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ASSESSMENT OF ECOSYSTEMS SERVICES FOR SUSTAINABLE DEVELOPMENT AND LAND USE MANAGEMENT

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Abstract. *A very important factor for sustainable development is a balance between the exploitation of natural resources for socio-economic development, and conserving ecosystem services that are critical to everyone's wellbeing and livelihoods. The strategical importance of ecosystem services is set by the UN Millennium Ecosystem Assessment in 2005, which put ecosystem services firmly on the policy agenda and the EU Biodiversity Strategy, which states that "Member States must map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020". The aim of the paper is to present and discuss the approach of ecosystem services assessment for sustainable land use and strategical development scenarios. The paper will focus on the role of ecosystem services in development and spatial planning, and this approach can be integrated in planning processes and decision making. There will be presented a case study for two coastal territories in Latvia, where an ecosystem services assessment was implemented and sequentially different development scenarios considered and analysed.*
Keywords: *ecosystem services, ecosystem services assessment, sustainable development, sectoral and integrated planning process, land use planning and management, decision making.*

Introduction

Historically the oldest records of the idea of ecosystem services is from Plato (c. 400 BC) who realised that deforestation could lead to soil erosion and the drying up of springs (Daily, 1997). But only in the year 1935 scientist Arthur Tansley introduced the concept of ecosystem and draw attention to the importance of transfers of materials between organisms and their environment, regarding

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ecosystems as the basic units of nature (Tansley, 1935). Much of the current understanding of ecosystem services was developed during the 1990s, which saw an explosion of books and articles dealing with and expanding the concept. The strategical importance of ecosystem services (ES) is set by the UN Millennium Ecosystem Assessment in 2005 and the EU Biodiversity Strategy to 2020 which put ES firmly on the policy agenda.

The concept of ES is gaining increasing recognition in politics, and decision-makers are beginning to integrate knowledge about ES into policy-making processes, management and planning. A case in point is the *EU Biodiversity Strategy to 2020* that links ES to concrete aims (European Commission, 2011): the strategy requires that "Member States (...) will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020" (European Commission, 2011).

In the context of Latvia, the concept of ES is a relatively new topic. Although several planning documents in Latvia anticipate ecosystem services, research studies and ES assessments have been only recently started. One of the priorities of the National Development Plan 2020 (Saeima of the Republic of Latvia, 2012) envisages the sustainable management of natural and cultural capital, respectively, maintaining the natural capital as a basis for sustainable economic growth, promoting sustainable ways of its use, and reducing the risks for the environmental quality caused by natural and anthropogenic factors. In order to achieve these goals in Latvia, it is planned to carry out an assessment of natural capital till 2030 (provided in the section "Sustainable use of the natural values and services") (Saeima of the Republic of Latvia, 2010). One of the projects to step towards reaching these strategic objectives is the project LIFE EcosystemServices started in 2014.

The paper focuses on the ecosystem services approach from the development planning perspective. The objective of the paper is to present and discuss the approach of ecosystem services assessment for sustainable land use and strategical development scenarios.

The paper addresses two main research questions: (a) how ES relate to sustainable development and what is the role of ES in sectoral and integrated planning and decision making; (b) what are the steps and methods for integrating the ES approach into development planning processes. The first research question is addressed by revising and analysing the relevant scientific literature, research studies and EU policies in the field. The second/third research question is answered by analysing a case study on Latvian coastal ecosystems, where appropriate methods were applied.

The role of ecosystem services in sustainable development and development planning

Ecosystem services can be defined as "the benefits people obtain from ecosystems" (MA, 2005). All natural ecosystems yield economically valuable services. Examples include production of food and medicines, regulation of climate and diseases, provision of productive soils and clean water, protection against natural disasters, opportunities for recreation, maintenance of cultural heritage and spiritual benefits, among many others.

Over the past 50 years, ecosystems more rapidly changed. It is a challenge to meet rapidly growing demands for food, fresh water, timber, fibre and fuel, while at the same time reducing an impact on the environment. The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs (MA, 2015). These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems. There are alarming findings, for example, that the destruction of nature has now reached levels where serious social and economic costs are being felt and will be felt at an accelerating pace if we continue with 'business as usual'.

