Report on new and enhanced Ecosystem Services Tools

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1. Introduction and aims

The primary goal of the OPERAs project is to operationalise (i.e. put into practice) ecosystem services (ES) and natural capital (NC) concepts and incorporate them into policy and decision-making. This report focuses on the development of new tools, and the enhancement of existing ones, completed as part of the OPERAs project, which aim to facilitate the uptake and use of the ES approach. By doing so, it will provide information to cover both Deliverable 4.4 and 4.6 in the OPERAs project. This deliverable builds on the OPERAs Milestone Report 4.15 (Ingwall King and Ivory, 2015), which provided an initial summary of the ES tools that have been developed and enhanced during the first three years of the project.

The report aims to answer the following four questions:

- What are the key characteristics of the tools that have been developed or enhanced?
- How can the tools be used together or independently to support the decision-making process?
- Do the newly developed or enhanced tools help to operationalise the ES/NC concepts?
- What challenges have the tool developers' experienced, and what lessons have been learnt, during the development and testing of their tools?

The report begins with a description of the tools that have been developed or enhanced, providing information on their main use and purpose, their geographical scale, and their data and resource requirements (Section 2). The third section of the report describes how the tools are, or can be, used together through a policy implementation diagram. The fourth section describes how the tools have been tested in the different exemplars and the challenges and lessons learned.

Information presented in this report comes from compiling the data each of the tool developers have provided through reporting templates. The template for each tool can be found in Annex 1.

2. Tools developed and enhanced under OPERAs

a. Purpose and use

Under the OPERAs project (Work Package 4), eleven tools focused on measuring, assessing and monitoring ES have been developed or enhanced. Table 1 provides further information on each of the tools and their use. The purpose of these tools are multiple and variable. Most of the tools focus on engaging stakeholders (91%) and providing decision support (82%). Many of the tools include ES assessment (64%) and/or valuation (55%), whereas others focus on ES mapping (36%). Only 18% of the tools focus on implementation support. This suggests that the majority of tools help in terms of defining and understanding the issue at stake and in developing and prioritising interventions and actions, while tools that support actual implementation of identified actions are rarer.

Tool	Description of Tool purpose and use
BackES	The integrated modelling system BackES was developed to simulate regionally aggregated and spatially explicit (100m x 100m) changes in ES benefits, accounting for both changes in ES supply triggered by global socio-economic and climate changes, and local residents' preferences for ES. It enables testing and evaluating the effect of a broad set of alternative policy strategies on ES benefits under different global change scenarios.
Ecometrica mapping	Ecometrica Mapping is a web-based land use and ecosystem mapping platform (tool). It enables access, sharing, organisation and querying of spatial data. Ecometrica Mapping is used by governments, corporations, investors and researchers. Applications of Ecometrica Mapping include: responsible sourcing of food fibre and biofuels; monitoring and evaluation of conservation, development and ecosystem restoration projects; research into environmental change and environmental policies; large-scale infrastructure, mining and agricultural development projects
Ecosystem Services Indicator Guidance (ES Indicator Guidance)	ES indicators can serve as an important tool for understanding the status and trends of ES provision. Indicators help assess if national or local targets have been met, understand impacts of policies or plans (including biodiversity, sectoral such as fisheries or agriculture, and cross-sectoral such as development or poverty reduction) and support decision-making. This guidance outlines a process for identifying and selecting policy-relevant indicators, which can be used as communication tools to support and influence policy and decision-making.
Iodine - Cost-Benefit Analysis (CBA)	The main audiences of this tool are strategic thinkers and stakeholders; the tool might be used by land managers as a way of structuring information to present to these groups. The previous application to the Public Forest Estate in the UK helped the Forestry Commission (FC) to justify the use of public funds to support its management strategy. Following a FC request, the flexibility of the tool enabled a rapid (within an hour) recalculation to update the latest carbon values from the Department of Energy & Climate Change in the UK and to focus on year 2032 instead of 2070. The Independent Panel on Forestry drew on the results.
LANDSCAPEization	The LANDSCAPEization toolkit allows the visualization of and reporting on ES- and non-ES-related information in real-time over spatial scales. Embedded in a decision support system, the provided information supports the communication of land-use changes and their impacts on ES. By allowing 3D visualizations of land-use patterns, the toolkit allows the communication of changes in the landscape and thus supports trade-off assessments between cultural ES and other ES. Additionally, besides interactive functionalities for accessing ES- and non-ES-related information, the LANDSCAPEization toolkit also allows a participatory mapping and rating functionality for cultural ES and thus offers an innovative approach to support integral ES-informed decision-making across all ES categories.

mDSS	mDSS can help decision makers to: a) Develop a shared model of the problem at hand with the involved actors (disciplinary experts, policy/decision makers, other stakeholders). b) Integrate modelling outputs in the decision making process. c) Explore possible decision options, also within the contexts of alternative scenarios. d) Contribute to solving conflicts related to different visions and interests around alternative courses of action.
No Net Loss (NNL)	Biodiversity offsets are one solution to managing the impacts of human activities on biodiversity and ES. They are designed to address the residual impacts from management decisions, (i.e. those impacts that couldn't be avoided or minimized through better decisions) by carrying out restoration or conservation activities in another location, that benefits the same biodiversity and ecosystem services as will be (or was) impacted. There is a growing requirement for developers to achieve "no net loss" of biodiversity and ecosystem services through appropriate use of offsets. This is the case, for example, in the context of housing or infrastructure projects in several EU countries.
STREAMLINE	Visually stimulating materials help to engage participants, enhance creativity and 'out of the box'-thinking. Images may overcome language barriers in a workshop, make concepts more explicit, and stimulate associations that widen the scope of the discussion. Streamline can be used with a variety of stakeholders in semi-structured interviews, or in group settings like workshops or focus groups.
TESSA	TESSA has been specifically developed to address the needs of conservation practitioners, such as land managers, on the ground, helping assess key ecosystem services with limited resource and time. The tool is also useful for: NGOs, site managers, developers / planners, conservationists / lobbyists, coordinators of site networks, and site stakeholders. The assessment process and its outputs aims to help decision-makers appreciate the true value of nature, and the consequences of loss and degradation of natural habitats.
ToSIA	ToSIA provides a quantified, balanced knowledge-based framework to undertake a Sustainability Impact Assessment (SIA) of alternative management decisions. It enables very different aspects of natural resource management, processing and manufacturing and consumption of products to be linked together in a logical and transparent way. ToSIA compares alternative process chains and changes between a status quo and an alternative. Impacts are assessed by calculating changes in material flows and indicators of environmental, economic and social sustainability within each value chain. The analyses can support decision-making processes or explore compromises involving different stakeholders with conflicting views on the sustainability of a nature-based value chain. Studies can range from detailed 'real' company applications to a more generic, aggregated level.

	The amount of detail can be independently chosen according to the requirements of the user.
WeLCA	**WeLCa** (Wine Ecosystem Life-Cycle Assessment) tool is a life cycle based tool to support decision making in the wine sector. Life-Cycle Assessment is widely used to assess the potential environmental impacts of a given product at each step of its life cycle. WeLCa builds upon the existing LCA methodologies, recognized and used by companies for environmental communication providing additional information on their impact on ecosystem services and biodiversity. The tool provides two separate levels of assessment: Phase I is suitable for awareness raising of the concept of ecosystem services. This phase also provides qualitative assessment of the impact of selected agricultural management and production practices related to ecosystem services and biodiversity. Phase II of the tool provides detailed quantitative environmental impacts assessment, suitable for progress monitoring through biodiversity indicators, identification of hotspots and evaluation of the impact of different scenarios. The tool could be used on a farm level or by industry associations and retailers for a comparison of different types of producers (e.g. organic vs. conventional) or producers from different regions.

Table 1: Ecosystem service tools developed or enhanced under Work Package 4

The envisaged general use of all the tools is to provide information to support the operationalisation of the ES concept. As such, the results from most tools can be used to guide environmental management (82%), spatial planning (63%) and scenario analysis (91%). Equally, many of the tools can be used across a broad range of policy sectors, with four tools (mDSS, STREAMLINE, ES indicator guidance) applicable to all sectors (Table 2). The two policy sectors most tools can be used for are 'agriculture and rural development' (45%) and 'spatial planning' (36%). All but one of the tools support multiple policy sectors.

Policy sector	Relevant tools	%
Agriculture and rural development	WeLCA, ToSIA, TESSA, Iodine, BackES	45
Spatial planning	TESSA, NNL, Landscapeization, BackES	36
Forest	ToSIA, TESSA, Iodine	27
Bioenergy	ToSIA, NNL, Iodine	27
Conservation and Protected Areas	TESSA, NNL, Iodine	27
Marine and coastal (including fisheries)	NNL, Iodine	18
Water	TESSA, Iodine	18
Transport	ToSIA, NNL	18

Soil	Iodine	9
Climate	TESSA	9
Air		0
All sectors	Streamline, mDSS, Ecosystem Services Indicator Guidance, Ecometrica mapping	36

Table 2: Relevance of tools to each policy sector with percentages.

b. Geographic Scale

The scale at which a tool can be applied is an important factor when selecting a tool. Many of the tools developed and enhanced under OPERAs can be applied at a range of scales, with over 90% being applicable at multiple scales. There is a clear dominance of tools applicable at the local (91%) and sub-national (82%) level, with four tools (BackES, NNL, TESSA, LANDSCAPEization) only applicable at either of these two levels. However, just over half of the tools can be applied at the national level, five can be applied at the continental level, and four (WeLCA, mDSS, Ecometrica mapping, ES Indicator Guidance) can be applied at the global level.

When comparing these tools with the findings of ES tool review papers (such as Grêt-Regamey *et al.* 2016, and Bagstad *et al.* 2013), it becomes clear that this is a common pattern, where a higher number of tools focus on the local and landscape scale than on the national and global scale. Overall, the tools developed and enhanced under OPERAs provide a good range of options for potential users, which is in line with the goal of operationalisation of the ES and NC concept.

Furthermore, the majority of the tools (73%) can be used or replicated in any geographic location. However, almost half of these tools require significant work such as primary data collection before they can be used in any other location. This is a common issue among ES/NC tools, as many of them use models that require both quantitative and spatial data to function properly. These models can take a long time to develop, modify and validate. Thus, a tool's usability at any geographic location should be a key consideration when developing tools, and should be established in consultation with potential users and funders of the tool to facilitate the tool's uptake and potential impact.

c. Requirements for using the tool

One of the key challenges for operationalising the ES and NC concept is the lack of awareness of and capacity to use the concepts among decision makers. It has therefore been identified that an important factor determining whether an ES tool will be used by others is the level of technical knowledge that is required (Bagstad *et al.* 2013). One of the common features of tools which have had a wide uptake by different groups of users is low technical knowledge requirements (Bagstad *et al.* 2013). Figure 1 shows that almost half the tools only require a low level of general ecological knowledge in order to apply them, which has facilitated their uptake among practitioners (e.g. TESSA, Ecometrica Mapping, STREAMLINE). However, there are a number of tools which require greater technical understanding and are designed

for more advanced users (e.g. ToSIA, NNL, BackES). Two tools (WeLCA, Iodine (CBA)) consist of multiple stages which require different levels of knowledge and experience, either requiring higher levels to 'set up' and configure the tools for the specific context and lower levels for actually running them, or requiring low levels for initial analysis but higher levels if more advanced analysis is desired.

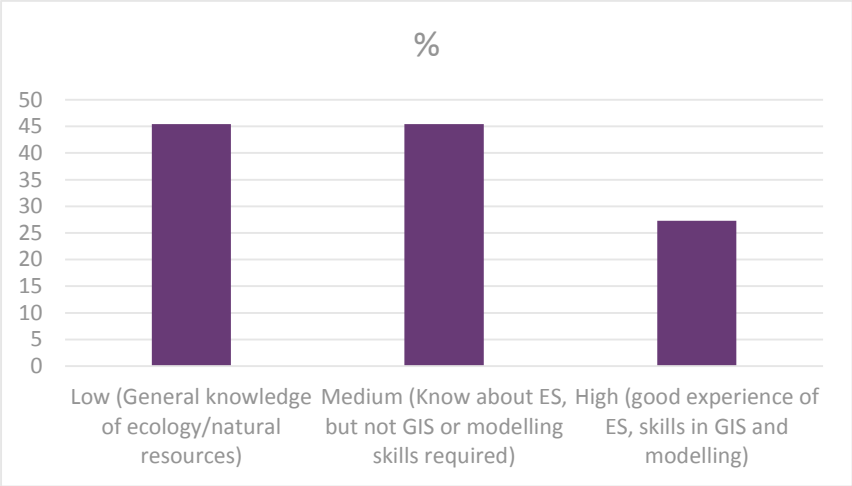

Figure 1: Level of knowledge and experience required by the tools developed and enhanced under OPERAs *(NB: The total of over 100% is due to some tools requiring differing levels of knowledge at different stages)*

Another important characteristic that determines whether a tool will be used is the cost to obtain and implement it. Most of the tools developed or enhanced under OPERAs are freely available, although some resources may be required to actually implement them (e.g. engaging stakeholders or collecting data).

With regards to the data requirements for the tools, again this is another key characteristic of a tool and will affect who can apply the tool and where. For three of the tools (STREAMLINE, TESSA, ES Indicator Guidance), data is not required as data collection is part of implementation, whereas the remaining eight tools, require quantitative data (55%) and/or spatial data (45%) for their application.

Experience from using and testing the tools, as found in MS4.15 (Ingwall-King and Ivory 2015) has shown that a lack of data availability can be a determining factor that prohibits the use of tools and assessments at many sites. Thus, tools that allow for data collection are important for operationalisation as they may be combined with other tools that require data for their assessments.

Another key characteristic that is important for a tool's operational use is the time requirement, and often tools requiring less time, and thus producing quicker results, are more widely taken up (Bagstad et al. 2013). Table 3 shows how the newly developed or enhanced tools time requirement vary greatly from less than one day, up to more than one year. Fortunately, there are many tools (64%) that only require a short time, typically one week to one month, and even two tools (LANDSCAPEization and Ecometrica mapping) that can only take a day to

complete. There are also quite a few tools (45%) that require several months to complete the assessment. The varying time requirements of the tools developed ensures that potential users can identify a tool suitable for their circumstances and resources.

