Planning for Ecosystem Services:
the ECOPLAN toolbox

Design: Natacha Hoevenaegel - Nieuwe Media Dienst
Picture cover: Cedric Marsboom

AGENTSCHAP INNOVEREN & ONDERNEMEN

ECOPLAN
Planning for Ecosystem Services

Universiteit Antwerpen

Colofon

ECOPLAN develops spatially explicit information and tools for the assessment of ecosystem services and the evaluation of functional ecosystems as a cost-efficient and multi-purpose strategy to improve environmental quality. We develop open-source end-products and knowledge to identify, quantify, value and monitor ecosystem services. These products can be used by governments and consultants in project development, cost-benefit analysis, environmental impact reporting, etc.

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Project team

Jan Staes (coordinator), Dirk Vrebos, Cedric Marsboom, Katrien Van der Biest, Annelies Boerema, Steven Broekx, Inge Liekens, Leo de Nocker, Ruben Van De Kerchove, Stephanie Delalieux, Elina Bennetsen, Dries Landuyt, Wim Verheyden, Rolinde De Meyer, Dieter Mortelmans, Hans Keune, Sander Jacobs, Diederik Tirry, Paul Jacxsens, Sam Ottoy, Karen Gabriels, Anuja Dangol.

Promotors

Patrick Meire (UAntwerpen), Peter Goethals (UGent), Jos van Orshoven & Martin Hermy (KULeuven), Francis Turkelboom (INBO), Steven Broekx & Els Knaeps (VITO).

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Ecosystem services: a pathway to a better spatial planning…

Open space is sparse in the Flemish Region. Many sectors and actors claim space for activities and infrastructure and many of these use functions overlap. Planning processes that affect spatial planning have to deal with this multitude of conflicting interests and non- combinable activities.

Open and green spaces provide many benefits that are less well known, the so-called *ecosystem services*. Nevertheless, these secondary use-functions and benefits are usually not captured in standard land-use categories. Including ecosystem services in the debate on planning and design of landscapes can broaden the vision building. In addition to the traditional land use, such as food production and recreation, we include services such as purification of air and water, erosion prevention and a pleasant living environment. In that way we are able to demonstrate how all users of the open space are dependent on the landscape, and from each other. This may facilitate a spatial planning that has a wider public support and result in a more multi-functional and sustainable use of the open space and its ecosystems.

Ecosystem services are the various benefits that soil, water, plants and animals in the landscape deliver to society

It is a challenge to bring all these land-use functions into agreement. Different policy levels try to achieve an optimal spatial allocation of functions, but usually with a limited number of land-use functions and ecosystem services. Considering a broader set of ecosystem services is desirable, but is a huge challenge.
The ECOPLAN project therefore provides a range of methods and tools that allow to integrate the scientific knowledge of ecosystem services in spatial planning. The ECOPLAN tools can be used at various stages of the planning process (analysis, vision, planning, implementation, evaluation). Tools can often be useful in multiple stages. The ECOPLAN tools have been tested in real-life applications on different study sites in collaboration with many end users.

In this brochure you can find out what the ECOPLAN tools can do for your project.