The Millennium Ecosystem Assessment conceptual framework represents interactions between biodiversity, ecosystem services, human well-being, and drivers of change (Figure 1). Changes in drivers that indirectly affect biodiversity, such as population, technology and lifestyle can lead to changes in drivers that are directly affecting biodiversity, such us catch of fish or application of fertilizes. This results in changes to ecosystems and the services they provide, thereby affecting human well-being. These interactions can take place at more than one scale and can cross scales (MA, 2015).

Sustainable development requires that societies only use nature's resources at the rate at which they can be replenished naturally. Maintaining an adequate quantity and quality of ecosystem services obviously plays a critical role in these processes. Some resources are more abundant than others and therefore we need to consider material scarcity, the damage to the environment from extraction of these materials and if the resource can be kept within Circular Economy principles. Environmental sustainability is one of the components besides economic and social sustainability or full sustainability.

Biodiversity and ecosystem services are not yet fully mainstreamed in development thinking. One major challenge is that ecosystem services have long been under-valued in decision-making and development planning processes. In all too many cases "environmental sustainability" goals are seen as being distinct from – and sometimes even as conflicting with – "development" goals (Kosmus, 2012). In the face of pressing needs for economic growth and poverty reduction,

and given the scarcity of public and donor funding, the environment tends to remain a low priority in development planning and policy formulation. A key concern is to affect a shift from the view that ecosystem services are a luxury that development planners cannot afford, to one where they are seen as a necessity that they cannot afford not to invest in (UNDP and UNEP, 2008).