Implementation time	%
One week to one month	64
Up to one week	45
Several months	45
More than one year	27
Less than one day	18

Table 3: Implementation time for tools (NB: Total of over 100% is due to some tools having wide ranges in possible implementation times and therefore falling into more than one category)

In regards to the training resources available, to aid the uptake and use of the tools, the majority (64%) of the tools have guidance documents that can be downloaded. One tool (ToSIA) offers both face to face training and an online course, while another tool (TESSA) has a freely available webinar online. For three of the tools (LANDSCAPEization, NNL, STREAMLINE), training materials are currently under development. All but two of the tools (81%) have case studies, which are publicly available or currently being published; these can also support use and uptake of the tools (see Table 7 for more detail).

Five key characteristics of an ecosystem services tool that influence greatly whether it will be applied by users have been discussed in relation to the tools developed or enhanced under OPERAs. The key characteristics are: level of technical knowledge required, cost of applying the tool, data requirements, time requirement and lastly available training resources. Together with the purpose of the tool and its geographic range, these are the key characteristics that tool developers and funders should consider in relation to the intended users of the tool if trying to develop ecosystem services tools that support the operationalisation of the ES/NC concepts.

3. Linkages between different tools

The different tools developed or enhanced have varying purposes and outputs, as discussed in the previous section. Many of them can either be used on their own or in conjunction with other tools, or feed directly into other tools. This means that the results of one tool could serve as the input data for another tool, the outputs of which can then inform decision-making. For example, the ES indicator guidance identifies suitable indicators for a given user and context, which could then used in ToSIA to assess the sustainability of a product. Data collected for these indicators, and thus for ToSIA, could then be displayed using Ecometrica Mapping to help inform decisions relating to the product.

Figure 2 demonstrates the potential linkages between different types of tools and the different levels through which data and knowledge feed into decision-making. The diagram in Figure 2 also shows the complexity of integrating ES and NC into policy, and that several different tools used in conjunction are most likely needed to influence policy-making, highlighting the importance of developing and applying several tools to achieve real change in policy and in practice.

The flow through the diagram can start from either the top or the bottom level. If starting from the bottom of the diagram, stakeholders' needs should first be identified. In response to these, data is collected using data tools (e.g., LANDSCAPEization, Streamline), which may take various forms such as survey data or maps derived from remote sensing. The data collected can then be fed into assessment tools (e.g. Iodine (CBA), mDSS, BackES). Some tools that can be used both as data collection tools and assessment tools (e.g. TESSA). The results from these assessment tools can then inform the next level: instruments and measures tools (e.g. No Net Loss) that help directly ensure the incorporation of ES into policy and decision-making.

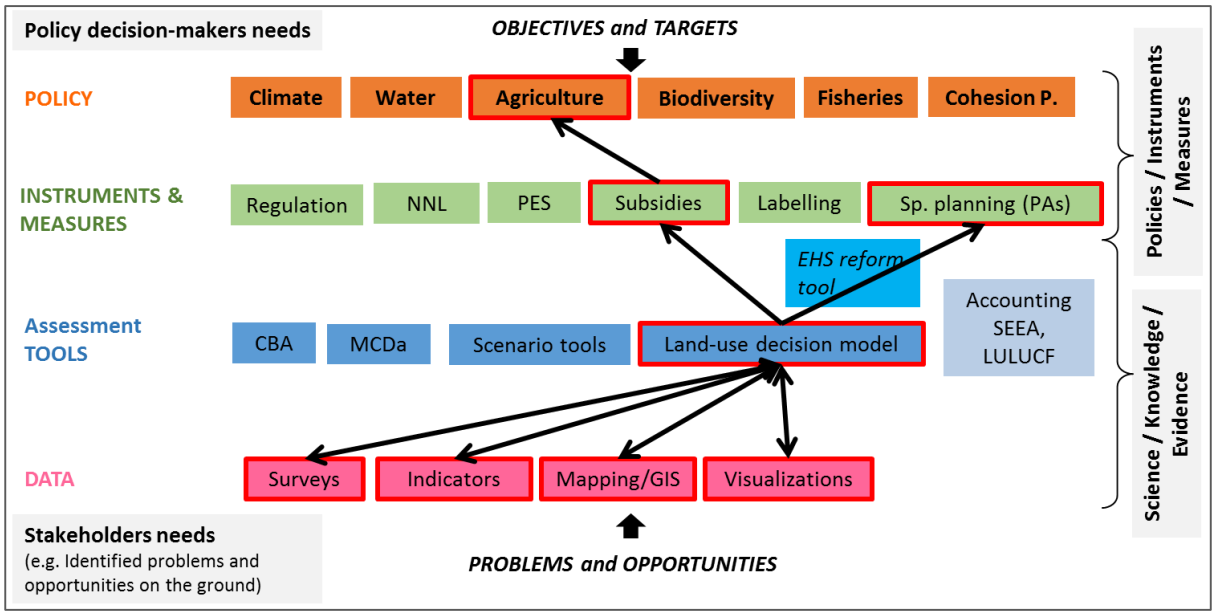

Figure 2: Diagram showing the multiple levels required to influence decision-making, with one example of flow connections between different tools

If starting from the top, from the 'policy' level, the flow is just reversed and particularly useful when undertaking an ex ante assessment of policy measures under negotiations. **Error! Reference source not found.** further demonstrates how the different tools developed and enhanced within OPERAs can be used together. On average, each tool can be linked to two other OPERAs tools, supporting the different levels of the diagram (Figure 2). Four tools are linked to only one other tool, whereas the rest can be used with up to four other OPERAs tools. It is possible that there are even more linkages between tools, which would be identified with greater shared understanding of the opportunities and functionalities of each.

In conclusion, the tools developed during OPERAs are well placed to address the different levels required to operationalise the ES and NC concepts into policy and decision-making.

Tool	Number of tools that can be used in conjunction	Tools from OPERAs that can be used in conjunction
BackES	2	ES Indicator, Landscapeization, Instruments and measures (in agriculture and spatial planning sectors in general)
Ecometrica mapping	1	ToSIA
ES Indicator Guidance	4	ToSIA, TESSA, Ecometrica mapping, BackES
Iodine (CBA)	1	Policy Instruments
LANDSCAPEization	4	BackES, ES Indicator Guidance, TESSA, ToSIA
mDSS	1	ES Indicator Guidance
NNL	2	Iodine (CBA)
Streamline	1	TESSA
TESSA	3	Streamline, ES Indicator Guidance, ToSIA
ToSIA	2	Ecometrica mapping, WeLCA
WeLCA	2	TESSA, Ecosystem Service indicator guidance, ToSIA

Table 4: The number of tools in OPERAs that can be used in conjunction with each other

4. Testing the tools

a. Overview of testing the tools in exemplars

All the tools are being or have been tested in at least one exemplar (Table 5). Just over half of the tools (55%) have completed their testing with the exemplar(s), and the remaining tools will finalise their testing during 2017. The majority of the tools (64%) have only been tested in one exemplar, while the other tools are being, or have been, tested in more than two sites.

As mentioned in MS4.15 (Ingwall King and Ivory 2015), the goal was to test each tool in at least two exemplars. This was to allow the tools to be tested in different environmental and cultural contexts and with different stakeholders. However, it proved more difficult than anticipated to achieve this.

There are a number of potential reasons for this. Firstly, in some instances there was not enough collaboration/communication between the tool and exemplar work packages. This meant that many of the initial ideas for these work packages where developed separately. However, for some exemplars, regular coordination calls overcame these issues and proved extremely useful. Thus, for future projects and similar collaboration it is worth noticing that starting communications between partners and stakeholders as early as possible is desirable to ensure that the outcome aligns for all involved parties. It might even be useful to include an early communication and collaboration milestone/output to highlight the importance of these activities.

Secondly, the lack of a timely needs assessment of ES tools at the very start of the project meant that it was harder to identify common goals between the tools and exemplar work packages. The Milestone Reports that undertook needs assessments (MS23 and MS45) were planned to be completed by month 12 and month 14, respectably. However, the tools work package had to choose what tools to prioritise for development or enhancement (MS41) at the same time (month12), meaning that the decisions as to which tools to prioritise could not be based on the needs assessment. To avoid similar problems in future projects it is thus important to schedule the needs assessment early on in the project and to ensure enough time is allowed so that this information can be used by other partners.

Thirdly, some tools required significant resources (particularly high data, time and knowledge requirements), which prevented them from being tested in more than one exemplar. For future projects which include such resource-intensive tools, it is useful to be aware of these issues and if possible plan for more resources, or plan for less ambitious testing if the resources are not available.

Lastly, some tools were developed for very specific contexts, making their application in other situations more complex or even impossible. For example, the WeLCA tool was developed mainly for the private sector, and, as OPERAs only had one exemplar in which the main focus was on the private sector, there were limited opportunities for testing the tool. However, the tool developers identified other exemplars that had some private sector links and worked with them, which helped in the development of the tool. For future projects, it might be useful to include at least two exemplar from each sector, to facilitate testing and enhance experiences from different sectors.

Tool	Exemplars and how tools been applied
Back ES	**Alps Exemplar**: The primary goal of applying BackES in the Alps exemplar is to examine and develop policy strategies required for enhancing the match between ecosystem services (ES) supply and demand in the mountain region.
Ecometrica mapping	**French Alps exemplar; Global exemplar; Montado exemplar; Scotland exemplar; Balearic exemplar**, potentially **Wine exemplar**: The Ecometrica Mapping tool is used as a communication and data dissemination tool from the data and information produced by the exemplars. The results that will be presented to stakeholders and other users are customised, with feedback provided by the research groups as well as testing of the results with offline data to ensure the results are accurately shown.
ES Indicator guidance	**Wine exemplar**: where it will be used as a first stage to define stakeholder needs and indicators before progressing on to use other tools/instruments.
Iodine (CBA)	**Balearic Exemplar**: we are producing a cost-benefit analysis of seagrass protection in the Balearic Islands. The scenarios include 'business as usual', a scenario of expanding the protected area, a scenario of weakening protection enforcement.
	Circum-Med Exemplar: A typology-based CBA approach is planned, with limited coverage of ecosystem services. Again some impacts may be spatially explicit, others aggregated only, with the integration of the CBA approach with the outputs of land-use modelling to be resolved. Progress on this case study will be made in the final months of 2016.
LANDSCAPEization	**Swiss Alps Exemplar**: We tested and applied potential modules of decision support systems in the Swiss Alps Exemplars. In a first step we developed a

	demand analysis based on requirement engineering approach. In a second step we conducted an eye-tracking study in a split sample design. Here we investigated how the user demands and behaviours differ between ES information users with and without connection to case study region and how this characteristic influence the cognitive process and therefore decision-making process. All this information was used in the setup of the LANDSCAPEization toolkit.
mDSS	**Lower Danube exemplar:** Traversing waters: Recognizing Wetland Ecosystems Value in the wetlands of Lower Danube. The mDSS tool have been used to test preferences for several real-life management options on re-wetting of Kaikusha marsh and to reveal in a more objective way the contradiction points between the different groups of stakeholders related with various management plans giving in this way the opportunity to the decision makers to deal with these contradictions. In the first stage we selected a group of significant stakeholders including park management, farmers and even mayors. Several real-life management options were defined based on expert assessment of the freshwater restoration team at WWF and the Persina park management regarding feasible solutions, as well as data from 2 years pilot experiment on mowing sections of the wetland, and documentation including a feasibility study for wetland mowing options. The economic valuation used data collected for the socio-economic assessment of Persina wetland, including market data for fish and agricultural and reed construction products, various data for economic losses and compensation obtained from local authorities. We had several experts collected the data and stakeholders interviewed beforehand. We applied the mDSS tool and we organized a stakeholder meeting in Persina where we showed the methodology and some of the preliminary results. The pilot study highlighted the consensus to change the management of the Kaikusha marsh showing that the current management is unsatisfactory for all participants in the survey being preferred some reed removal management options for better economic use of the marsh.
NNL	**French Alps exemplar**: Various offsetting approaches were applied to modelled land-use changes, and the resulting levels of ES provision. Proxies were developed to serve as metrics for assessing 'no net loss". These combine land-use and land-cover data. Conclusions show that aggregated and strategically located offsets provide more efficient biodiversity outcomes.
	The tool has been an important part of the European Exemplar, in a context where the European Commission (DG Environment) has been developing a "no net loss initiative". Several analyses were conducted in the context of OPERAs and services contracts with the Commission. The tool is also tested in other case studies not included in OPERAs exemplars.
Streamline	**Scottish exemplar**; The tool will be used to triangulate findings from choice experiments and deliberative mapping, and provide a deeper understanding of social and cultural ecosystem benefits provided by the Inner Forth, and the potential impacts of coastal realignment on the local communities. Finally the tool will be used to explore avenues of cooperation on coastal realignment projects between the local community, NGOs and decision makers that could maximise the delivery of social and cultural benefits.
TESSA	**Global exemplar (Peru):** In the Apurimac region, the regional environment commission (part of the regional government) and a commission on ES and biodiversity have shown an interest in assessing and mapping ES. CIFOR, have thus started to work with them on these topics and using TESSA to assess key ES in this area.

	Dublin exemplar: The goal to use TESSA is to assess the social and cultural values in the urban coastal setting of Fingal (Ireland). The exemplars overall aim is to improve the incorporation of ecosystem services and socio-cultural values in the consultation process of the Planning Departments. In this exemplar they focus to test the Cultural ecosystem services module of TESSA and they have so far undertaken two parts of three in this process.
	Scotland exemplar: The goal to use TESSA is to assess cultural ES in the Inner Forth (Scotland) area, and particular in relation to potential coastal realignment work. By using TESSA, the decision to do the realignment work or not will be aided, as this tool will demonstrate the pro and cons in regards to the cultural ES of the sites.
	Montado examplar: The goal with using TESSA was to define different land use scenarios to compare with the current land use baseline at the selected farmstead, and quantify and map ecosystem services. Another aim was to compare the results with another free-supporting tool: InVEST.
ToSIA	**Global exemplar (Peru):** in region of Alto Maya National Parc. Solutions and scenario analysis for impacts of migration and different agroforestry systems in areas neighbouring national park.
	Montado exemplar: Impacts of management decisions and market demands on cork production in Portugal. Goal to show effects of management changes and develop system for improved environmental reporting.
	Wine exemplar: Impacts of management changes to include eco-labelling, certification and/or organic production, both at producer and at retailer/consumer side. Develop system for improved environmental reporting and marketing, as well as Eco-label Review and Rating system.
WeLCA	**Wine exemplar**: The application of the tool provides to the user: • Understanding of the performance on ecosystem quality indicators • Understanding of the practices that have high impact on the ecosystem services and have to be improved or maintained in a good state • Awareness about how each management practice influences the different ecosystem services The user could evaluate the potential outcome of the introduction of various changes in the applied management practices and communicate externally the achieved progress. The tool is yet to be applied at a winery in the Montado region in Portugal.