An overview of the ECOPLAN tools

Policy questions

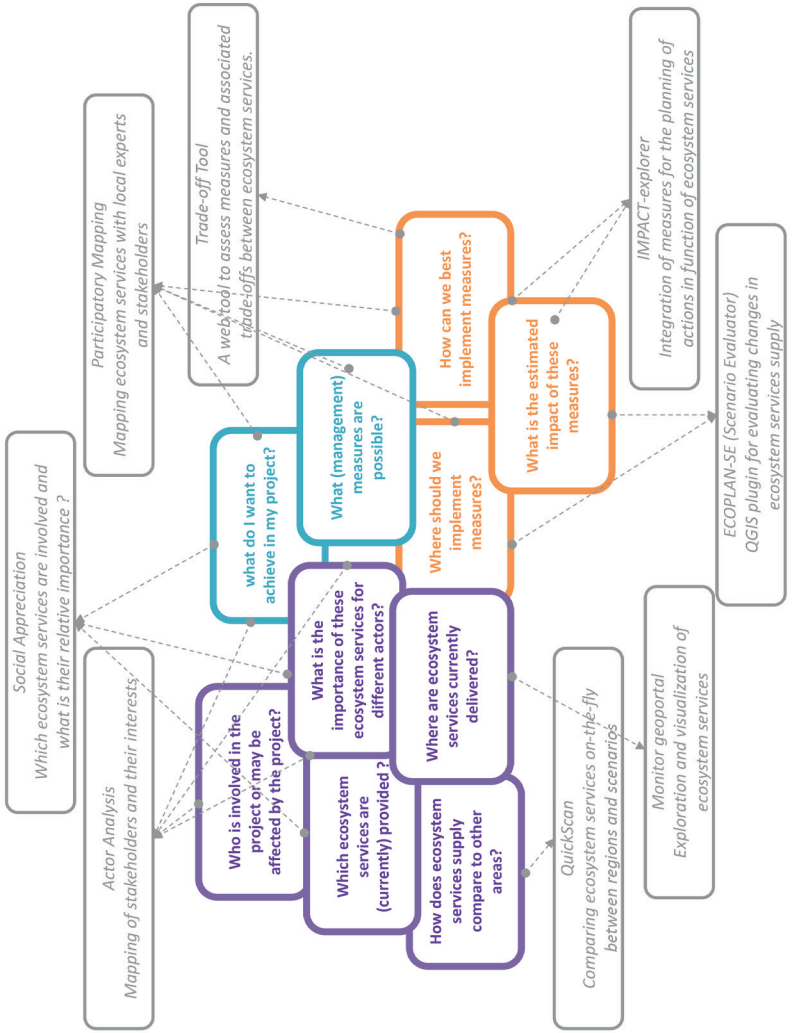
The ECOPLAN tools can be used flexibly to provide answers to typical questions emerging from projects for spatial planning, where the development of multifunctional landscapes is a key objective.

In the analysis phase, this concerns questions such as "who is involved in the project or can be affected by the project?" Or "where are ecosystem services currently delivered?" ECOPLAN tools that focus on these kinds of questions are the **Actor analysis, Social appreciation, Quick Scan and the Monitor Geoportal.**

During the planning phase, one could think of questions such as "What do I want to achieve in my area?" And "What interventions are possible?". ECOPLAN tools that can help answering these questions are **the Actor Analysis, Social appreciation, participatory mapping and the Trade-off tool.**

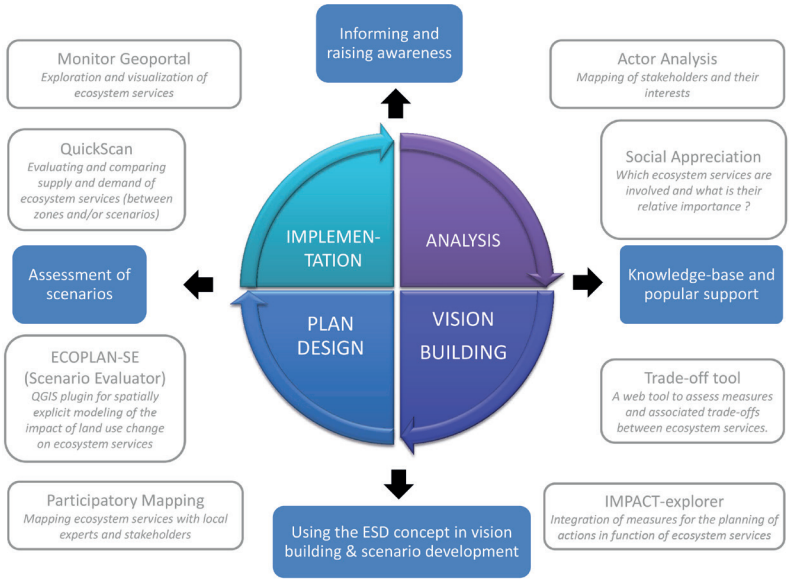
The questions that can be addressed during the implementation phase are, for example "Where and how measures could be implemented?" and "What is the estimated impact of these interventions?" ECOPLAN tools that can support this phase are, the **ECOPLAN SE (scenario evaluator), Impact explorer, Trade-off tool and participatory mapping**.

The ECOPLAN tools provide answers to typical questions in planning projects for multifunctional landscapes. The tools can be combined, adapted and flexibly deployed in the ***analysis****,* ***planning*** *and* ***implementation*** *of projects.*



Phases in planning processes

Most planning processes and projects go through phases of (problem) analysis, vision building, plan design and finally implementation. Although clear boundaries between these 'phases' do not exist and many alternative approaches can be developed, we think this can provide a robust approach to the diverse challenges for planners and practitioners that would like to include ES in their projects. The overview given in this document, describes the main purpose and function of the tool, in which phases their application could be usefull and how the tool works.



