As given in the Gauja River Basin Management Plan 2016-2021, the river Peterupe is assessed in good quality (class 4), while the river Incupe has been assessed as poor (class 2). However, the monitoring has not been performed regularly during previous years in the latter water body.

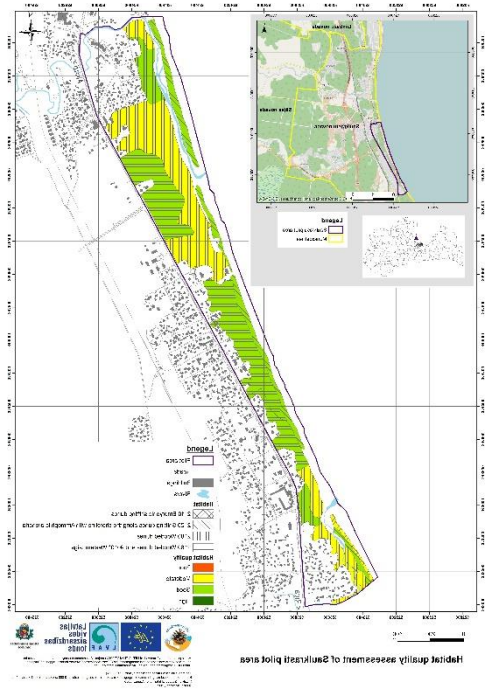

Figure 1.1.a. Habitat quality assessment of Saulkrasti pilot area

Figure 1.1.b. Habitat quality assessment of Jaunkemeri pilot area

1.3. Supplementary characterisation and mapping

In order to carry out ecosystem assessment additional criteria and parameters where identified. The forest ecosystem was classified into two groups according to the age structure: middle and pre-mature stands; mature and over-mature stands. The beach and coastal dunes were classified according to the intensity of the erosion and accumulation process. Additional criteria were introduced during the definition of the indicators for the ecosystem service assessment.

2. Methodology of mapping and assessment of ecosystem services

The methodology for mapping and assessment of ecosystem services (ES) was developed at the beginning of implementation of the contract. The methodology clarifies the concept of ecosystem services, interlinks between different concepts and relationships in the framework of ecosystem services. Next, different assessment methods (biophysical, social and economic) are described briefly

in the paper. As the project is targeted to support spatial development in Latvia, the methodology describes the bio-physical mapping and assessment which is relevant for enhancing land-use policy.

The methodology introduces the assessment approach and related ES assessment matrix developed by B. Burkhard et al, 2009, 2012 and 2014. The matrix or so called *spreadsheet method* provides a quick output in a spatial explicit manner and can involve different stakeholder/expert perceptions about ES. The method can be used in data-scarce areas like it is in the case of the Project where time was limited to collect new field data over seasons. Initially, experts provide a score of ecosystem services supply or demand for each type of land cover/ecosystem/habitat (according to the project needs). These scores can be used to directly map ES from the land cover map itself. This approach may be suitable for ES that are closely related to land use or land cover. In case the data are available, the scoring system can incorporate extra data to add detail and accuracy of the assessment.

In case of the Project, 5 point scoring system for ES assessment was introduced. The individual scale and interpretation was defined by relevant expert elaborating an indicator for the ES assessment. The 5 point scale was designed based on the values of Latvian conditions in ecosystems and environment, thus to ensure replicability in other parts of the coastal zone of Latvia as far as possible. The developed scheme allows to enhance the assessment by integrating exact site specific values when available. The development of indicators was documented in single indicator sheets.

The following steps were carried out to map and assess ES in Jaunkemeri and Saulkrasti pilot areas:

- Development of typology of the ecosystems/land cover classes for the assessment needs;
- Identification of the coastal ES according to the Common International Classification of Ecosystem Services (CICES);
- To select robust indicators for mapping and assessment of ES;
- To develop an assessment scale for ES provisioning by collecting and gathering data and information from literature and available data bases on indicator values;
- To provide an assessment in a relative scale from 0-5 for each ecosystem/land cover type in the pilot areas.