Table 5: Summary of how each tool was tested in exemplars

Feedback from the exemplars testing the tools has been very positive, and the tools have clearly met the objectives the exemplars desired. The following statements from the tool developers illustrate their experiences:

"Early results are promising, we've had very positive feedback from our participants, and a lot of interest from non-academic organisations looking to use STREAMLINE in future projects" (Streamline)

"The tool was only tested in one Exemplar, however, very successfully." (BackES)

"The tool has proved its worth technically, but remains to be presented and discussed with stakeholders." (NNL)

"The users succeeded in identifying the most important cultural ES in the study areas, describing the uses of the cultural ES, identifying direct and indirect beneficiaries, and mapping cultural ES supply and uses where possible." (TESSA)

The next section will discuss in more detail the challenges the tool developers and the exemplars have had in testing the tools, and the lessons learned from these experiences.

b. Challenges encountered in testing the tools

i. Feedback received and measures taken

Stakeholder engagement in tool use

There have been a number of key issues found during the testing of tools relating to stakeholder engagement, and recommendations for improving this have been incorporated into tools as appropriate.

A recurring challenge has been in communicating technical concepts and methods to stakeholders, and ensuring their understanding is sufficient to allow them to participate and communicate values, for example in the application of TESSA Cultural Ecosystem Services module in Ireland and Scotland. This has largely been addressed through improving guidance for the tool users and those facilitating the stakeholder engagement, for example by providing suggestions as to how technical terms can be better explained for non-technical audiences.

Some of the tools, such as BackES, require long-term stakeholder engagement and repeated interactions with the same stakeholders; maintaining engagement can be challenging, but the tool developers have overcome this through continuity of researchers and personal interactions. Certain stakeholder groups may find attending workshops or responding to long questionnaires challenging, in particular elderly people or mothers with young children; having individuals available specifically to support such participants, e.g. by entertaining children, can help ensure representative and balanced stakeholder groups.

Equally, soliciting honest and personal values from stakeholders can prove difficult, as is getting stakeholders to recognise and differentiate between different types of values such as individual values and community values. This again was encountered in the testing of TESSA, which aims to elicit from stakeholders not just the tangible and concrete cultural ecosystem services benefits but also intangible benefits. Care must be taken with survey design and questions/prompts to ensure stakeholders are clear on what is being asked of them and how the information will be used.

A difficulty in testing some tools arose from stakeholders' limited understanding of the concept of ecosystem services and biodiversity, and, as a result, a lack of interest in the operationalisation of these concepts in their contexts. As a result, the tools and the benefits from their application have not been perceived as important or of high priority. A full user needs assessment at the outset, which includes stakeholders, would help ensure stakeholders will be engaged and interested in the implementation

User friendliness of tools

A number of tools received feedback from exemplars to improve their user-friendliness. For example, for TESSA this included making text clearer and more succinct, improving consistency in terminology, and including definitions for key concepts and terms. Another key related piece of feedback received by tools (e.g. ES Guidance) was clarifying the purpose and

aims of the tool, in order for users to be clear upfront on what it would help them to achieve and how it worked, including data sources. Tools, for example mDSS, also received comments on the user interface in order to make it clearer for the user or stakeholders to provide input.

Data and technical issues

In testing some tools, data availability was an issue – for example, where valuation data was lacking for the Iodine cost-benefit analysis tool, a value transfer approach was used. Where a lack of physical data presented an issue, for the No Net Loss tool, modelling and proxies were used to address the gaps, whereas in the Iodine CBA tool a sensitivity analysis helped understand what the missing value would have be.

A number of tool-specific issues were also raised, for example:

- EcoMetrica Mapping had to be technically adjusted to respond to the exemplars needs, for example adding new queries or adjusting existing ones.
- BackES found a long validation phase for models to be challenging, but was unavoidable.
- BackES, a multidisciplinary tool, also faced challenges in harmonizing methods across disciplines, which were resolved through iterative discussions and adaptations involving experts from different disciplines.

Uptake of the results

Some tool users have also seen challenges in getting the results used and taken up by the decision-makers. For some, the immediate policy relevance of the results for decision-makers were unclear. For others, the challenge was more in engaging decision-makers as stakeholders in the implementation of the tool itself. The general conclusions were that decision-makers need to be engaged early on in the process, even in choosing the appropriate tool, in order that the correct questions are being asked and therefore that the results are appropriate and useful, both in terms of their scope and in terms of their scale and resolution.

Challenges in uptake and testing of tools by exemplars

A key challenge, which almost half of the tools (45%), faced were delays in testing and finalising the tool. For some this is due to delays in the exemplar responsible for testing the tool, which is difficult for the tool developer to resolve or address. For other tools, delays have been due to data availability and issues in stakeholder engagement.

Another challenge in ensuring uptake of tools by exemplars was due to lack of clarity of the aims and scope of the tool, which meant either exemplars were not clear on when or how to apply the tool, or committed to use it before realising that it was not suitable for their needs, such as in the case of the Ecosystem Services Indicator Guidance. As a result, some tools saw less uptake than initially envisaged.

These issues will be addressed to some extent once the tool is available and being accessed through OPPLA, which will clearly state its scope and purpose and help a user decide if it is appropriate or not. However, it is very important that tool developers work to clearly understand and communicate the aims of their tool, its requirements and the contexts in which

it can or can not be applied, in a manner that can be understood by those who are not familiar with the tool.

ii. Key lessons learned from testing the tools

The experience of testing the tools with exemplars provided a very useful understanding as to for whom the tool was most appropriate, and the contexts in which it should be used or should not be used (Table 6). It also helped with a better understanding of the time and resources required to implement the tool, as well as the data and information requirements, the implications of limited or reduced data availability, and different stages of work. This information will all feed into OPPLA to help guide future users in selecting the most appropriate tool.

Testing the tools also helped understand which aspects were not easy for users to apply without support, and to ensure that support was available at the right times, or to improve guidance to help users implement the tools independently.

Stakeholders being engaged during the implementation of the tools should be familiar with and interested in the issue at stake; there is a balance between ensuring broad and extensive stakeholder engagement, and ensuring that all stakeholders have genuine interest and therefore can provide valuable and relevant contributions. For this, good contacts and strong communication and facilitation skills may be required.

Stakeholder engagement can take time and you may not be able to achieve all your objectives in just one session; however, inviting stakeholders to multiple sessions also risks losing interest of stakeholders and therefore a lack of continuity. This should be carefully planned at the outset, and the commitment expected of stakeholders clearly communicated.

A very important lesson was that guidance was required to help users interpret data and results in a policy-relevant way in order for it to feed into policymaking and decision-making processes. Stakeholder engagement is also a key part of this, and having the key stakeholders involved throughout the process to ensure results are relevant and appropriate.

Tool	Key feedback and lessons learnt
BackES	The time and resources required to implement the tool are very high. In general, it could be useful testing it in other mountain regions. A lot of data and information on management practices, policy programs etc. need to be collected and implemented in the model.
	Preliminary work also includes interviews with stakeholders and workshops. Therefore, the implementation of the model is an interdisciplinary or even transdisciplinary task which cannot be complemented by one person only. The tool can however be run with less context-specific information, but consequently less context-specific results.
	If the full potential of the tool to incorporate on-the-ground management systems and decisions of real agents is used, the tool is able to simulate very well observed processes on the ground (good validation results). Therefore, results are credible and – in our experience – serve as a good basis for stakeholder engagement and negotiations on development strategies to maintain desired ES.

	The backcasting approach which is the backbone of the tool could be easily adapted to other contexts using existing models and data. The paper available on http://www.sciencedirect.com/science/article/pii/S1364815215300761 informs on how such an approach could work out also using other tools.
Ecometrica	As the tool can be accessed anywhere just using an internet connection, the exemplars were able to view and provide feedback on their data and how the results for those data were presented to their users quickly and easily.
	The tool is also able to extract information for a user's specific area of interest, summarise and present those results in a user-friendly format (for example in graphs, charts or tables); which means non-expert users can be guided through quite complex scenario and modelled data and extract meaningful results easily.
Iodine	The tool is probably best suited to initial analysis and scenario screening, identification of important uncertainties and gaps. More spatially explicit methods would probably be needed for specific decision support.
Landscapization	Too early to provide feedback
mDSS	To be correctly applied, the instrument needs facilitators to help the linkage between the software and stakeholders, to correctly translate the stakeholders views as inputs in the software.
NNL	A key lesson is that data alone isn't enough, and interpretative guidelines are required for it to make sense and feed into decision-making processes. Science can provide some of that, but stakeholder engagement can be very important to ensure ecosystem services reflect actual priorities, and are assessed in ways that are acceptable to decision makers.
TESSA	This tool works best when stakeholders are familiar with the site in question and can relate closely to it.
	The tool seems to work well in a spatial planning context, with good positive feedback from local authorities that received information from the assessment.
	Workshops might need more than 2 hour sessions if the user wants to complete several of the activities. Estimates are about 1 hour for each activity (Free listing, mapping and scoring) but users might need to include a break if doing all three activities in one workshop.
	If spreading the activities between different session, try to get everything done in two workshops, as the third workshop resulted in much fewer stakeholders participating.
	The tool provides some good alternative methods for eliciting CES, and describes how to use the methods and where they may/may not be appropriate.
	The outputs demonstrate the importance of CES within a given area, at one point in time – and as such can provide baseline information.
	The process itself provides the opportunity for participants to consider the benefits and values that they associate with the place and helps them to reflect on what they prefer and want from CES. It provides deeper insights into what is also important to people connected with the study area – they would also get some sense of what the

	people want for the future and insights into any management deficits that are falling short of delivering on the current preferences/demands of stakeholders.
	Potential users of the tool should first consider what kind of outputs they wanted, where the information might be used, who might use it, who are they trying to influence or what/who are they trying to advocate for (nature, people or policy).
ToSIA	Intimate knowledge on the topic for which the value chain is being assessed is crucial in order to define value chains and to populate them with data. Alternatively, interested and willing stakeholder or experts to help with providing that knowledge.
WeLCA	During the identification of user needs it was determined, that the concept of ecosystem services and protection of biodiversity is not well known and understood by target stakeholders. Also, the need to address inexperienced stakeholders was identified. For that reasons, the initial concept of the tool was revised and two separate approaches (phases of the tool) were implemented – providing a qualitative and quantitative assessment respectively. Phase I of the tool was designed for beginner users. This phase is applicable for farmers or grape growers, focusing on the first stage of wine production. The advantages of the tool are that it is simple, user-friendly for both experienced and inexperienced users and requires only data that is readily available within the farm. The results of the assessment needed to be easy to understand, so the information was presented visually – using spider diagrams and traffic-light system.
	Phase II of the tool was designed for intermediate users. This phase is applicable for a wider range of users. It can be used by grape growers – for assessment of the impacts on vineyard level, wine producers for assessment of impacts on both vineyard and winery level. It could be possibly used by retailers or industry associations for decision making based on the impact of different suppliers or members. It has higher data needs compared to Phase I. The user has to provide measured/assessed quantitative data for the most significant inputs and outputs of the process of wine production. The main feedback, which was received by stakeholders included the following: - Efforts should be dedicated on awareness raising of the concept of ecosystem services. Outside of the science community, the concept is yet to be widely accepted. Moreover, the topic should be presented in an easy to understand way related to used language and vocabulary (e.g. less scientific terms, more explanations). - Results of the assessment should be easy to understand and presented in a visual way - There should be an option to make a “quick” assessment, which requires less data. The application of complex tools is very often limited due to lack of detailed data, required for the assessment. If detailed data is required, then a good option would be to provide reference/default values. - The tool should highlight the benefits for the user and the society from improved ecosystem quality.

	Some of these suggestions have been already addressed or will be addressed within the framework of the project.

Table 6: Key feedback and lessons learnt for each tool

c. Documentation of case studies and links to tools

For many tools, detailed case studies of their application are available, both in exemplars and outside of the OPERAs project. Table 7 provides links to both the tools and these case studies, where available.

Tool	Links to Tools	Links to Case studies
BackES	http://www.sciencedirect.com/science/article/pii/S1364815215300761	http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fview_casestudy.jsp&_marketplace_WAR_OpplaGCMportlet_casestudyId=138
	http://www.sciencedirect.com/science/article/pii/S1462901116301241	http://www.sciencedirect.com/science/article/pii/S1462901116301241
	http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fshow_product.jsp&_marketplace_WAR_OpplaGCMportlet_productId=5	
Ecometrica Mapping	https://ecometrica.com/platform/mapping/eo-labs/public-apps	https://ecometrica.com/platform/mapping/eo-labs/public-apps
Ecosystem Services Indicator Guidance	http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fshow_product.jsp&_marketplace_WAR_OpplaGCMportlet_productId=4	http://www.bipindicators.net/LinkClick.aspx?fileticket=dqFvm3SF%2bpo%3d&tabid=214 http://nbsapforum.net/#read-resource/828
Iodine (CBA)	http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fshow_product.jsp&_marketplace_WAR_OpplaGCMportlet_productId=6	There is an existing example of this approach applied to UK forests; work on the OPERAs case studies is ongoing.
LANDSCAPEization	http://www.landscapeization.ethz.ch/	Not yet, but submitted paper to the special issue, Putting Ecosystem services into practice. Assessment tools and indicators for land management. In the journal Ecosystem Services
mDSS	Documentation: http://www.netsymod.eu/DSSUserGuide.html Online instrument: http://www.netsymod.eu/apps/mDSS/mDSSweb	http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR

		_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fview_casestudy.jsp&_marketplace_WAR_OpplaGCMportlet_casestudyId=133
NNL	In development	http://bbop.forest-trends.org
Streamline	www.streamline-research.com	www.streamline-research.com
TESSA	http://tessa.tools/	http://www.birdlife.org/assessing-ecosystem-services-tessa/case-studies http://www.birdlife.org/worldwide/science/tessa-publications
ToSIA	Documentation: http://tosia.efi.int/material.html Demo version: http://tosia.efi.int/installation.html http://tosia.efi.int/tmug.html	_http://tosia.efi.int/forest-wood-chains.htm
WeLCA	In development	The WeLCA tool has been developed within OPERAs and especially for the stakeholders of the project within the Wine exemplar. WeLCA is still under a series of testing to allow for more potential users (e.g. Userboard) to express suggestions for improvement of the tool. The use of the tool within the context of OPERAs will be presented as a case study by the end of the project at Oppla.