ANALYSIS

The first step in a (spatial) project is usually a scoping phase. A broad scoping is undertaken to identify and prioritize the objectives and preconditions of the project. Often this is based on a traditional issue analysis, but extending this investigation with an ecosystem services analysis, including the identification of strengths and opportunities in terms of ES, offers possibilities for a more integrated approach.

- When using ES as a concept in the scoping phase, we advise to analyze which stakeholders are potentially affected by the plan (in terms of ES). This includes potential beneficiaries or users of ES, but also landowners that can affect the (potential) supply of ecosystem services. Interests and potential influence in the project can be mapped out in detail using various methods that have been bundled into the "Actor Analysis".

- In this stage of the project it is usefull to have basic information on the patterns and magnitude of ES-supply (and demand) for a current situation. The "**ECOPLAN SE"** is developed to model and assess spatial explicit scenarios for land cover, land-use and land management, but also provides a detailed assessment of the current situation, which can be a basis for an initial (problem) analysis. These maps have been made available through a "geoportal", where maps can be viewed in combination with thematic data on landuse, landcover, hydrology and georeferenced aerial maps. The "Monitor" (www.ecosysteemdiensten.be) also contains descriptions on the respective ES-maps and guidelines for interpretation. Technical metadata on the mapping and modelling approach for individual ES can also be consulted.

- The "**QuickScan"** is developed to make results of mapping and modelling insightful to stakeholders and planners. For a set of designated areas, the explicit spatial information is aggregated and expressed as a total supply per area and per unit area (both in biophysical units and in monetary terms. The QuickScan tool is also applied to a series of commonly used zonation's (municipalities, provinces, basins, ecoregions etc.). The results for a selected area can then easily be compared to other areas. The QuickScan results are an ideal basis for a discussion on supply and demand for ecosystem services in a particular area. This information can then be used as input for (participatory) vision building and scenario development.

VISION BUILDING

In most cases the analysis (or explorative-study) is followed by a (participatory) vision building phase, where various actors are involved and surveyed for what they wish to achieve in an area. This is then translated into specific objectives for an area. In previous spatial planning projects, ecosystems services are seldom included as an explicit objective. Including an ecosystem services perspective, provides opportunities to build an inspiring vision on future developments. But it is imperative that one has sufficient insight in how a particular land management or land-use change can affect ES-supply.

- The **"Trade-off tool"** was developed to answer the typical 'What if?' questions that arise from stakeholder deliberations about potential measures. It operates as a non-spatial tool that allows assessing ES-delivery for a given combination of abiotic conditions (soil, hydrology), biotic conditions (land-cover) and anthropogenic management (land-use & management). The tool provides ad-hoc answers to user selected combinations of input variables. It also allows leaving input variables blank (as missing information). A statistical output is provided (predicted ES-delivery and probability distributions) for multiple ES. Therefore it is able to clearly demonstrate the trade-offs that may follow from changes in land-cover and land-use. It implicitly gives information on how missing information is affecting the quality of the predictions. The tool is driven by a Bayesian Belief Network (statistical model). In the future this tool can be consulted online on www.ecosysteemdiensten.be and www.natuurwaardeverkenner.be.

- The "**Impact Explorer**" provides comparable information, but in a more qualitative manner. Statements about the effects of land-use and management on the delivery of ES were put in a relational database. This information has been drawn from both scientific and grey literature. In general this type of information is fragmented and qualitative. At most this is quantitative for a specific measure (planting hegderows) and context (a case study), but does not allow extrapolation for quantitative (spatial) modelling. Although they can be very site specific, many of these interventions may actually improve ES delivery and such a database can be inspirational to landscape planners.

- The "**Social Appreciation**" describes and illustrates how to assess the local demand for ES. Compared to typical top-down planning objectives, local stakeholders often have a different vision and perception on land-use and ecosystem services. Taking into account these local perceptions on ES in planning processes can be a crucial factor for successful implementation. The ES-simulation tool quantifies and values ES from a societal benefit perspective, but often neglects the local benefits and trade-offs. In this manual, different techniques (such as card games and interviews) are described and illustrated that allow to capture these local ES-related concerns. These methods have been applied on the ECOPLAN study sites and are illustrated with practical examples and results.