The assessment values are used to create a map for each ES as well as to generate a multi-layer map of ES provided as sum of different services. Outputs of the assessment work are also presented in a matrix for multi-layered ecosystem services assessment for Saulkrasti and Jaunkemeri pilot areas.

3. Mapping of ecosystems and their services

In order to map ecosystem services, boundaries of ecosystems and habitats or its units need to be spatially established. The delineation of spatial units for the ES assessment was based on several data sources:

- Habitat map 1: 5000, © Nature Conservation Agency, 2015;
- Topography map 1:10 000, © Latvian Geospatial Information Agency, 2009;
- Ortophoto map 1:10 000, © Latvian Geospatial Information Agency, 2013;
- Forest plot structure, spatial data base on forest age structure 1:10 000, © State Register of Forests, 2015;
- Spatial plan of Saulkrasti local municipality 2012-2024;
- Spatial plan of Jurmala city 2012-2024;

- Data base of University of Latvia, Faculty of the Geography and Earth Science, Coastal laboratory.

Development of typology of the ecosystems/land cover classes for the assessment needs resulted in delineating the spatial units (see Table 3.1.). The ecosystem services were preliminary identified based on the expert knowledge. However, the list was adjusted (number of ES reduced) based on expert capacity to develop an indicator and to assess the ES. See the final list integrated in the ES assessment matrix in Table 5.1. and 5.2.

Table 3.1. Spatial units used for assessing ES

Ecosystem	Spatial units used for assessing ES	Jaunkemeri	Saulkrasti
Beach	Sandy beach	x	x
Dunes	Embryonic dunes	x	x
	White dunes	x	x
Forests	Wooded dunes, middle age and pre-mature stands	x	x
	Wooded dunes, mature and over-mature stands	x	x
	Wooded dunes including natural old pine forests, middle age and pre-mature stands	x	x
	Wooded dunes including natural old pine forests, mature and over-mature stands	x	x
Rivers	Natural water courses: small, rapid flow	n.a.	x
	Natural water courses: middle size, rapid flow	n.a.	x
Built-up areas	Ruderal grasslands	n.a.	x
	Individual residential housing areas	n.a.	x
	Multi-story residential housing areas	n.a.	x
	Public housing with areas	x	x
	Alone standing buildings	x	n.a.
	Transport infrastructure	x	x

4. Indicators for assessment of ecosystem services

Most ES can be measured by using selected indicators. The development of robust indicators for mapping, modelling and assessing ES is also an important step in the promoting wider applicability of ES in policy development work. Indicators is a tool to describe in quantified or qualitative manner an environmental or social phenomena. They are based on available data and information that is regularly up-dated. The indicators shall be responsive to changes in the environment and the related human activities (EEA, 2005).

Contracted experts identified the relevant indicators for ES mapping and assessing. The indicator could be a parameter, or a value derived from parameters. In some cases an ES was characterised based on an index - a set of aggregated or weighted parameters or indicators. The development of the indicators were documented into individual indicator data sheets. In total 22 indicators & indexes were developed.

5. Results from the assessment of ecosystem services

The assessment of ES was performed based on identified indicators and the assigned values. Each ES is described by the most relevant environmental or social indicator or index. The assessment is based either on expert knowledge, literature reviews, available data and information from Latvia or the site related.

The relative scale has been defined as follows: 0 - ES is not provided; 1 – ES has very low value; 2 – ES has low value; 3 – ES has moderate value; 4 – ES has high value; 5 – ES has very high value.