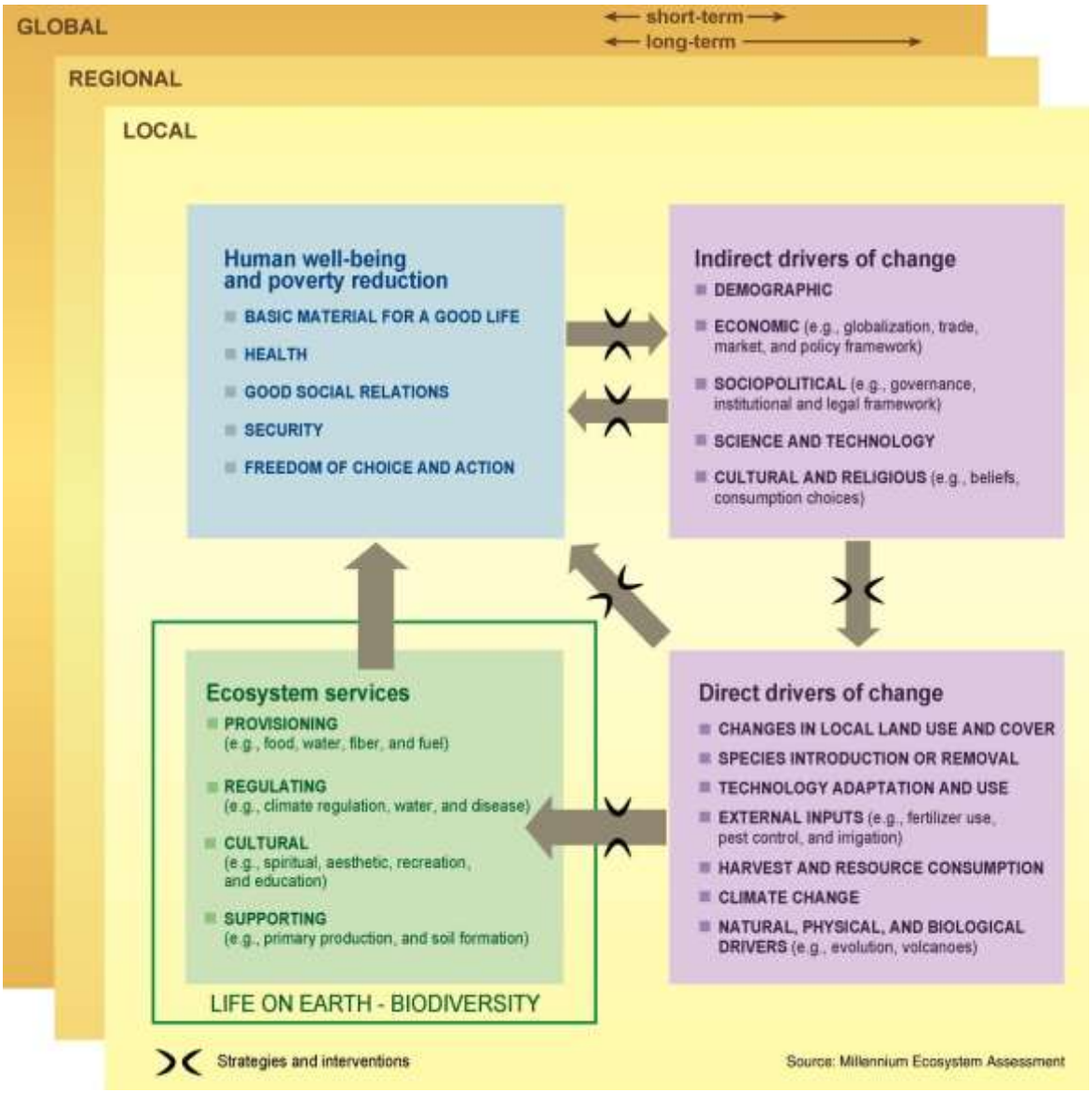

Figure 1 **Millennium Assessment Framework (MA, 2015)**

Modifying ecosystems to facilitate socio-economic development is necessary, but it is crucial how can we avoid damaging important ecosystem services. As a prerequisite, we need to understand how ecosystem services contribute to people's livelihoods and wellbeing, in other words we must map and assess the ecosystem services. Impacts of climate change on ecosystems also show strong interrelationships with ecosystem processes and human activities at

various scales over time. Addressing these impacts requires a coordinated, integrated, cross-sectoral policy framework with a long-term focus.

It is therefore of critical importance to ensure that ecosystem services are incorporated into development planning, because they are essential to equitable and sustainable growth and development. At the same time, most people and governments cannot afford to bear the long-term economic and social costs associated with ecosystem degradation and loss (Kosmus, 2012).

The authors of the paper consider that the ES approach must be integrated in sectoral, strategic and spatial planning processes and documents (Figure 2). Almost all sectoral output depends in some way on ecosystem services, either directly or indirectly. While these linkages are obvious for the natural resource-based sectors that are based directly on provisioning services (such as forestry, fisheries or agriculture), they are often equally important for other industrial and service sectors (for example, health, water and sanitation, energy or urban development). This is largely due to the important role that supporting and regulating services play in enabling, maintaining and protecting production, consumption and infrastructure. ES support and underpin sectoral output; they also typically help to minimize costs and expenditures. Ecosystem services are dynamic. It is useful to consider them in terms of the drivers and pressures for change and how these result in policy responses (DEFRA, 2010). Bringing ecosystem services into development planning at local, regional and national requires an integrated approach.