Table 7: List of tools developed and enhanced under the OPERAs project, with links to the interface or published paper, and links to known case studies applying the tool.

5. Conclusion

This report has provided an overview of the tools developed and tested during the OPERAs project. It has focussed on the key characteristics of the tools which will determine their suitability for different users, as well as the process, challenges and lessons learnt through testing the tool in the OPERAs exemplars.

What are the key characteristics of the tools which have been developed or enhanced?

The review of the tools shows that they vary widely in their core characteristics, demonstrating suitability for different users and contexts. The tools have a broad range of objectives and are designed for a variety of policy sectors, with some being more specific in their application whereas others are more general and broad in their scope, and more readily adapted for a given purpose. The tools are applicable for a range of scales, with some adaptable to any scale whereas others are, for example, just suited to local-scale application. Time, financial and data requirements also vary; those tools that require greater data inputs tend to require more time (and therefore, potentially, money) to implement. These are also more likely to be the tools that require greater knowledge and experience. At the other end of the scale, some tools require minimal time or resources and are designed for those without extensive knowledge and experience in assessing ecosystem services.

How can the tools be used together or independently to support different stages of the decision-making processes?

Most tools target a specific 'level' in the flow from data to decision-making: data collection, assessment, or instruments and measures. The outputs of tools focussing on the lower levels of the diagram, such as data collection and assessment, will most likely be less suited to feed directly into decision-making. As such, these tools can often feed into tools which target higher levels, for example with their results being used as inputs to instruments and measures. However, presenting this flow as a linear process does potentially risk oversimplification, as some tools address more than one 'level', and some tools have the potential to be used in conjunction with one another at just one level of the diagram (see Figure 2). By only showing one example of flow connections between different tools, it is quite likely that not all the linkages between tools have been identified due to tool developers working largely independently of one another. However, Table 4 clearly shows how the tools developed are well linked and distributed on the three levels of the diagram (Figure 2) and thus support the incorporation of ES into policy and decision-making.

Do the newly developed or enhanced tools help to operationalise the ES/NC concepts?

The evidence suggests that the tools developed have been successful in their aims when applied in exemplars and are suitable for a range of contexts. It was also demonstrated that many of the tools meet the key characteristics that determine if a tool will be applied. These were: low technical knowledge requirement, free to use, low or no data requirement, low time requirement and training resources or guidances available. The main potential weakness, as demonstrated by feedback from a few tools, is in ensuring that results are useful for and thus taken up by decision-makers.

However, decision-making and policymaking processes take time and the timescale of the OPERAs project might not be long enough to see any impact from these tools and their results on decision-making or policymaking. Such impact is, of course, an essential component of operationalising the ES concept, and clear feedback shows that this can be promoted through involvement of the decision-makers during the early stages, and even during the selection of the tool, as this can ensure results are useful and appropriate, and are well-communicated.

What challenges have the tool developers' experienced, and what lessons have been learnt, during the development and testing of their tools?

Tool developers have experienced a number of challenges. A key challenge, experienced by many tools, was found in ensuring that exemplars selected appropriate tools at an early stage. Some selected tools that were later realised to be inappropriate for the context; others overlooked tools that would have been useful. As such, clarity in the aims and scope of tools, and in the key characteristics that could help users decide on their relevance and appropriateness, is of great importance. This challenge will largely be addressed through the OPPLA platform, which will help users to clearly identify appropriate tools for their needs. It also highlights the importance of tool developers being clear on these issues from the start. Other challenges included: stakeholder engagement, particularly non-technical stakeholders on technical issues and ensuring that stakeholders' contributions were relevant and useful;

lack of data availability, to make up for which different methods were employed for different tools; and ensuring results were able to feed into the appropriate policy and decision-making. A large amount of tool-specific feedback was received, particularly around the user-friendliness of tools (presentation, language and clarity) and technical feedback on individual methods. Each tool developer has taken on board the feedback from exemplars, and lessons learnt in testing the tools, in order to enhance their tool and ensure it is ready for general use.

Overall, it was clear that the tool developers have benefited greatly by testing the tool in the exemplars and for some under different environmental and cultural contexts, which has made the revised versions of the tools much stronger and better able to be used independently and successfully by the users. It is hoped that future tool developers and funders will learn from the experiences documented here to ensure that future tools developed fill a known gap and have a clear policy sector(s) aim, that the intended user has been involved from the start and that they provide feedback on its use and the usability of final outputs.

References

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Grêt-Regamey, A., Sirén, E., Brunner, S.H. and Weibel, B., 2016. Review of decision support tools to operationalize the ecosystem services concept. *Ecosystem Services (in press)*.

Ingwall King, L. and Ivory, S. (2015). MS4.15 Updated report on testing of information tools for ES/NC. See online link [http://operas-project.eu/resources}

Annex 1: Individual Tool Templates

Integrated backcasting modeling system BackES

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	
Ecosystem services mapping	√
Ecosystem services valuation	√
Decision support	√
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	
Local Authorities	
Governmental bodies	√
Private sector	
Other? Please specify	

3. What are the main uses of the tool?

The integrated modelling system BackES was developed to simulate regionally aggregated and spatially explicit (100m x 100m) changes in ES benefits, accounting for both, changes in ES supply triggered by global socio-economic and climate changes, and local residents' preferences for ES. The model can be used to, among other purposes, to (1) evaluate how the capacity of mountain social-ecological systems to provide a set of demanded ES evolves over time in different scenarios of global change, to (2) test the effect of a rich set of policy strategies under all these scenarios to identify types and timing of interventions that are robust under multiple global change settings, to

(3) map uncertainties in future ES benefits, that is to pinpoint areas where changes in benefits are independent of the scenarios and delineate others where management and policy making have to deal with uncertainty to secure the provision of demanded ES.

The results of the model application can inform decision-makers on (i) milestones of policy interventions that have to be accomplished in time to prevent irreversible losses of ES with regard to a desirable future, (ii) policy strategies inducing land-use transition pathways that are resilient under different global change scenarios, and (iii) trade-offs among ES along these pathways.
BackES is integrated into a collaborative and interactive user interface, with the help of which stakeholders can visually and quantitatively explore transition pathways and related ES trade-offs under alternative policy strategies.

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4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	√
Subnational	√
National	
Sub-continental	
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	√
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

Yes

7. Is the assessment quantitative and/or qualitative?

quantitative

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	
Medium (Know about ES, but not GIS or modelling skills required)	
High (good experience of ES, skills in GIS and modelling)	√
Other? Please specify	

9. What resources are required to use the tool?

Resources	Please choose appropriate answer
Internet requirement *(web based/ Download Pdf/none*)	To run BackES: none, the collaborative user platform is web based
GIS *(Y/N)*	Yes
Models *(Y/N, if yes, please specify)*	Software required: Linear Programing Language (LPL), Virtual Optima; ILOG CPLEX Optimization Studio, IBM Software availability: LPL academic license available on purchase, http://www.virtual-optima.com/en/index.html; CPLEX academic license available at no charge, http://www-01.ibm.com/software/commerce/optimization/cplex-optimizer/index.html Software required for linked modules: NLOGIT 5, Econometric Software Inc. (Education license available on purchase, http://www.limdep.com/products/nlogit/); R x64 3.1.0: A language and environment for statistical computing, R Core Team, Foundation for Statistical Computing (Available at no charge, http://www.r-project.org/)
Financial *(Free/cost in Euros X, please specify)*	See above: CPLEX academic license available at no charge, LPL academic license available on purchase,

	NLOGIT 5 Education license available on purchase, R available at no charge
Other? Please specify	*See above*

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	
None, the tool makes use of available data	
Spatial data required	√
Quantitative data, please specify what data needed	
Other? Please specify	Base maps are a digital elevation model, downscaled monthly precipitation and temperature maps and a soil property map. Additional spatial inputs are a crop yield and a forest yield map. Furthermore many case-study specific socio-economic data and parameters related to agricultural practices and political restrictions and programs (e.g. subsidies) are required.

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	
One week to one month	

Several months	
More than one year	√
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

The tool can map uncertainties in future ES benefits that result from the uncertainty of how global socio-economic and climatic conditions and regional preferences will change. So, areas can be pinpointed where changes in benefits are independent of the scenarios and where interventions will hardly be effective and delineate others where management and policy making have to deal with uncertainty to secure the provision of demanded ES. The tool can also evaluate different spatial planning or development plans with regard to how their implementation can maintain the provision of desired ES.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

The tool can at the moment not directly implement management scenarios, but rather inform on where management might reduce the uncertainty of future ES benefits (see 12). In addition, the tool provides information on how different global change conditions or policy regimes impact environmental management and thus enhance the process understanding of the dynamics of the social-ecological system. From the understanding of the link between global changes, regional policy strategies, local land management given these boundary conditions, the resulting provision of ES, and how this supply translates into benefits given the preferences of stakeholders, we can derive many useful information for land management.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

Yes, for different scenarios of global socio-economic and climatic changes and for different regional to national policy scenarios.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	
Soil	
Forest	
Agriculture and rural development	√

Marine and coastal (including fisheries)	
Climate	
Bioenergy	
Transport	
Spatial planning	√
Conservation and Protected Areas	
All	

16. What training resources are available? *(Where appropriate, provide links to the resources)*

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	
In development (please specify which resources)	
None	√
Other? Please specify	

16. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

    http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fview_casestudy.jsp&_marketplace_WAR_OpplaGCMportlet_caseStudyId=138

    http://www.sciencedirect.com/science/article/pii/S1462901116301241

17. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Link to **Knowledge: Economic valuation** (Mark Koetse): For eliciting ES demand, we conducted a discrete choice experiment which is a demonstration and application of one of the economic valuation methods within OPERAs. Choice experiments offered several advantages, important in the context of our tool, over other methods: First, choice experiments link to the economic concept of demand based on utility maximization under a budget

constraint allowing the link to the economic-based model ALUAM-AB. Secondly, they are also applicable to non-marketable ES, such as cultural ES, which are in the focus of the exemplar. Finally, they allow an estimation of the value of marginal changes in ES, which is important because policy decisions normally act at the margin, rather than with a complete loss or gain of the services.

Link to **Knowledge: Trade-offs** (Sandra Lavorel): The knowledge workpackage aims to explore the current practice in terms of ES trade-off analysis. BackES can present three facets of trade-offs: supply-supply, supply-demand, and demand-demand. Furthermore, trade-offs can be studied over time and along a variety of policy pathways.

Link to **Instruments: Collaborative Web-Platform** (Tom Klein): Results of a BackES were integrated in a collaborative web-platform developed by T.Klein. The decision-support platform used different visualization techniques to represent different aspects of the modeling results. Users were able to explore their future landscape and spatio-temporal ES trade-offs resulting from alternative policy decisions.

Link to **Instruments: Policy instruments** (Marianne Kettunen): Mariannes' assessed the current level of integration of ES and natural capital into the current EU policy framework. The assessment provided a comprehensive overview of the current situation and outlined the requirements for developing a comprehensive policy framework for the sustainable management of ecosystem services and natural capital in the EU. The analysis showed that effective integration is needed to minimize the damage to ecosystems caused by sectoral activities and maximize the positive contribution of these activities to conservation. Furthermore, there is a need to explore the development of policy instruments, including innovative policy instruments such as market-based instruments, which can help to address ES in an effective manner. As Switzerland is not member of the EU, we could not directly take her analysis as input to our tool. However, we tested innovative policy instruments and cross-sectoral policy strategies for their effect on ES supply in our Exemplar, and therefore provide kind of a non-comprehensive sub-analysis of policy instruments in Switzerland.

Link to **Instruments: Information tools – Indicators** (Lisa Ingwall-King and Sarah Ivory): One result of BackES are spatially explicit and regionally averaged indicators for ES. BackES uses relatively simple indicators which were chosen in a way that they could be assessed from both, the demand and supply perspective. That is, the prerequisite was that they could be assessed within the frame of a choice experiment as well as be modeled with ALUAM-AB. The consistency of these indicators throughout the whole application of BackES allowed us to quantitatively assess ES mismatches.

Testing the tool: Results and progress

17. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Alps Exemplar: The primary goal of applying BackES in the Alps exemplar is to examine and develop policy strategies required for enhancing the match between ecosystem services (ES) supply and demand in the mountain region. Our tool can especially test national and regional policy schemes and integrative strategies that take into account local ecosystem properties,

region-specific demand as well as global economic, political and ecological changes. Following a backcasting approach, we have developed future visions supported by the mountain residents as an anchor for evaluating policy actions with the land-use and ES modeling tool ALUAM-AB. In a first step, we have assessed future demand for ES with a discrete choice experiment involving residents to obtain their stated preferences for ecosystem services changes. Secondly, we have simulated various pathways of ES supply under different policy strategies and global change scenarios. Finally, we have evaluated for each model run, how well ES demand is satisfied at a mid-term planning horizon. Results from the backcasting exercise were made available to policy-makers for discussing and negotiating concrete policy interventions that balance conflicting interests and maintain ecosystem services in the Exemplar.

18. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

As can be seen from above, the tool was only tested in one Exemplar, however, very successfully. We aimed at testing the tool also in the French Alps exemplar, but personal resources and the very high data, time and knowledge requirements did not allow us to do so.

19. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

We have finished the testing phase and are now working on evaluating and synthesizing the results.

20. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
Long validation phase	Swiss Alps Exemplar	Addressed by patience
Harmonization of methods from different disciplines	Swiss Alps Exemplar	Iterative discussion about terminology and revision of interfaces of methods among experts of different disciplines
Engagement of stakeholders	Swiss Alps Exemplar	Personal interaction with stakeholders, continuity of Exemplar
Immediate policy relevance of the results for regional decision-makers	Swiss Alps Exemplar	Application of the tool needs to be discussed in the broader policy context, at which level can it best

		support decision-making processes? Who can benefit from the pathway analysis? How do global change and regional/local resilience relate? These issues will be taken up in further research
Spatial resolution of results (100m x 100m) too coarse for local planners and managers	Swiss Alps Exemplar	Difficult to address with available data. Still, the spatial aspect will be taken up in further research

21. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

The time and resources required to implement the tool are very high. In general, it could be useful testing it in other mountain regions. A lot of data and information on management practices, policy programs etc… (see above) need to be collected and implemented in the model. Preliminary work also includes interviews with stakeholders and workshops. Therefore, the implementation of the model is an interdisciplinary or even transdisciplinary task which cannot be complemented by one person only. The tool can however be run with less context-specific information, but consequently less context-specific results. If the full potential of the tool to incorporate on-the-ground management systems and decisions of real agents is used, the tool is able to simulate very well observed processes on the ground (good validation results). Therefore, results are credible and – in our experience – serve as a good basis for stakeholder engagement and negotiations on development strategies to maintain desired ES. The backcasting approach which is the backbone of the tool could be easily adapted to other contexts using existing models and data. The paper available on http://www.sciencedirect.com/science/article/pii/S1364815215300761 informs on how such an approach could work out also using other tools.

22. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

http://www.sciencedirect.com/science/article/pii/S1364815215300761

http://www.sciencedirect.com/science/article/pii/S1462901116301241

EcoMetrica Mapping

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	√
Ecosystem services meaning	√
Ecosystem services assessment	√
Ecosystem services mapping	√
Ecosystem services valuation	√
Decision support	√
Implementation support	√
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	√
Local Authorities	√
Governmental bodies	√
Private sector	√
Other? Please specify	

3. What are the main uses of the tool?

Ecometrica Mapping is used by governments, corporations, investors and researchers. Applications of Ecometrica Mapping include:

- Responsible sourcing of food fibre and biofuels
- Monitoring and evaluation of conservation, development and ecosystem restoration projects
- Research into environmental change and environmental policies

Large-scale infrastructure, mining and agricultural development projects

4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	√
Subnational	√
National	√
Sub-continental	√
Continental	√
Global	√

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

Yes.

7. Is the assessment quantitative and/or qualitative?

The mapping tool can incorporate both spatial qualitative and quantitative assessment data, along with guidance on how users can interpret the data and results presented.

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	√
Medium (Know about ES, but not GIS or modelling skills required)	

High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	√
GIS *(Y/N)*	
Models *(Y/N, if yes, please specify)*	
Financial *(Free/cost in Euros X, please specify)*	Only an owner of an application (i.e. a suite of data products that are queryable) needs a licence. Users (visitors) to the application can access it for free. License fees for application owners vary based on a combination of factors such as size of data, and number of expected visitors. From EUR1,245/yr.
Other? Please specify	

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	
None, the tool makes use of available data	√
Spatial data required	
Quantitative data, please specify what data needed	
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	Please tick where applicable (√)
Less than one day	√
Up to one week	√
One week to one month	
Several months	
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

The tool is designed to allow non-expert users to easily visualise and interact with spatial data for land, water, ecosystem, climate and natural resource projects. Spatial planning/development data can be included within the platform to guide decision-making, with customised results for specific user groups.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

Spatial data on environmental management and risks can also be published using the platform tool to allow a wide audience to use and interact with these data resources.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

Where scenario analysis data is available or produced by research groups, the tool can be used to show scenario results for specific areas of interest for users with all levels of technical expertise.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	Please tick where applicable (√)
Air	
Water	
Soil	
Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	
Climate	

Bioenergy	
Transport	
Spatial planning	
Conservation and Protected Areas	
All	√

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	√
In development (please specify which resources)	
None	
Other? Please specify	

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

A number of publicly-available platform applications to explore at https://ecometrica.com/platform/mapping/eo-labs/public-apps

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

The Ecometrica webmapping tool will be linked to ToSIA in the Global exemplar Peru Case. Ecometrica mapping will act as both a source for calculating input to ToSIA, and by presenting the results of ToSIA on a user-friendly interface alongside other data relevant to the Peru case.

Testing the tool: Results and progress

19. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

French Alps exemplar

Results of the French Alps exemplar ES mapping and modeling have been (and some still to be added) uploaded to the webmapping tool. Information on the project and the data is provided in English and French and users can visualise and query the data layers using a

user-friendly interface. This application is currently in progress with some of data results being quality-assessed and some data still to be added.

Global exemplar

Results of Rene Sachse's global modeling can be visualized and queried on the webmapping tool. The structure of the query report is currently preliminary and to be refined based on user board feedback.

Montado exemplar

Early mapping results of the Montado exemplar have been uploaded to the webmapping tool. More mapping results to be added later. Information on the project and the data is provided and users can visualise and query the data layers using a user friendly interface. This application is currently in progress as most of the data is still to be added, and the structure of the query report will be set up accordingly.

WP 3 study: C sequestration: a GHGV perspective

Results of Anita Bayer's global modeling on C sequestration: a GHGV perspective can be visualized and queried on the webmapping tool. . Information on the project and the data is provided in English and users can visualise and query the data layers using a user friendly interface. The structure of the query report has been refined based on user feedback. . There is also a link to the publication this work is based on (Bayer et al (2015).

WP 3 study: ES mapping in Scotland

This is still in the planning phase. Results of Astrid van Teeffelen's student (Willem Verhagen) on mapping of ES for Scotland will be uploaded on the webmapping tool and queries will be set up to enable users to extract useful information in a user friendly interface.

Balearic Sea grass exemplar

Mapping results of the Balearic sea grass exemplar will be uploaded on the webmapping platform and queries will be set up to enable users to interact with the data. This application is in progress - some preliminary data has been received and more data will be sent.

Global exemplar, Peru case (link with ToSIA tool)

This is currently in the planning phase. The plan is to link outputs from the ToSIA tool to the OE webmapping tool on the Peru case.

Wine exemplar (possibly)

There is ongoing discussion with the wine exemplar about how the OE webmapping tool can be useful in the exemplar, depending on the availability of spatial data.

20. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

The Ecometrica Mapping tool is used as a communication and data dissemination tool from the data and information produced by the exemplars. The results that will be presented to stakeholders and other users are customised , with feedback provided by the research groups as well as testing of the results with offline data to ensure the results are accurately shown.

21. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

For many of the applications, the testing of the data results is iterative as the data is produced and provided. Testing and QA for most of data sent has been completed, however more data is still to be added once produced and will require a final phase of testing.

22. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
Limitations in query function	For a specific query on the WP3 GHGV modelling study	Query function added by Ecometrica development team (at own development cost). Query adjusted using the new query functionality.

23. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

As the tool can be accessed anywhere just using an internet connection, the exemplars were able to view and provide feedback on their data and how the results for those data were presented to their users quickly and easily.

The tool is also able to extract information for a user's specific area of interest, summarise and present those results in a user-friendly format (for example in graphs, charts or tables); which means non-expert users can be guided through quite complex scenario and modeled data and extract meaningful results easily.

24. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

Each exemplar has their own webmapping application with a dedicated url link in order to distribute their data and results interactively to their user groups. These links can be made publicly-available once complete.

Some examples of publicly available applications using the tool can be found at https://ecometrica.com/platform/mapping/eo-labs/public-apps

Measuring Ecosystem Services: Guidance on Developing Ecosystem Services Indicators

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	√
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	√
Ecosystem services mapping	
Ecosystem services valuation	
Decision support	
Implementation support	
Other? Please specify	Develop ES Indicators

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	√
Local Authorities	√
Governmental bodies	√
Private sector	√
Other? Please specify	

3. What are the main uses of the tool?

Ecosystem services indicators can serve as an important tool for national development planning, reporting and decision making, sector planning (e.g. fisheries, agriculture, water policies), report and decision making (e.g. NBSAPs) and local decision making (e.g. watershed management plans, Payment for Ecosystem Services (PES) schemes and district development plans). Governmental

bodies can use indicators to track and report progress against specific policy objectives for sustainable development and conservation.

The guidance also focuses on entry points, enabling factors and approaches/tools for mainstreaming ecosystem service indicators into existing monitoring and reporting systems of policies and plans at international, national, sub-national and sectoral levels. Thirdly, the guidance showcases ecosystem service indicators developed by South Africa, where the concept of ecosystem services is becoming well embedded into environmental policy

4. At what geographic scale is the tool applicable?

Scale	**Please tick where applicable (√)**
Local	√
Subnational	√
National	√
Sub-continental	√
Continental	√
Global	√

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	**Please tick where applicable (√)**
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?
   No. The tool helps define which indicators are required. These indicators may or may not be spatially explicit.

7. Is the assessment quantitative and/or qualitative?
   Qualitative

8. What level of technical knowledge is required?

Level Technical knowledge requirement	**Please tick where applicable (√)**
Low (General knowledge of ecology/natural resources)	√
Medium (Know about ES, but not GIS or modelling skills required)	
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	Download PDF
GIS *(Y/N)*	No
Models *(Y/N, if yes, please specify)*	No
Financial *(Free/cost in Euros X, please specify)*	The guidance document is free but some resources are required in order to engage stakeholders, and potentially to produce the indicators that are selected.
Other? Please specify	

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	
None, the tool makes use of available data	

Spatial data required	√ Data required depends on indicators selected
Quantitative data, please specify what data needed	√ Data required depends on indicators selected
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	
One week to one month	
Several months	√
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

The tool can be used to select indicators that will inform spatial planning and development, if relevant stakeholders and users are engaged early on in the process.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

The tool can be used to select indicators to inform decision-making in relation to environmental management, if relevant stakeholders and users are engaged early on in the process.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

The indicators defined could be suitable for use in exploratory scenarios.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	
Soil	

Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	
Climate	
Bioenergy	
Transport	
Spatial planning	
Conservation and Protected Areas	
All	√

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	√
In development (please specify which resources)	
None	
Other? Please specify	

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

Not for this tool, but for a comparable tool for biodiversity indicator development:

http://www.bipindicators.net/LinkClick.aspx?fileticket=dqFvm3SF%2bpo%3d&tabid=214

http://nbsapforum.net/#read-resource/828

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

As the Ecosystem Services Indicator Guidance is intended to guide the process of selecting the most appropriate indicator, it can be used together with a number of the other tools. For example, it can guide the choice of indicators in ToSIA, or the identified indicators can then be presented in Our Ecosystem. Equally, the indicators identified can feed into the Scenarios Tool. It would also potentially inform the selection of indicators in life cycle analyses.

Testing the tool: Results and progress

19. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

It was initially intended that the ecosystem services indicator guidance be tested in a number of exemplars. However, it will now be tested in the Wine exemplar, where it will be used as a first stage to define stakeholder needs and indicators before progressing on to use other tools/instruments. The intention is to build on an extensive literature review around wine, by engaging the research community in identifying key questions and then develop indicators which could inform sustainable wine production.

20. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

Testing is not yet completed.

21. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

As mentioned previously, despite interest from a number of tools, the guidance was not taken up. This is believed to be due to a lack of clarity on the purpose, structure and use of the guidance document, and on how it might draw on or feed into other tools.

22. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
Lack of clarity on actual aims and scope of guidance document	A number of exemplars are no longer using the tool, having previously committed to doing so. This is likely due to lack of understanding on the aims and scope of the tool.	On OPPLA the aims and scope will be explicit, as will potential for use with other tools, in order to help to guide potential users.

23. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as

scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

N/A

24. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fshow_product.jsp&_marketplace_WAR_OpplaGCMportlet_productId=4

wcmc.io/ESIguidance

Cost Benefit Analysis (iodine): Land-use typologies for strategic planning

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	
Ecosystem services meaning	
Ecosystem services assessment	
Ecosystem services mapping	
Ecosystem services valuation	x
Decision support	x
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	
NGOs	x
Local Authorities	x
Governmental bodies	x
Private sector	
Other? Please specify	

3. What are the main uses of the tool?

The main audiences are strategic thinkers and stakeholders; the tool might be used by land managers as a way of structuring information to present to these groups.

The previous application to the Public Forest Estate in the UK helped the Forestry Commission (FC) to justify the use of public funds to support its management strategy. Following a FC request, the flexibility of the tool enabled a rapid (within an hour) recalculation to update the latest carbon values

from the Department of Energy & Climate Change in the UK and to focus on year 2032 instead of 2070. The Independent Panel on Forestry drew on the results..

4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	
Subnational	√
National	√
Sub-continental	√
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	x
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

Not necessarily: although it can be used with spatially explicit information, that is not essential.

7. Is the assessment quantitative and/or qualitative?

Quantitative and monetary is the primary aim, though qualitative variables can also be used i

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	

Medium (Know about ES, but not GIS or modelling skills required)	
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	X low skill to use for analysis once typology and value transfer for specific area set up. Those initial steps require a good level of skill in ES and valuation, though not necessarily spatial modelling

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	Download guidance and example spreadsheets
GIS *(Y/N)*	Not needed but could be used 'upstream' of the tool to generate scenarios
Models *(Y/N, if yes, please specify)*	Optional. Need to like land uses to services and values, this can use models or literature/assumptions
Financial *(Free/cost in Euros X, please specify)*	Free
Other? Please specify	The tool is more a methodology than a functioning software – example spreadsheets and guiodance can be provided, but application to a new setting will require development of a land use typology and set of unit values

	via literature review and use of value transfer techniques

10. What type of data is required?

Type of data	Please tick where applicable (√)
None, data collection is part of the tool	
None, the tool makes use of available data	
Spatial data required	
Quantitative data, please specify what data needed	
Other? Please specify	To set up for any specific situation, data will be required on the ecosystem services associated with particular land uses and on the values associated (based on existing studies via literature review adjusted using data on human populations)

11. What time is needed for a new user to use the tool?

Implementation time	Please tick where applicable (√)
Less than one day	
Up to one week	
One week to one month	X for basic use of existing model
Several months	X for developing a new model
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

    The tool is designed for broad-scale exploration of land-use choices/scenarios. Spatial variables can be incorporated in the typology (e.g. proximity to human populations or watercourses) giving guidance on the kinds of areas where certain land uses are more valuable, but not on specific areas/locations. The tool could be used along with a GIS in order to assess location-specific land use changes.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

Yes, the tool seeks to evaluate scenarios for different land use strategies at a broad scale, see answer to 14.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

    Yes. The scenarios are different land-use / management strategies. For example, application to the UK public forest estate examined scenarios of different management and planting regimes that focused on timber production, enhancing public access, maximising biodiversity conservation. The Balearic exemplar looks at scenarios of reduced/maintained/increased conservation of seagrass beds. The circum-Med exemplar looks at scenarios of rainfed vs irrigated agriculture, and standard practices vs soil conservation practices .

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	X
Soil	X
Forest	X
Agriculture and rural development	X
Marine and coastal (including fisheries)	X
Climate	
Bioenergy	X
Transport	
Spatial planning	

Conservation and Protected Areas	X
All	

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	
In development (please specify which resources)	
None	
Other? Please specify	No formal training but happy to discuss with anyone interested in developing models of this sort

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

There is an existing example of this approach applied to UK forests, work on the OPERAs case studies is ongoing.

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Link to Knowledge: Economic valuation (Iodine): work on valuation is limited to desk study / value transfer methods.

Link to Knowledge: Trade-offs (Iodine): CBA is inherently a trade-off tool, here in the context of scenario comparisons .