The assessment values are used to create a map for each ES as well as to generate a multi-layer map of ES provided as a sum of different services. Outputs of the assessment work are also presented in a matrix for multi-layered ecosystem services assessment for Saulkrasti and Jaunkemeri pilot areas (see Annex 1 and 2). In order to produce a multi-layer map, an index was calculated for each spatial unit as a sum of the average assessment values of each ES section (provision, regulation and cultural). The section's average values are calculated to reduce an influence of a number of indicators on the total ES value:

$$EP_i = \overline{EP}_A + \overline{EP}_R + \overline{EP}_K$$

EP_i – aggregated ecosystem service assessment,

EP_A – average assessment value of provision ecosystem services,

EP_R – average assessment value of regulating ecosystem services,

EP_K – average assessment value of cultural ecosystem services.

According to the overall assessment the forest ecosystem has been assessed as most valuable, followed by sandy beach, dunes and river ecosystems.

See the multi-layer map of ecosystems and their services for Jaunkemeri pilot area in Annex 1 and for Saulkrasti area in Annex 2.

6. Scenarios for the pilot areas

Scenario development method is applied in strategic planning and decision making process when the possible spatial use is dependant from various, often controversial interests and sectorial priorities (Brown et.al, 2001)[1]. In case of the Project a scenario is developed against the current status of the land use in the pilot areas. Saulkrasti and Jurmala are popular recreation and tourism destinations, therefore the main controversial interests are – nature conservation versus tourism development. In order to provide leisure opportunities including sport activities and other activities outside the summer season, Jurmala city has designated a part of Jaunkemeri pilot area as a resort park. Saulkrasti municipality anticipate establishing a nature design park in a part of the pilot area. The development of the nature design park is included as an activity in the LIFE Project. Implementation

[1] Brown et al. 2001. Trade-off analysis for marine protected area management. Ecological Economics, 37:417-434.

of the activities as described in scenarios would cause a pressure – new infrastructure, an increase of tourists and recreational users – which result in changes of ecosystems and their quality.

The impact of the scenarios on ES was assessed by applying the same approach as for the assessment of the current status of ES provisioning. The expert team prepared another matrix which illustrated a change in ES values due to establishment of the Kemeri Resort Park in Jaunkemeri pilot area and Nature Design Park in Saulkrasti pilot area.

New matrixes for multi-layered ecosystem services assessment for Saulkrasti and Jaunkemeri pilot areas with establishing of Nature Design Park or Kemeri Resort Park respectively are presented in Annex 5 and 6.

The multi-layer map of ecosystems and their services for the Jaunkemeri pilot area with establishing the Kemeri Resort Park is included in Annex 3 and for the Saulkrasti pilot area with establishing the Nature Design Park is included in Annex 4.