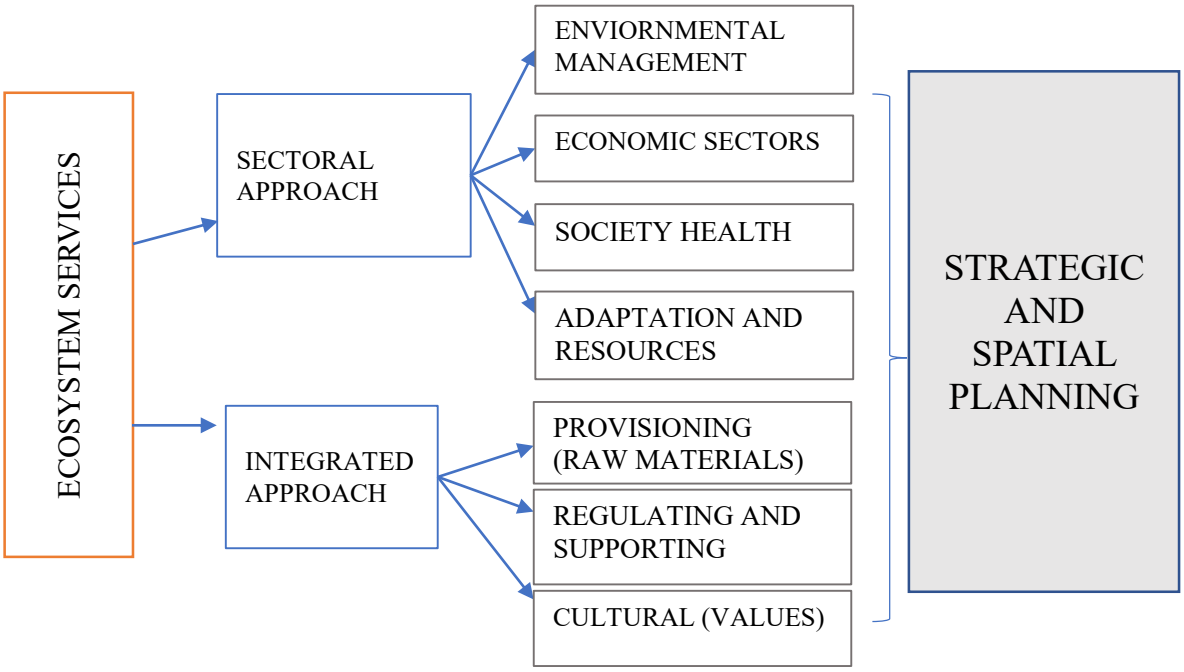

Figure 2 **Ecosystem services approaches for sectoral, strategic and spatial planning (author's construction)**

Case study: Applying the stepwise approach to integrating ES into development planning

The authors of this paper have previously proposed the conceptual framework for ecosystem approach integration into decision making which consists of 7 steps: (a) mapping and assessing the condition of ecosystems; (b) assessing and mapping of ecosystem services; (c) valuing of ES (values and trade-offs, non-monetary/monetary values); (d) assessment of current management and alternative options; (e) involvement of stakeholders; (g) support systems for decision making; (h) decisions (Konstantinova, 2016). This approach is tested in practice within the case study analysed hereafter in the paper.

The case study of ES assessment in coastal areas of Latvia is related with the EU supported project "LIFE EcosystemServices" started in 2014. The objective of ES assessment in the framework of the project 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 approach and methodology shall contribute to application of the ecosystem approach in planning of coastal development by respecting the possible benefits and impacts related to ES.

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

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. Pilot area "Jaunķemeri" is located within the city and is part of Kemeri National Park. It includes a sandy beach and a biologically valuable habitat of EU importance – wooden dunes. The area is not much transformed and relatively poorly visited (90,85 ha). Pilot area "Saulkrasti" is located in Saulkrasti municipality. It includes a sandy beach and a biologically valuable habitat of EU importance – wooden dunes and a remarkable cultural and nature monument – White Dune. The well maintained nature object is frequently visited and subjected to excessive anthropogenic pressure and erosion (132,86 ha) (Konstantinova, 2016).

At the beginning, the methodology for mapping and assessment of ecosystem services (ES) was developed. The methodology clarifies the concept of ecosystem services, interlinks between different concepts and relationships in the framework of ecosystem services. 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 following key tasks were implemented in the two coastal pilot areas:

- Mapping of ecosystem services using biophysical data and expert judgement and assessing of the supply of and demand for ecosystem services;
- Test and assess the criteria and indicators for the ecosystem service assessment;
- Gathering necessary information on causal- effect relationships among ecosystem services to support development of the planning tool;
- Building-up scenario - one per each site - to assess a change in provisioning ES (Baltic Environmental Forum, 2016).

ES mapping and assessment

For ES mapping, the methodology introduces the assessment approach and a related ES assessment matrix developed by B. Burkhard et al., 2009, 2012 and 2014. (Burkhard, et al., 2014). The matrix or so the called spreadsheet method provides a quick output in a spatial explicit manner and can involve different stakeholder/expert perceptions about ES.