Link to Instruments: Policy instruments (Marianne Kettunen, Paul Weaver): in the Balearic case, we are considering possible financial mechanisms for conservation, focused on tourism taxes/payments, and how CBA could inform and support these instruments. Paper is under preparation with aim of submitting late 2016 or early 2017.

Testing the tool: Results and progress

19. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Balearic Exemplar: we are producing a cost-benefit analysis of seagrass protection in the Balearic Islands. The scenarios include 'business as usual', a scenario of expanding the protected area, a scenario of weakening protection enforcement. Developing a fully spatial typology has not been feasible with the data/models available so CBA is being carried out using a typology of habitat types and values based on total supply/demand over the area. Spatial mapping is being used upstream of the tool to determine the seagrass areas in each scenario.

Circum-Med Exemplar: there was little enthusiasm in this exemplar for a CBA approach, and initially we thought it might be possible to carry out economic impact assessment instead, using environmentally-extended input-output tables drawing on the EXIOBASE project and outputs from the land-use modelling in the Circum-Med work. However this does not appear to be feasible (or at least, not with the skills and resources available). A typology-based CBA approach now planned, with limited coverage of ecosystem services. Again some impacts may be spatially explicit, others aggregated only, with the integration of the CBA approach with the outputs of land-use modelling to be resolved. Progress on this case study will be made in the final months of 2016. Scenarios to be assessed include

- Rainfed, normal use of soils
- Rainfed, soil conservation practices
- Irrigation, normal use of soils
- Irrigation, soil conservation practices

20. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

The testing is underway in the Balearic exemplar. It appears to be meeting the aims of providing an evaluation of the different scenarios and highlighting the potentially high external costs of failure to protect seagrass.

21. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

    The Balearic exemplar started later with Iodine stepping in to replace another partner, and work is proceeding well.

    The original ideas for application in Circum-Med exemplar were not feasible with the data, skills and resources available. A more straightforward CBA approach is under development. The Iodine researcher (Cindy Schoumacher) who was working on this has left the company and the work has been taken over by Rob Tinch, but this staff change has been a source of delay.

22. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
Lack of valuation data for some services	Both, and this will probably always be the case for models	Value transfer where possible. Sensitivity analysis (e.g. what would the missing value have to be to materially influence results?) Full explanation of assumptions and caveats in reporting results.
Lack of physical data/ knowledge of how scenarios influence some service provision	Both, and this will probably always be the case for models	Sensitivity analysis (e.g. what would the missing value have to be to materially influence results?) Full explanation of assumptions and caveats in reporting results

23. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

    The tool is probably best suited to initial analysis and scenario screening, identification of important uncertainties and gaps. More spatially explicit methods would probably be needed for specific decision support.

24. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

This is still under development and will be provided late 2016 / early 2017 along with the exemplar results.

LANDSCAPEization

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	√
Ecosystem services mapping	√
Ecosystem services valuation	
Decision support	√
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	
NGOs	
Local Authorities	
Governmental bodies	
Private sector	
Other? Please specify	

3. What are the main uses of the tool?

The LANDSCAPEization toolkit allows the visualization of and reporting on ES- and non-ES-related information in real-time over spatial scales. Embedded in a decision support system, the provided information supports the communication of land use changes and their impacts on ES. By allowing 3D visualizations of land use patterns in real-time, the toolkit allows the communication of changes in the landscape and thus supports tradeoff assessments between cultural ecosystem services and other ES. Additionally, besides interactive functionalities for

accessing ES- and non-ES-related information, the LANDSCAPEization toolkit also allows a participatory mapping and rating functionality for cultural ecosystem services and thus offers an innovative approach to support integral ES-informed decision-making across all ES categories.

4. At what geographic scale is the tool applicable?

Scale	**Please tick where applicable (√)**
Local	√
Subnational	
National	
Sub-continental	
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	**Please tick where applicable (√)**
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

Yes

7. Is the assessment quantitative and/or qualitative?

Quantitative

8. What level of technical knowledge is required?

Level Technical knowledge requirement	**Please tick where applicable (√)**
Low (General knowledge of ecology/natural resources)	

Medium (Know about ES, but not GIS or modelling skills required)	√
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	Web based
GIS *(Y/N)*	N
Models *(Y/N, if yes, please specify)*	N
Financial *(Free/cost in Euros X, please specify)*	Free
Other? Please specify	-

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	
None, the tool makes use of available data	
Spatial data required	√
Quantitative data, please specify what data needed	
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	Please tick where applicable (√)
Less than one day	√
Up to one week	√
One week to one month	√
Several months	
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

Yes, the toolkit allows the generation of highly realistic virtual landscapes linked to ES information. Impacts on ES of various land change scenarios can be visualized and communicated rapidly, thus supporting a qualified selection of land management/spatial planning strategies.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

Yes, see above. It can project the impact of both, spatial planning and land management scenarios.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

Basically, any kind of land change scenarios. The user has to provide, however, an input Spatial vector data set with land use attribute information under the different scenarios. So, it is only a visualization of different scenarios and does not simulate the different scenarios on its own. This has to be done beforehand with another tool.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	Please tick where applicable (√)
Air	
Water	
Soil	
Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	
Climate	
Bioenergy	

Transport	
Spatial planning	√
Conservation and Protected Areas	
All	

16. What training resources are available? *(Where appropriate, provide links to the resources)*

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	√
In development (please specify which resources)	√
None	
Other? Please specify	

16. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

    Not yet, but submitted to the special issue, Putting Ecosystem services into practice. Assessment tools and indicators for land management. In the journal Ecosystem Services

17. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Theoretically and potentially, our methods/results can be applied to all ES information and tools if they provide their outputs in a spatially explicit manner.

Testing the tool: Results and progress

18. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Swiss Alps Exemplar: We tested and applied potential modules of decision support systems in the Swiss Alps Exemplars. The focus on these application lies on receiving feedback for designing supportive collaborative web-platforms that allows improved visualization and communication workflows of ES information. Because of this basic research and experimental character in our

approach, we can provide single developed modules, technical descriptions or recommendations on how to visualize and communicate ES information.

In a first step we developed a demand analysis based on requirement engineering approach (Klein et al., 2015). By the results of the demand analysis we found out that the demands of ES community is very heterogeneous. The user needs vary among the purpose of applying ES information. Based on these different purposes of applying ES information demands differ between different representation types, display scales and level of details.

In a second step we conducted an eye-tracking study in a split sample design. Here we investigated how the user demands and behaviors differ between ES information users with and without connection to case study region and how this characteristic influence the cognitive process and therefore decision-making process (Klein et al., 2015b).

All this information was used in the setup of the LANDSCAPEization toolkit. http://www.landscapeization.ethz.ch/

19. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

It has not yet been tested in an exemplar, it is still in its prototype phase.

20. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

3D library of objects is a computational challenge and slows down the real-time visualization, the representation of realistic developments in a spatially valid way is very difficult to obtain in a generic way

21. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?

⇨ Not yet possible to fill in the table as no experiences of testing the tool exist

22. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

⇨ Not yet possible to answer

23. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

(see two attached documents)

mulino Decision Support System tool (mDSS)

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	√
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	
Ecosystem services mapping	
Ecosystem services valuation	
Decision support	√
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	√
Local Authorities	√
Governmental bodies	√
Private sector	√
Other? Please specify	

3. What are the main uses of the tool?

It can help decision makers to:

- Develop a shared model of the problem at hand with the involved actors (disciplinary experts, policy/decision makers, other stakeholders).
- Integrate modelling outputs in the decision making process.
- Explore possible decision options, also within the contexts of alternative scenarios.

- Contribute to solving conflicts related to different visions and interests around alternative courses of action.

.

4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	√
Subnational	√
National	√
Sub-continental	√
Continental	√
Global	√

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

The desktop version can supply spatially-explicit information.

7. Is the assessment quantitative and/or qualitative?

Only quantitative assessment.

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	

Medium (Know about ES, but not GIS or modelling skills required)	√
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	The web based version needs MS Silverlight plug-in;
GIS *(Y/N)*	No for the web based version; Yes for the spatial part of the desktop version;
Models *(Y/N, if yes, please specify)*	No
Financial *(Free/cost in Euros X, please specify)*	Free
Other? Please specify	

10. Whattype of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	
None, the tool makes use of available data	
Spatial data required	
Quantitative data, please specify what data needed	√ - it is an indicator based instrument
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	Please tick where applicable (√)
Lessthan one day	
Up to one week	√
One week to one month	
Severalmonths	
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.
The desktop version can supply spatially-explicit information that can be used for guidance on decision making in relation to spatial planning/development

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.
The mDSS instrument can be used to rank management plans from various stakeholders points of view

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?
Yes. The instrument is built to work in various scenarios. The desktop version can deal with spatial and non-spatial scenarios and the web version can deal only with non-spatial scenarios.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	Please tick where applicable (√)
Air	
Water	
Soil	
Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	
Climate	
Bioenergy	
Transport	
Spatial planning	

Conservation and Protected Areas	
All	√

16. What training resources are available?*(Where appropriate, provide links to the resources)*

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	√
In development (please specify which resources)	
None	
Other? Please specify	

16. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies
    OPERAs: Traversing waters : Recognizing Wetland Ecosystems Value in the Lower Danube (Persina case study - http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fview_casestudy.jsp&_marketplace_WAR_OpplaGCMportlet_casestudyId=133)

17. If your tool can be combined with another OPERAs tool, please specify and shortly explain how.
    The mDSS instrument is an indicator based DSS. It can be combined with any OPERAs instrument that has indicators as outputs.

Testing the tool: Results and progress

18. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

mDSS was used in the OPERAs: Traversing waters : Recognizing Wetland Ecosystems Value in the Lower Danube (Persina case study - WWF Bulgaria) http://oppla.eu/marketplace?p_p_id=marketplace_WAR_OpplaGCMportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_count=1&_marketplace_WAR_OpplaGCMportlet_mvcPath=%2Fhtml%2Fmarketplace%2Fview_casestudy.jsp&_marketplace_WAR_OpplaGCMportlet_casestudyId=133

19. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?
    The main research question was how different group of stakeholders perceive various types of management options for a wetland in a nature park, based on their ES/landscape preferences. Different groups of stakeholders have been involved: protected area managers, farmers, environmental inspectorate, municipality. We explored 7 scenarios of change in the Kaikusha marsh wetland ecosystem in the next 10 years based on various reed vegetation management measure options. Initial results:
    1) Business as usual (BAU) is one of the worst option in all cases;
    2) Distinct opinions between the groups of stakeholders;
    3) Clusterisation of the results ;
    We found that demand was also tied with the perception of potential subsidies under EU CAP policy direct payments, as we were asked during interviews whether ecosystem services could be "compensated" as actual payment in some way.

20. What is the expected timeline for testing the tool if not already completed?
    What has caused the delay?

21. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
The interface between the software instrument and stakeholders		By creating intermediate facilitations Improving stakeholder surveys and asking clarifying questions that take into account stakeholder group
	Making stakeholders consider values from their own perspective, rather that thinking on behalf of protected area management	Improving stakeholder surveys and asking clarifying questions that take into account stakeholder group
	Uncertainty in outcome indicators when designing management options	Creating probability range-based outcome indicators for specific management options

22. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as

scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.
To be correct applied the instrument needs facilitators to help the linkage between the software and stakeholders, to correct translate the stakeholders views as inputs in the software

23. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.
http://www.netsymod.eu/DSSUserGuide.html

No Net Loss and offsets

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	√
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	√
Ecosystem services mapping	
Ecosystem services valuation	
Decision support	√
Implementation support	√
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	
NGOs	√
Local Authorities	√
Governmental bodies	√
Private sector	√
Other? Please specify	

3. What are the main uses of the tool?

Biodiversity offsets are one solution to managing the impacts of human activities on biodiversity and ecosystem services. They are designed to address the residual impacts from management decisions, (i.e. those impacts that couldn't be avoided or minimized through better decisions) by carrying out restoration or conservation activities in another location, that benefits the same biodiversity and ecosystem services as will be (or was) impacted. There is a growing requirement for developers to achieve "no net loss" of biodiversity and ecosystem services through appropriate

use of offsets. It's the case, for example in the context of housing or infrastructure projects in several EU countries.

As such, offsets cannot easily be implemented independently of avoidance and minimization, and together they form a mitigation "hierarchy" for addressing impacts on biodiversity and ecosystem services. In addition, they require data on the state and trends of biodiversity and ecosystem services at various spatial and temporal scales, as relevant to the project being considered. For sub-national rather than local plans and policies, the mitigation hierarchy and offsets can be incorporated into strategic environmental assessment and cost-benefit analyses.

4. At what geographic scale is the tool applicable?

Scale	**Please tick where applicable (√)**
Local	√
Subnational	√
National	
Sub-continental	
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	**Please tick where applicable (√)**
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	√
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

   It could if necessary, but it can be used with non-spatial and aggregate data.

7. Is the assessment quantitative and/or qualitative?

   Quantitative or semi-quantitative.

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	
Medium (Know about ES, but not GIS or modelling skills required)	√
High (good experience of ES, skills in GIS and modelling)	√
Other? Please specify	

9. What resources are required to use the tool?

Resources	Please choose appropriate answer
Internet requirement *(web based/ Download Pdf/none*)	Guidance available on-line
GIS *(Y/N)*	Y, to prepare input data
Models *(Y/N, if yes, please specify)*	
Financial *(Free/cost in Euros X, please specify)*	The model can be used and adapted freely, but tailored services are available from consulting firms and research institutions
Other? Please specify	

10. What type of data is required?

Type of data	Please tick where applicable (√)
None, data collection is part of the tool	

None, the tool makes use of available data	√
Spatial data required	√
Quantitative data, please specify what data needed	Occurrence of species, habitat quality, ecosystem service provision levels etc.
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	√
One week to one month	√
Several months	
More than one year	√
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

    The tool is specifically designed to guide decision-making in relation to spatial planning / development, and is suitable for Environmental Impact Assessment and Strategic Environmental Assessment frameworks.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

    The tool can be used to determine the net biodiversity and ecosystem service outcome of alternative management plans for a given area. It has been used in the context of forestry and agriculture (plantations).