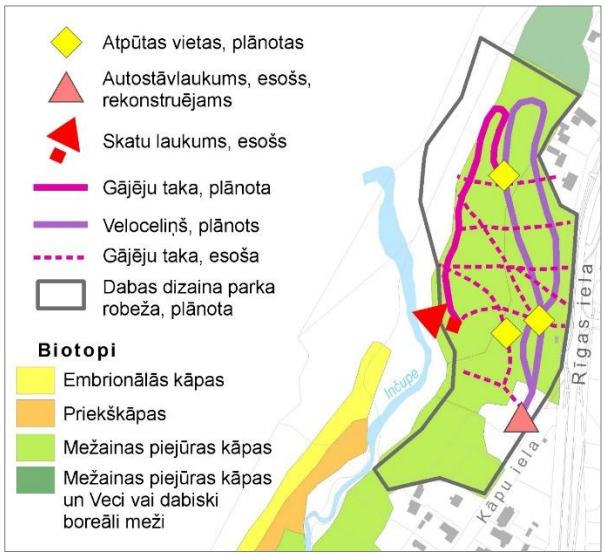

Figure 6.1. Spatial scenario for the Nature Design Park in Saulkrasti

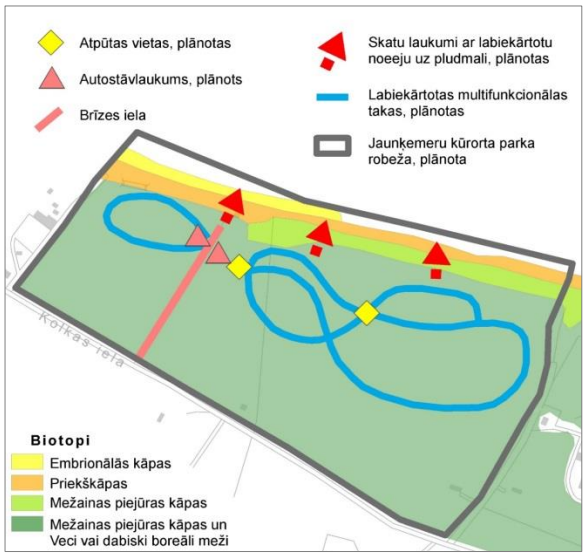

Figure 6.2. Spatial scenario for the Kemeri resort Park in Jaunkemeri

7. Causal-effect relationships and assessment of ecosystem services

Assessment of causal-effect relationships is one of the most commonly used concepts for the environmental management, utilised for national and European environmental policy reviews, state of the environment assessments and for evaluation of the caused changes in the environment (EEA, 2014). The Driving force-Pressure-State-Impact-Response (DPSIR) conceptual framework is very often employed for these purposes including the application of environmental indicators. As the assessment of ES was based on indicator approach, the indicators can be easily integrated in the DPSIR model to characterise the interactions between the state of ecosystems, pressures and impacts on the ES supply. Moreover, the DPSIR framework supports assessment of the current status and the causal-effect relationships as well as to evaluate potential changes due to development scenarios. For example, a land cover change caused by the establishment of a resort park due to increased leisure needs and larger number of recreational users and tourists can cause an increased

pressure on ecosystems, change in structure and functions which will result in impact on ES supply distribution – reduction of the supply of regulating ES whereas an increase in cultural services in the area (see Chapter 6).