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

- Development of a typology of ecosystems/land cover classes for assessment needs;
- Identification of 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 databases on indicator values;
- To provide an assessment on a relative scale from 0-5 for each ecosystem/land cover type in the pilot areas. 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 a very low value; 2 – ES has a low value; 3 – ES has a moderate value; 4- ES has a high value; 5 – ES has a very high value. In total 22 indicators & indexes were developed.

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.

The assessment of ES was performed based on identified indicators and the assigned values. Each ES is described by one most relevant environmental or social indicator or index. For each of the identified geospatial units, the value of an ecosystem service is specified.

The assessment values are used to create a map for each ES as well as to generate a multi -layer map of EP 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. 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.

$$EP_i = \overline{EP}_A + \overline{EP}_R + \overline{EP}_K \quad (1)$$

- EP_i – total 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 (Baltic Environmental Forum, 2016).

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

Scenarios for pilot area and causal effect relationships of ES

The scenario development method is applied in strategic planning and the decision making process when the possible spatial use is dependent on various, often controversial interests and sectorial priorities (Brown et.al., 2001). In case of the case study, a scenario is developed in comparison 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. The implementation of the activities as described in the 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 the establishment of the Kemeri Resort Park in Jaunkemeri pilot area and the Nature Design Park in Saulkrati pilot area.

Experts assessed a change in the supply of ES if the developed scenarios would be implemented in both pilot areas. In order to assess the impact caused by the scenario on each ES class, the 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.