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

    The tool can be used to compare and rank scenarios, and this is one of its main uses in the context of “alternatives analysis” for developers seeking environmental permits for their projects.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	Please tick where applicable (√)
Air	
Water	
Soil	
Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	√
Climate	
Bioenergy	√
Transport	√
Spatial planning	√
Conservation and Protected Areas	√
All	

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	Please tick where applicable (√)
Face-to-face training course	
Online course	
Webinar	
Guidance document/manual	
In development (please specify which resources)	Guidance
None	
Other? Please specify	

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

    The Business and Biodiversity Offsets Programme (BBOP) offers guidance and case studies. See here: http://bbop.forest-trends.org

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

The tool is linked to the identification, mapping and assessment of biodiversity ES, which provides input to the tool, and to MCDA and CBA, which offer a framework for using tool outputs to guide actual decision-making on land-use. The tool represents an improvement on current practice in environmental impact assessment and spatial planning but remains tied to existing practices to ensure it remains operational.

Testing the tool: Results and progress

24. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

The tool has been tested in the Alps exemplar. Various offsetting approaches were applied to modelled land-use changes, and the resulting levels of ES provision. Proxies were developed to serve as metrics for assessing 'no net loss". These combine land-use and land-cover data. Conclusions show that aggregated and strategically located offsets provide more efficient biodiversity outcomes. Various publications are in press and in preparation to share results.

The tool has been an important part of the European Exemplar, in a context where the European Commission (DG Environment) has been developing a "no net loss initiative". Several analyses were conducted in the context of OPERAs and services contracts with the Commission.

The tool is also tested in other case studies not included in OPERAs exemplars.

25. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

The tool has proved its worth technically, but remains to be presented and discussed with stakeholders.

26. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

Not applicable.

27. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	**Exemplars encountering issues**	**How have these been addressed in the tool?**
Access to relevant field data on ES and biodiversity	Alps Europe Others	Focus on modelling Use proxy indicators Limit / define scope of NNL objectives

Capacity of stakeholders and practitioners to grasp concepts and methods	Alps Europe Others	Improve guidance

28. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

A key lesson is that data alone isn't enough, and interpretative guidelines is required for it to make sense and feed into decision-making processes. Science can provide some of that, but stakeholder engagement can be very important to ensure ecosystem services reflect actual priorities, and are assessed in ways that are acceptable to decision makers.

29. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

There is no link as such. Publications are being prepared.

Streamline

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	V
Ecosystem services meaning	
Ecosystem services assessment	
Ecosystem services mapping	
Ecosystem services valuation	V
Decision support	
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	V
NGOs	V
Local Authorities	V
Governmental bodies	V
Private sector	
Other? Please specify	

3. What are the main uses of the tool?

Visually stimulating materials help to engage participants, enhance creativity and 'out of the box'-thinking. Images may overcome language barriers in a workshop, make concepts more explicit, and stimulate associations that widen the scope of the discussion. The format can be used with a variety of stakeholders in semi-structured interviews, or in group settings like workshops or focus groups.

4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	√
Subnational	√
National	√
Sub-continental	
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	V
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?
   No, but could be expanded or combined with other tools.

7. Is the assessment quantitative and/or qualitative?
   Qualitative

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	V
Medium (Know about ES, but not GIS or modelling skills required)	
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	V
GIS *(Y/N)*	
Models *(Y/N, if yes, please specify)*	
Financial *(Free/cost in Euros X, please specify)*	Free
Other? Please specify	

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	V
None, the tool makes use of available data	
Spatial data required	
Quantitative data, please specify what data needed	
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	
One week to one month	V
Several months	√

More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.
    N/A

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.
    N/A

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?
    Yes, normative and/or narrative scenarios

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	
Soil	
Forest	
Agriculture and rural development	
Marine and coastal (including fisheries)	
Climate	
Bioenergy	
Transport	
Spatial planning	
Conservation and Protected Areas	
All	V

16. What training resources are available? *(Where appropriate, provide links to the resources)*

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	

Guidance document/manual	
In development (please specify which resources)	V - User Guide
None	
Other? Please specify	

16. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies
    Examples can be found at: www.streamline-research.com

17. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

The tool will be developed considering the knowledge generated under the social-cultural valuation task, and concepts developed in the TESSA tool.

Testing the tool: Results and progress

18. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

For now it is being tested in the Scottish exemplar, linked to Anja Liski's work on coastal realignment. The tool will be used to triangulate her findings from the choice experiments and deliberative mapping, and provide a deeper understanding of social and cultural ecosystem benefits provided by the Inner Forth, and the potential impacts of coastal realignment on the local communities. Finally the tool will be used to explore avenues of cooperation on coastal realignment projects between the local community, NGOs and decision makers that could maximise the delivery of social and cultural benefits. We are also working on an urban case study to assess the cultural ecosystem services of green space in deprived neighbourhoods in Edinburgh.

19. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

    Testing is still under way. Early results are promising, we've had very positive feedback from our participants, and a lot of interest from non-academic organisations looking to use STREAMLINE in future projects. Early feedback also suggests adopting the tool for use in workshops or group interviews has great potential.

20. What is the expected timeline for testing the tool if not already completed?
    What has caused the delay?

    Testing will be completed near the end of the OPERAs project.

21. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

N/A Too early

22. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

    N/A

23. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

www.streamline-research.com

Toolkit for Ecosystem Services Site-Based Assessment (TESSA)

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	√
Ecosystem services mapping	√
Ecosystem services valuation	√
Decision support	√
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	√
Local Authorities	√
Governmental bodies	√
Private sector	
Other? Please specify	

3. What are the main uses of the tool?

It has been specifically developed to address the needs of conservation practitioners, such as land managers, on the ground. The tool is also useful for: NGOs, site managers, developers / planners, conservationists / lobbyists, coordinators of site networks, and site stakeholders.

It can help decision-makers appreciate the true value of nature, and the consequences of loss and degradation of natural habitats. The information provided can also guide practitioners on whether more detailed studies of ecosystem services would be useful.

4. At what geographic scale is the tool applicable?

Scale	Please tick where applicable (√)
Local	√
Subnational	√
National	
Sub-continental	
Continental	
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	Please tick where applicable (√)
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?
   Certain methods included in the toolkit output spatially explicit results.

7. Is the assessment quantitative and/or qualitative?
   Primarily quantitative; some more qualitative methods are included (e.g. relating to CES).

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	√

Medium (Know about ES, but not GIS or modelling skills required)	
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	Download PDF
GIS *(Y/N)*	N
Models *(Y/N, if yes, please specify)*	N
Financial *(Free/cost in Euros X, please specify)*	Free to obtain the Toolkit, but implementing will require resources.
Other? Please specify	

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	√
None, the tool makes use of available data	√
Spatial data required	
Quantitative data, please specify what data needed	
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	Please tick where applicable (√)
Less than one day	
Up to one week	
One week to one month	
Several months	√
More than one year	
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

The tool will provide information on the ecosystem services provided by a site in its current state, as well as in a potential 'alternative state' (e.g. after development or conversion to agriculture) to allow decision-makers to compare the ecosystem values of the two states and make an informed decision.

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

The tool will provide information on the ecosystem services provided by a site in its current state, as well as in a potential 'alternative state' (e.g. after restoration or conversion to agriculture) to allow decision-makers to compare the ecosystem values of the two states and make an informed decision.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?

Scenarios could be used to determine the 'alternative state' of the site, in order to compare the results of the tool for each state.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	Please tick where applicable (√)
Air	
Water	√
Soil	
Forest	√
Agriculture and rural development	√
Marine and coastal (including fisheries)	**(√) forthcoming**

Climate	√
Bioenergy	
Transport	
Spatial planning	√
Conservation and Protected Areas	√
All	

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	**Please tick where applicable (√)**
Face-to-face training course	
Online course	
Webinar	√
Guidance document/manual	√
In development (please specify which resources)	
None	
Other? Please specify	Face-to face training courses are arranged according to demand

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

Yes

http://www.birdlife.org/assessing-ecosystem-services-tessa/case-studies

http://www.birdlife.org/worldwide/science/tessa-publications

http://tessa.tools/

http://www.niney.org/showcase/rain/downloads/TESSAToolkit-V1_1-20130927.pdf

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Global exemplar (Peru): ToSIA could be used but not until next year.

Dublin exemplar: Use knowledge developed in WP3 by Craig Bullock to influence the strategy and methods tested in this exemplar. No other tools developed in OPERAs are being used.

Scotland exemplar: Are using TESSA and Streamline to triangulate their findings

Montado: Besides the comparative approach between TESSA and InVEST, they started to apply ToSIA to compare the results with the other instruments. However this is difficult due to the characteristics of the model system (multifunctionality) and next steps are still being decided.

Other tools, instruments and knowledge are also included in their research, namely stakeholders' workshops and analysis of preferences and economic valuation using on-line and face-to-face surveys.

Testing the tool: Results and progress

19. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Global exemplar (Peru): In Peru, several emerging regional initiatives are aiming for a better understanding and management of ecosystem services. In the Apurimac region, the regional environment commission (part of the regional government) and a commission on ecosystem services and biodiversity (composed of representatives of regional government, national ministries, NGOs, private sector and local communities) have shown an interest in assessing and mapping ecosystem services. CIFOR, have thus started to work with them on these topics and using TESSA to assess key ecosystem services in this area.

Dublin exemplar: The goal to use TESSA is to assess the cultural ecosystem services in the urban coastal setting of Fingal (Ireland). The exemplars overall aim is to improve the incorporation of ecosystem services in the consultation process of the Planning Departments. In this exemplar they focus to test the Cultural ecosystem services module of TESSA and they have so far undertaken two parts of three in this process. They have undertaken two workshops where they used the stakeholders from the Fingal area to identify the ecosystem services they value and as a second activity they asked them to map these using the methods described in TESSA. A last workshop is planned for spring next year where they aim to apply the last part of TESSA which is to compare the current site with an alternative site and score to illustrate the benefits and disadvantages between the different states.

Scotland exemplar: The goal to use TESSA is to assess cultural ecosystem services in the Inner Forth (Scotland) area, and particular in relation to potential coastal realignment work . By using TESSA, the decision to do the realignment work or not will be aided, as this tool will demonstrate the pro and cons in regards to the cultural ecosystem services of the sites.

Montado: The goal with using TESSA was to define different land use scenarios to compare with the current land use baseline at the selected farmstead, and quantify and map ecosystem services. Another aim was to compare the results with another free-supporting tool: InVEST.

The montado is a unique agro-forestry ecosystem with high ecological and socio-economic relevance, generating a range of provisioning (e.g. cork, wood, charcoal, honey, wild mushrooms, livestock fodder), regulation and maintenance (e.g., climate regulation) and cultural (e.g., nature-based recreation) ecosystem services (ES). Its preservation is highly dependent on management

done at the farmstead level. In this context, the largest montado farmstead in Portugal was chosen as the study area to assess and map ecosystem services at a site-scale and evaluate the impacts of management options on ES provided.

20. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

For all exemplars, the overall aims were achieved.

In the Peru exemplar, the users succeeded in identifying the most important CES in the study areas, describing the uses of the CES, identifying direct and indirect beneficiaries, and mapping CES supply and uses where possible.

In the Scotland exemplar, the tool allowed the users to understand what ES citizens think are important and would like to see improved. They identified priority sites where ES benefits should be improved. Results produced a rich dataset for creating CES maps, which is useful for assessing impacts of other 'alternative states' (not just salt marsh). The tool provided deliberative exercises during which people demonstrated a deep consideration of values held for the natural environment, and learned about the coastal ecosystem services it provides.

In the Fingal exemplar, stakeholders were able to articulate the tangible and less tangible values for ES – but found it difficult to cognitively construct them. The participatory mapping exercise identified locations of CES at the landscape level and clusters of CES also emerged. The overall process identified new knowledge from stakeholders about their socio-ecological relationship which is important for decision-makers. However, the tool did not help identify potential conflicts regarding specific types of values, and in particular the scoring exercise did not prompt stakeholders to reflect on trade-offs in ES, which had previously been hoped for.

21. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

Testing the tool is completed; however, all the exemplars are still in the process of communicating the results back to local decision-makers and planners, and feedback from this will inform the very important section on 'communication' in the module.

22. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	**Exemplars encountering issues**	**How have these been addressed in the tool?**
Text and Terminology would benefit from in some sections being clearer, shorter and more consistent.	Peru, Scotland, Ireland	The whole module have been re-edited to: condense the text for the introduction section; consistency in terminology and explanations where

		needed; text has also been edited throughout to ensure clarity, particularly around issues highlighted to be difficult such as methods and alternative state.
Clarifying the overlap between the recreation services in the CES module and the module on 'Nature-based recreation'	Peru	Further clarification of the overlap has been added to the first page of the module and extra links to the other module have been incorporated where needed.
Differentiating between benefits on an individual, family or community level (what people perceive vs what they are comfortable discussing) – effects design of methods, e.g. prompts used.	Ireland	Text has been added to clarify this.
Include 'helpers' as a resource to support workshop participants e.g. elderly/women with children	Scotland	Suggestion has been added as an example.
Free listing: Challenge capturing less tangible benefits – suggest listing natural features and then describing why do they matter?	Scotland	Suggestion has been added as an example
Visioning did not really link the exercise back to ES	Scotland	The method and table template has been updated to address this gap/
Term 'alternative state' is confusing for participants	Ireland	Further clarification and editing in addition to referencing the toolkit introduction.

23. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as

scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

- This tool works best when stakeholders are familiar with the site in question and can relate closely to it.
- Tool seem to work well in a spatial planning context, with good positive feedback from Local authorities that received information from the assessment.
- Workshops might need more then 2h sessions if want to complete several of the activities. Estimates about 1 hour for each activity (Free listing, mapping and scoring) but might need to have a break if doing all three activities in one workshop.
- If spreading the activities between different session, try to get everything done in two workshops, as the third workshop resulted in much fewer stakeholders participating.

Fingal :

I would tell them that the module provides some good alternative methods and describes how to use the methods and where they may/may not be appropriate. I would say it is somewhat time consuming and the outputs demonstrate the importance of CES within a given area, at one point in time – and as such can provide baseline information. The process itself provides the opportunity for participants to consider the benefits and values that they associate with the place and helps them to reflect on what they prefer and want from CES. I would tell them to use it if they wanted more/deeper insights into what is also important to people connected with the study area – they would also get some sense of what the people want for the future and insights into any management deficits that are falling short of delivering on the current preferences/demands of stakeholders.

If you were to help another person decide which methods to use in the CES Module, how would you go about doing so?

I would ask them to think about what kind of outputs they wanted, where the information might be used, who might use it, who are they trying to influence or what/who are they trying to advocate for (nature, people or policy).

Peru

Should always start with a method to identify CES, better then providing them with a list or trying to explain ES. That’s up to researcher/ assessor to do.

Scotland

I would recommend it to anyone considering including CES in their ES assessment.

24. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

http://tessa.tools/

Tool for Sustainability Impact Assessment (ToSIA)

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	Please tick where applicable (√)
Problem formulation	√
Stakeholder engagement	√
Ecosystem services meaning	
Ecosystem services assessment	√
Ecosystem services mapping	
Ecosystem services valuation	√ **(MCA component)**
Decision support	√
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	Please tick where applicable (√)
Academics	√
NGOs	√
Local Authorities	√ **(results)**
Governmental bodies	√ **(results)**
Private sector	√
Other? Please specify	

3. What are the main uses of the tool?

ToSIA provides a quantified, balanced knowledge-based framework to undertake a SIA (Sustainability Impact Assessment) of alternative management decisions. It enables very different aspects of natural resource management, processing and manufacturing and consumption of products to be linked together in a logical and transparent way. ToSIA compares alternative process chains and changes between a status quo and an alternative. Impacts are assessed by calculating

changes in material fows and indicators of environmental, economic and social sustainability within each value chain.

The analyses can support decision-making processes or explore compromises involving different stakeholders with conflicting views on the sustainability of a nature-based value chain. Studies can range from detailed 'real' company applications to a more generic, aggregated level. The amount of detail can be independently chosen according to the requirements of the user.

4. At what geographic scale is the tool applicable?

Scale	**Please tick where applicable (√)**
Local	√
Subnational	√
National	√
Sub-continental	√
Continental	√
Global	

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	**Please tick where applicable (√)**
Yes, it can be used/replicated anywhere	√
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	√
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

Non spatial at core, possibility to display results on maps, but no automatic add-in

7. Is the assessment quantitative and/or qualitative?
   The assessment is quantitive (material flows and indicator values). Qualitative aspects can be included through specific indicators that quantify values within a range (e.g. done for Aethetics as a poin tysstem)

8. What level of technical knowledge is required?

Level Technical knowledge requirement	Please tick where applicable (√)
Low (General knowledge of ecology/natural resources)	
Medium (Know about ES, but not GIS or modelling skills required)	√
High (good experience of ES, skills in GIS and modelling)	√
Other? Please specify	

9. What resources are required to use the tool?

Resources	Please choose appropriate answer
Internet requirement *(web based/ Download Pdf/none*)	√
GIS *(Y/N)*	
Models *(Y/N, if yes, please specify)*	
Financial *(Free/cost in Euros X, please specify)*	EUR 300/ year
Other? Please specify	Java

10. What type of data is required?

Type of data	Please tick where applicable (√)
None, data collection is part of the tool	
None, the tool makes use of available data	
Spatial data required	

Quantitative data, please specify what data needed	√ (value chain specific knowledge, indicator values, material flow data). ToSIA is entirely data-driven
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	√
One week to one month	√
Several months	√
More than one year	√
Not applicable	

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

    no

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

    yes. It quantifies impacts of management decisions, policy/technology/market/natural changes for specified value chains. On top o fthe SIA, an MCA and a CBA analysis tool is available.

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?
    yes. User-defined scenarios. ToISA does comparative (ex-ante or ex-post) assessment of scenarios based on management decisions, policy/technology/market/natural changes for specified value chains.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	
Soil	

Forest	√
Agriculture and rural development	√
Marine and coastal (including fisheries)	
Climate	
Bioenergy	√
Transport	√
Spatial planning	
Conservation and Protected Areas	
All	

16. What training resources are available? *(Where appropriate, provide links to the resources)*

Training resources	**Please tick where applicable (√)**
Face-to-face training course	√
Online course	√
Webinar	
Guidance document/manual	√
In development (please specify which resources)	
None	
Other? Please specify	

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

    outside OPERAS: http://tosia.efi.int/forest-wood-chains.html
    inside OPERAS: Wine, Montado, Peru (Global) Exemplar

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Scenario tool: for developing storylines for baseline case and scenarios in stakeholder cooperation. Will be tested in Wine case; possibly also in Montado (cork) case

OE: development of map-based indicators, such as risk for land slides or risk for deforestation, in Which OE will work both as a source for calculating indicator values, as well as for displaying impact results from ToSIA. Global exemplar; Peru

MCA: ToSIA has already a MCA-tool connected in a single user mode. This MCA tool will be improved. Wine exemplar, Montado Exemplar

LCA: link of combining LCA perspectives as specific indicators into ToSIA framework; Wine exemplar

Testing the tool: Results and progress

23. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Peru / Global exemplar: case study in Peru, region of Alto Maya National Parc. Solutions and scenario analysis for impacts of migration and different agroforestry systems in areas neighbouring national park.

Cork exemplar: Impacts of management decisions and market demands on cork production in Portugal. Goal to show effects of management changes and develop system for improved environmental reporting.

Wine exemplar: Impacts of management changes to enclude ecolabelling, certification and/or organic production, both at producer and at retailer/consumer side. Develop system for improved environmental reporting and marketing, as well as Ecolabel Review and Rating system.

24. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

work in progress. First results for Cork case.

25. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

    Data availablity and stakeholder engagement has delayed the work.

26. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
no interest from English wine stakeholders and with that no scenario formulation or indicator selection	wine	change of stakeholder group and assessment are to Portugal

suitable, quantifyable indicators for assessing ES/NC and integration into ToSIA	Peru, wine, cork	ecolabel review (wine / cork) paper on ES indicators (under construction) cooperation with producers, NGO and local authorities to understand need for ES management information to turn into indicators

27. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

    Intimate knowledge on the topic is crucial to define value chains and populate them with data, or – alternatively – interested and willing stakeholder or experts to help with providing that knowledge.

28. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

link to tool access: http://tosia.efi.int/tmug.html, demo version: http://tosia.efi.int/installation.html, documentation: http://tosia.efi.int/material.html

Wine Ecosystem Life Cycle Assessment-based tool - Phase I & II

Information/Use of the tool

1. What is the purpose of the tool?

Purpose	**Please tick where applicable (√)**
Problem formulation	
Stakeholder engagement	x
Ecosystem services meaning	
Ecosystem services assessment	x
Ecosystem services mapping	
Ecosystem services valuation	
Decision support	x
Implementation support	
Other? Please specify	

2. Who is the intended user of the tool?

User	**Please tick where applicable (√)**
Academics	
NGOs	
Local Authorities	
Governmental bodies	
Private sector	V
Other? Please specify	

3. What are the main uses of the tool?

The WeLCa consists of 2 phases:

Phase I:

Qualitative assessment

Phase II :

Life Cycle-based quantification of the impacts on biodiversity of wine production

The WeLCA tool could contribute to

- Awareness raising of the concept of ecosystem services and biodiversity
- Improved visibility of the natural capital aspect in a non-academic context
- Continuous improvement by identifying environmental hotspots through wine's life cycle
- Improving decision-making in the industry
- Strengthening reputation through open communication and public engagement and increasing recognition in the sector
- Substantiating environmental marketing claims by basing them on hard data
- Entering new markets by meeting rapidly changing customer needs
- Consumers making an informed choice between products, based on their environmental performance

4. At what geographic scale is the tool applicable?

Scale	**Please tick where applicable (√)**
Local	√
Subnational	
National	
Sub-continental	
Continental	V
Global	V

5. Can the tool be used/replicated in any geographic location (e.g. town, region, watershed)?

Opportunity for use/replication	**Please tick where applicable (√)**
Yes, it can be used/replicated anywhere	
Yes, but significant data/work is needed to replicate the tool for another location (e.g. build new models)	V
No, it can only be used in a specific geographic location	

6. Does it provide spatially-explicit information?

No.

7. Is the assessment quantitative and/or qualitative?

Both, depends on the phases

8. What level of technical knowledge is required?

Level Technical knowledge requirement	**Please tick where applicable (√)**
Low (General knowledge of ecology/natural resources)	Phase 1
Medium (Know about ES, but not GIS or modelling skills required)	Phase 2
High (good experience of ES, skills in GIS and modelling)	
Other? Please specify	

9. What resources are required to use the tool?

Resources	**Please choose appropriate answer**
Internet requirement *(web based/ Download Pdf/none*)	Excel based tool
GIS *(Y/N)*	
Models *(Y/N, if yes, please specify)*	
Financial *(Free/cost in Euros X, please specify)*	Free for the version developed within OPERAs
Other? Please specify	

10. What type of data is required?

Type of data	**Please tick where applicable (√)**
None, data collection is part of the tool	

None, the tool makes use of available data	
Spatial data required	
Quantitative data, please specify what data needed	Phase I requires basic information on soil quality and crop health indicators and a selection of currently applied management practices. Phase II requires detailed information on land occupation, production, use of energy and resources.
Other? Please specify	

11. What time is needed for a new user to use the tool?

Implementation time	**Please tick where applicable (√)**
Less than one day	
Up to one week	
One week to one month	V
Several months	
More than one year	
Not applicable	

Phase I is targeted at novice users, which are not familiar with the concept of ecosystem services. Phase II is targeted at advanced users, requiring a comprehensive assessment of their environmental impact.

12. Will the tool provide information/guidance on decision-making in relation to spatial planning/development? If so, please provide some further details.

no

13. Will the tool provide information/guidance on decision-making in relation to environmental management? If so, please provide some further details.

WeLCA contributes to:

- Continuous improvement by identifying environmental hotspots through wine's life cycle
- Improving decision-making in the industry by choice guidance of management practices and promotion of best practices in the supply chain
- Strengthening reputation through open communication and public engagement and increasing recognition in the sector
- Substantiating environmental marketing claims by basing them on hard data
- Consumers making an informed choice between products, based on their environmental performance

14. Is the tool appropriate for scenario analysis? If so, for which kind of scenarios?
Scenarios could be developed based on input data variations. No in-built scenarios are available.

15. For which policy sector is the tool designed? (please tick as appropriate)

Policy sector	**Please tick where applicable (√)**
Air	
Water	
Soil	
Forest	
Agriculture and rural development	V (vineyards & wine supply chain)
Marine and coastal (including fisheries)	
Climate	
Bioenergy	
Transport	
Spatial planning	
Conservation and Protected Areas	
All	

16. What training resources are available? (Where appropriate, provide links to the resources)

Training resources	**Please tick where applicable (√)**
Face-to-face training course	V (fee)
Online course	
Webinar	
Guidance document/manual	V

In development (please specify which resources)	
None	
Other? Please specify	

17. Are there any published or documented examples of the tool in practice (inside and outside OPERAs)? Please provide links to case studies

Nope, the tool has been developed within OPERAs and especially for the stakeholders of the project.

18. If your tool can be combined with another OPERAs tool, please specify and shortly explain how

Scenario tool: for developing storylines for baseline case and scenarios in stakeholder cooperation

Testing the tool: Results and progress

19. Which exemplars are testing the tool? Please provide a brief description (one paragraph) of how the tool is being used in each exemplar.

Wine exemplar: The goal is to show effects of management practices change on selected ecosystem services. Evaluate the potential outcome of these changes and communicate externally through the use of self-declared ecolabels. This will serve as a basis to develop a system for improved environmental reporting and marketing. Possible plan: test ecolabels via a survey with selected retailers.

The tool has been developed based on the input from the Userboard of OPERAs. Userboard expressed the need to better understand the concept of ecosystem services and to quantify and manage the impact of business on the ecosystem services. A particular interest in life-cycle based decision-support tool to quantify the impacts on ecosystem services & biodiversity has been identified.

Based on the feedback from various stakeholders (experts in biodiversity, wine makers, grape growers in UK, Portugal, Bulgaria, retailers) we designed WeLCA tool in a way that it covers all the objectives: to operationalize the ecosystems concept, to be informative, to be decision-support and LCA-oriented.

Currently the draft tool is being tested by wine makers, scientists in the field on natural capital.

We plan by the end of the OPERAs project in 2017, to have more test users. The coming Userboard meeting in the end of 2016 represents an opportunity for further testing.

The main difficulties with WeLCA testing in a business context are related to the expected low priority of our project/topic to companies and lack of dedicated time and resources for tools testing in an external project for companies, as OPERAs happens to be.

Label communication and testing will be limited to recommendations. The development of an EPD/label scheme seems to be rather ambitious and too early in time. However, we could

recommend changes to the existing labels assessed via a ranking system based on our research and recent developments in the LCA community.

20. Please provide an overview of testing the tool with the exemplars, did it meet the aims of the assessment for all the exemplars it was tested?

Overview feedback from stakeholders testing:

User friendliness 4 out of 5
Clear and easy to use
Traffic light system is easy to understand
Tremendous amount of work put into developing
Fantastic tool

21. What is the expected timeline for testing the tool if not already completed? What has caused the delay?

Delay - delayed stakeholder engagement process; insufficient stakeholder interactions; OPERAs is a low priority for most external stakeholders.

We expect to continue testing by the end of OPERAs with business (no harvest in winter, maybe more time for feedback) & Userboard

22. For any challenges and issues identified during the testing of the tool in one or more exemplars, please outline how this feedback has been addressed using the table below:

Challenges/issues identified during testing of tool	Exemplars encountering issues	How have these been addressed in the tool?
Insufficient Guidance on data sources, how the tool works, terms, etc.	Wine exemplar	In progress: adding explanatory notes and finalizing the guidance
User friendliness: Make cells that have to be filled in by the user in a different colour	Wine exemplar	Change colour
Provide reference values or range of fluctuation	Wine exemplar	In progress - collect literature data, raw data if possible.
Include short recommendations based on results	Wine exemplar	The tool is designed to support decisions. Recommendations would depend very much on the

		input data, context (retailer, farmer, location), resources (knowledge, finance, time).
Simplify language	Wine exemplar	Explanations added

23. Based on the experiences in the exemplars, what lessons have been learned from the testing of your tool that could help guide future potential users in deciding if this is the appropriate tool or not (e.g. time, resources, skills required; situations/contexts [such as scale/stakeholders etc.] in which the tool works better than others etc.)? Please provide as much detail as possible.

Phase I – beginners

This phase is applicable for the farmers or grape growers – the first stage of wine production.

The advantages of the tool are that it is simple, user-friendly for both experienced and inexperienced users and requires only data that is readily available

Phase II – intermediate users

This phase of the tool is applicable for a wider range of users. It can be used by grape growers – for assessment of the impacts on vineyard level, wine producer for assessment of impacts on both vineyard and winery level. It could be possibly used by retailers for decision making based on the impact of different suppliers.

It has higher data needs compared to Phase I. The user has to provide measured/assessed quantitative data for several different inputs and outputs.

24. Please add link to the tool and guidance if applicable, or if not available on line please provide it as a document, so it can be annexed to the report and serve as documentation.

The tool & guidance will be uploaded to OPPLA.