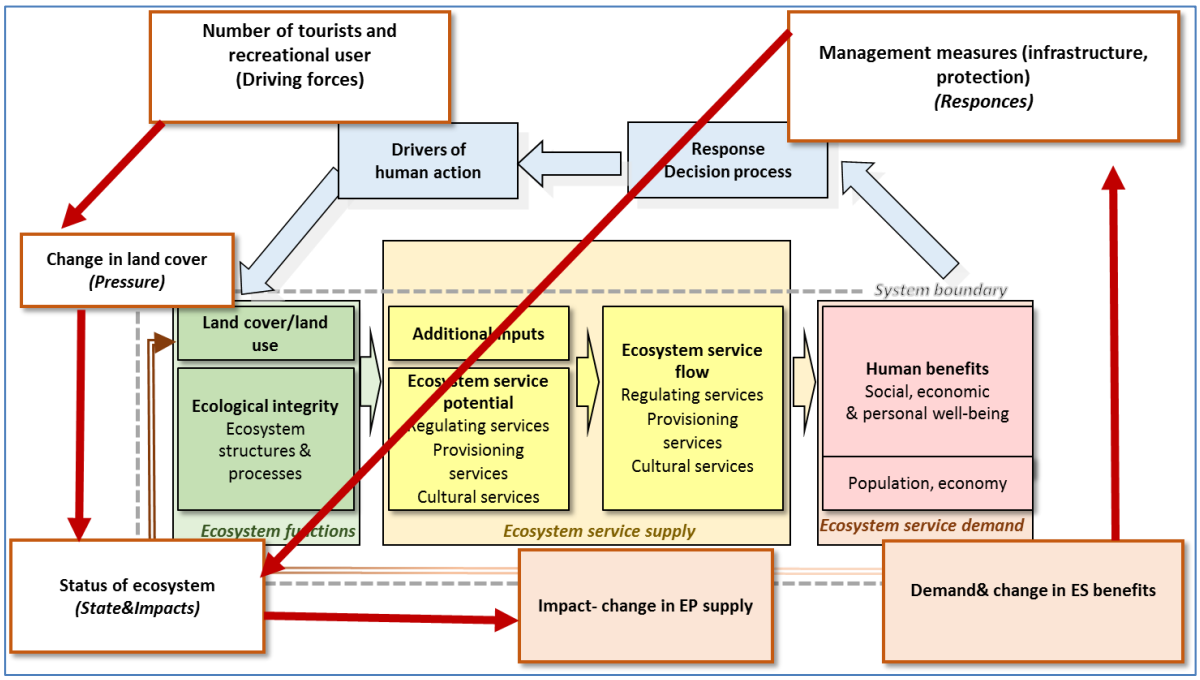

Figure 7.1. Conceptual model (framework) for assessment of the status and changes of ecosystem services (after B. Burkhard, 2014 and EEA, 2014).

Experts assessed a change in ES supply if the developed scenarios would be implemented in both pilot areas. The assessment results are presented in the Annex 5 and 6 whereas the spatial change is displayed in Annex 7 and 8. In order to assess the impact caused by the scenario on each ES class an average weighted assessment value was calculated by relating the ES value with an area covered by the respective land cover/ecosystem in the pilot area.

The assessment results show that no change in majority of ES is detected due to the impact of the proposed development scenarios. The potential impact could be insignificant as the assigned assessment values do not change. The cultural ES are an exception – an increase is expected in both areas. In turn, few regulating ES would decrease in Jaunkemeri area – mediation of noise impacts, hydrological cycle and water flow maintenance. The scenario would also have an impact on yield of wild berries; the benefits would increase due to reduced density of stands in forests.