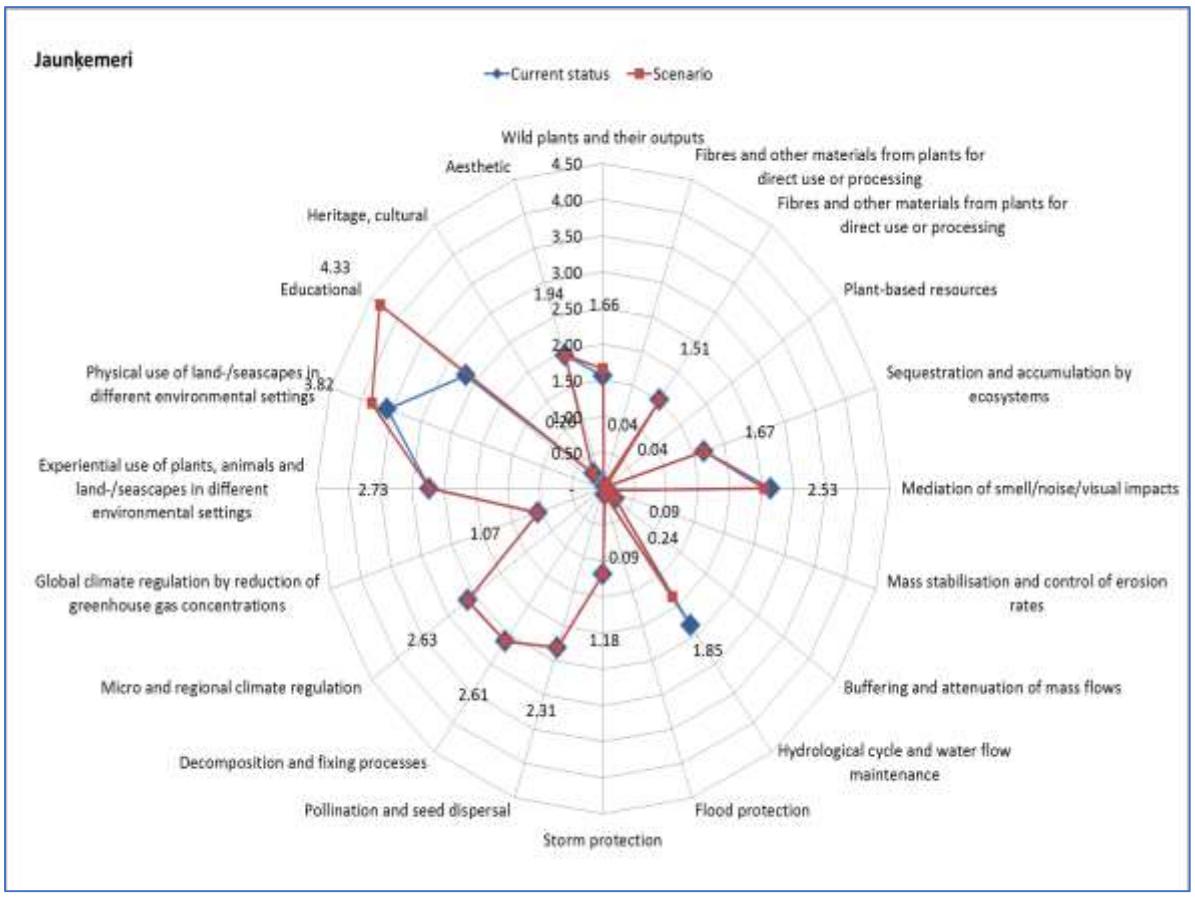

Figure 3 **Spidergram on ES assessment on the current status and the change due to implementation of the scenario in Jaunkemeri pilot area (Baltic Environmental Forum, 2016)**

The assessment results show that no change in the majority of ES is detected due to the impact of the proposed development scenarios (Figure 3, 4). 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, the 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. These plans will be pilot plans in Latvia where the ES approach are integrated and most suitable development incentives are considered.