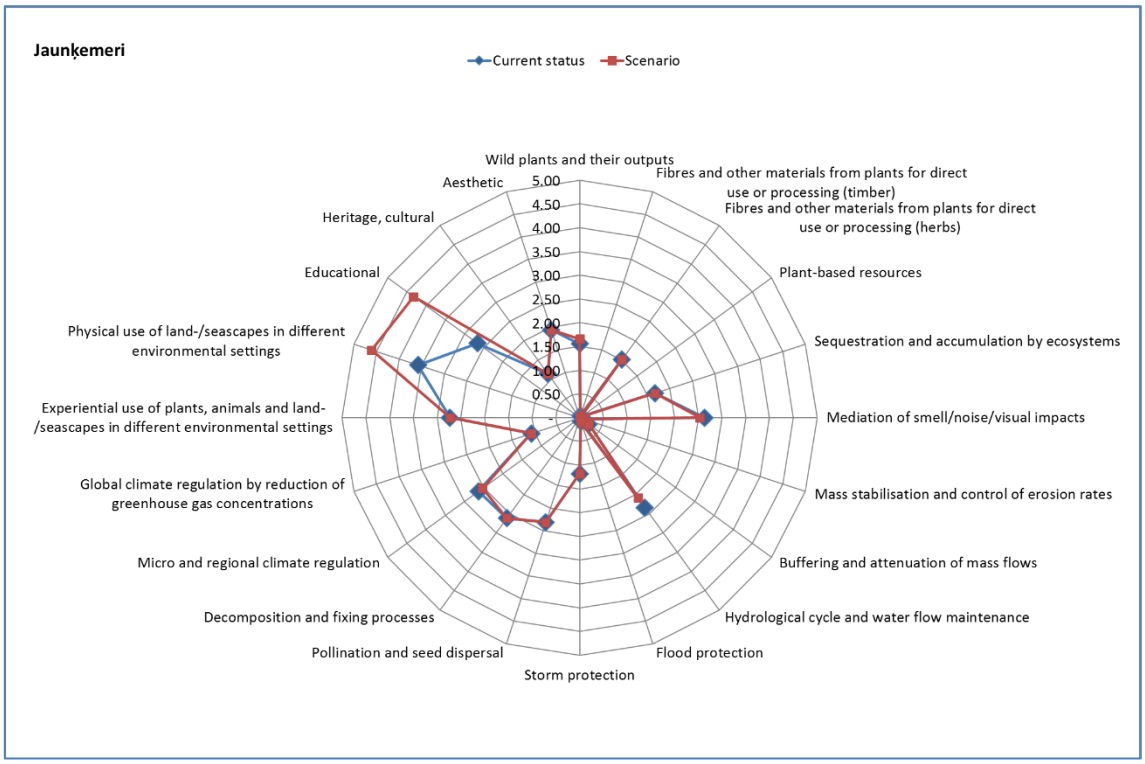

Figure 7.2. Spider gram on ES assessment of the current status and the change due to implementation of the scenario in Jaunkemeri pilot area

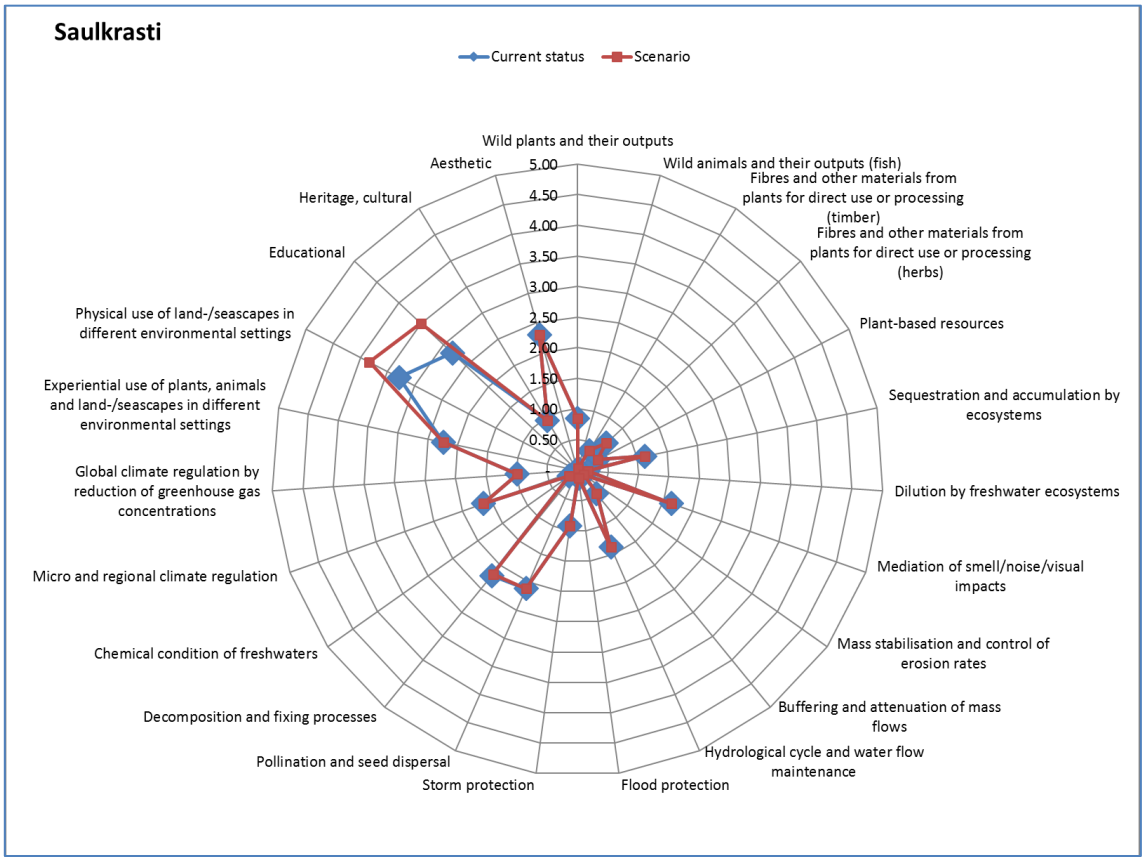

Figure 7.3. Spider gram on ES assessment of the current status and the change due to implementation of the scenario in Saulkrasti pilot area

Key conclusions

1. The developed method for mapping and assessment of ecosystem services (ES) provides an opportunity to describe spatially distribution and importance of ES in the given area, to identify most valuable areas with regard to the ES supply as well as to evaluate the impact on the ES supply when development scenario would be implemented.
2. The process of the mapping and assessment of ES was determined by the relatively small size of the selected pilot areas and small number of ecosystems. Based on area coverage the boreal forest ecosystems are prevailing in the pilot areas, followed by dunes. In Saulkrasti a river mouth of two rivers is defined as the habitat of EU importance – natural water courses.
3. The ecosystem quality assessment is given for forest habitats and dunes. The overall conclusion is that the latter habitats are most threatened in both pilot areas. The available information on ecological water status on the river Incupe shows that its quality is poor.
4. The methodology developed within the contract focuses on the biophysical mapping and assessment of ES. Initially the methodology was developed to carry out ES assessment based on the expert judgment approach. During the implementation of the contract, experts collected information and data and enhanced the ES assessment based on the developed indicators & indexes. This step wise process was possible due to the selected ES mapping and assessment method – multi-layer matrix or "spreadsheet table". It allows to incorporate extra data and to increase the level of detail and accuracy of the assessment.
5. The ES mapping and assessment in Jaunkemeri and Saulkrasti pilot areas resulted in selected and assessed 23 ES classes based on the Common International Classification of Ecosystem Services (CICES). The indicator based approach was used to describe the current status as well as to present a change in ES supply. The ES assessment was provided for each ES individually, filling in the consolidated multi-layer ES assessment matrix as well as presented spatially in the developed ES assessment maps.
6. In order to produce a multi-layer map for both pilot areas, an index was calculated for each spatial unit as a sum of the average assessment values of each ES section (provision, regulation and cultural). The section's average values are calculated to reduce an influence of a number of indicators on the total ES value. Based on the calculations, the forest ecosystems were assessed as most valuable. The consolidated assessment on total values is provided spatially as a multi-layer maps for Jaunkemeri and Saulkrasti pilot areas.
7. An illustrative scenario was developed for each pilot area according to the spatial plans of the city Jurmala and Saulkrasti municipality and their views on the resort park and tourism development. The leisure and tourism is most feasible economic development sector in both areas due to the fact that they are located in the coastal protection belt of the Gulf of Riga and within or in the vicinity of nature protected area. The experts carried out an ES assessment in the iterative way for the developed scenario case. The results indicate that positive impact is expected for the cultural ecosystem services whereas the decrease in several regulating ecosystem services could be detected. Nevertheless, the majority of the identified and assessed ES values did not show a change.

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Annexes

Annex 1. Matrix of the multi-layered ecosystem services assessment for Jaunkemeri pilot area

Annex 2. Matrix of the multi-layered ecosystem services assessment for Saulkrasti pilot area

Annex 3. Multi-layer map of ecosystems and their services for Jaunkemeri pilot area

Annex 4. Multi-layer map of ecosystems and their services for Saulkrasti pilot area

Annex 5. Matrix of the multi-layered ecosystem services assessment for Jaunkemeri pilot area with establishing the Resort Park

Annex 6. Matrix of the multi-layered ecosystem services assessment for Saulkrasti pilot area with establishing the Nature Design Park

Annex 7. Multi-layer map of ecosystems and their services for Jaunkemeri pilot area with establishing the Resort Park

Annex 8. Multi-layer map of ecosystems and their services for Saulkrasti pilot area with establishing the Nature Design Park

Annex 9. Habitat quality assessment of Jaunkemeri pilot area

Annex 10. Habitat quality assessment of Saulkrasti pilot area