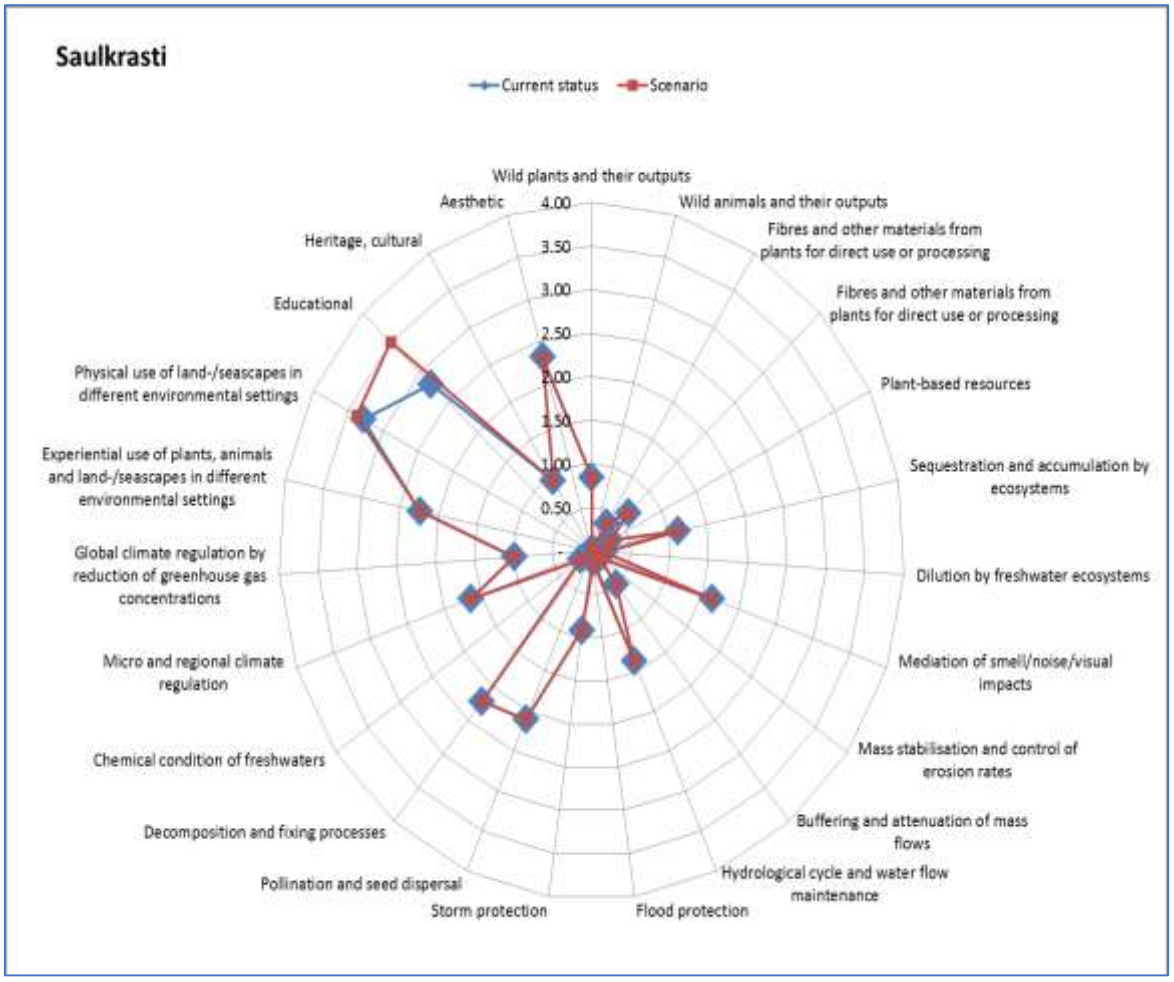

Figure 4 **Spidergram on ES assessment on the current status and the change due to implementation of the scenario in Saulkrasti pilot area (Baltic Environmental Forum, 2016)**

The results of the ES assessment on the current status and development scenarios are in the process of incorporation in the Spatial Development Plan of one of thepilot area municipalities – Saulkrasti - and in two Nature Conservation Plans, including both pilot areas. It will serve as a good example and innovation on a national scale.

Integrating ES into spatial planning might be a promising approach towards sustainable development because it supports making such services explicit, and thereby fosters the discussions about tradeoffs between ecological and socio-economic aspects when choosing more sustainable development scenarios. Showing that humans benefit from and depend on nature can also help when putting forward additional arguments for those conservation measures that have been regarded so far as having value only in relation to the intrinsic value of nature itself, e. g., coastal forests conservation. In this context, it could be beneficial to adopt the ES concept not only to help conserve coastal forests for its beautiful trees but also its positive role in mitigating greenhouse gas emissions (Hauck, 2013).

Conclusions

The implementation of the ES concept provides the unique opportunity to harmonize divergent perspectives on natural resources and to avoid unsustainable management practices. This approach enables decisions to be made on the basis of ecosystems' capacity to provide services, while also taking into account different preferences for particular services in development planning and decision-making (Hauck, 2013).

Introducing ES in sustainable development and spatial planning is based on the following considerations:

- The value of ecosystem services needs to be integrated into accounting and - decision making to ensure that we do not erode the natural capital.
- The multifunction of ecosystems needs to be maintained when developing land-use methods.
- Optimizing the use of only one ecosystem service could negatively affect other services.
- Smart development, including multiple sustainable use, could result in 1+1=3, creating prosperity and job opportunities.

Despite obvious long term benefits of the ES approach, in practice, however, there not yet developed the scientific basis, nor the policy and finance mechanisms, for incorporating ES into development planning and land-use decisions on a large scale. TEEB defines three main entry points for integrating ecosystem services into development and these instruments and measures can easily be mainstreamed into most development plans:

- Information: e.g. indicators and green accounting systems, integrating values of ecosystem services into policy assessment.
- Incentives: e.g. fiscal and market based such as payments for ecosystem services, certification and labelling, reducing harmful subsidies, biodiversity offsets, emissions charges, environmental taxes, etc.

- Planning and regulation: e.g. guiding land use decisions through spatial planning and environmental assessment, protected areas, investments in ecological infrastructure. (TEEB for Local and Regional Policy Makers, 2010).

The developed method for the mapping and assessment of ecosystem services for coastal ecosystems presented in the paper provides an opportunity to describe spatial distribution and importance of the ES in the given area, to identify most valuable areas with regard to the supply of ES as well as to evaluate the impact on the supply of ES when a development scenario would be implemented. It is important to provide the framework for improvements for the strategic planning documents and to promote the understanding of various stakeholder groups on the topics of sustainable planning for the enhancement of common benefits. It is important place a greater focus on decision making, based on relevant ecosystem services assessment values and the support system.

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