PLANNING

A third phase (planning) examines which land-use transitions (agricultural, residential, industrial, nature) are desirable and achievable, taking into account the existing spatial context, legislation and project constraints. Alternative development scenarios (with expected differences in ES-delivery) can be compared and evaluated. For the "**ECOPLAN-SE"** (see phase 4), input data is needed with a high spatial and thematic accuracy. Planning processes seldom result in such a very detailed spatial scenario, especially when a plan targets a long term perspective. Developing such detailed scenarios may be a huge challenge, especially when local stakeholders are being involved.

- **"Participatory Mapping"** can be used to include local expert knowledge as well as different interests (demand / value of ESD) in spatially explicit maps. This tool can also be used for local validation / calibration of the baseline maps (from the geoportal - Monitor). The methods are described in a manual to assist planners in constructing a baseline scenario that is accepted by local stakeholders. The process of participatory scenario development is then used to develop a common vision for a project site. A main objective is to assist in a social learning trajectory to better understand the strategies and policy options needed to build such an alternative future. At the same time, participants gain a better understanding of the positions and strategies of various stakeholders (through a social learning process) and the process of co-creation of future scenarios and corresponding action plans facilitating the realization afterwards work in hand. The evaluation of different scenarios can be done using more coarse assessments such as Multi-Criteria-Decision-Analysis (MCDA).

IMPLEMENTATION

Finally, the project reaches the implementation phase, where decisions are made on specific land-cover, management and mitigation measures. This can also specifically address the management of particular zones (e.g. The type of trees, installment of infiltration ponds, construction of buffer strips, botanical management, nature management, limitations on fertilizer application, etc.).

- "**ECOPLAN-SE**" allows assessing spatial explicit scenarios of changes in land cover, land-use and a set of specific management practices. The simulation tool calculates 18 ecosystem functions and services in a specific sequence. Analogous to the conceptual ES-cascade, as initially presented in CICES, it places supporting and intermediate services at the top of the cascade. This "cascade" ES-modelling approach was developed in close collaboration with institutional stakeholders and governmental research institutes. The modelling approach incorporates shared variables, off-site effects and interdependencies that determine trade-offs and synergies between ES. Users can make use of the preloaded dataset with the most recent regional datasets on LULC, water abstractions, fertilizer application, population, etc... A user interface guides users through the input procedure by which they can construct a scenario.

- Again, the **QuickScan** can be used. It summarizes the changes in ES-supply that follow from a scenario assessment with the ES-simulation tool. Users can define zones of specific interest and for each zone results are aggregated in totals and per area unit. Changes are represented graphically as a relative change of ES-supply per area unit. Evidently these results can provide feedback to the vision building stage.

1. Actor analysis - identifying actors and their interests

What is the added value of the Actor Analysis for your project?

In the densely populated Flanders, there are diverse groups that make use of open space. If one intends to develop a new plan or project, it is essential to take account of the different claims, needs and desires that exist. Therefore it is important to identify all actors that affect or influence this process in an early stage. An actor analysis is a useful tool when starting a plan or project.

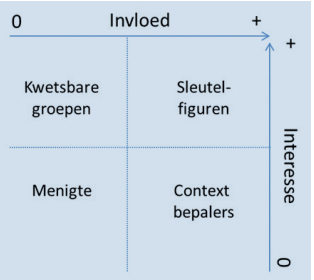


Figure: The power - interest matrix

When to perform an actor analysis?

An Actor Analysis is best done as early as possible in the planning process. This tool is essential in an exploratory phase, can be used to identify relevant stakeholders, and allows analyzing their involvement and position. Based on their interests, influence and impact, actors can be categorized into different action frameworks. This allows developing tailor-made strategies and trajectories for actors. To develop shared visions for a project, it is important that all relevant parties can participate. Also for subsequent stages of project development, the information from the actor analysis provides a blueprint for whom to involve in each stage. Finally, different actors can also evaluate the success of the project: what is the impact for them, who's getting the benefits and who is carrying the burden (e.g. costs, disadvantages)?

The Actor Analysis is a useful tool for project planners, regional managers or coordinating organizations. Required expertise: understanding social dynamics, analytical expertise, and expertise in facilitation. A neutral and open attitude to the often divergent and sometimes radical views of some actors is necessary.

Picture: Participatory development of the power-interest matrix for the municipality Voeren.

How does the actor analysis work?

An actor analysis consists of three steps:

1. Identify all the actors that can be affected or influenced by the planned activities, interventions or changes in management.
2. Identify their stakes in these changes.
3. Categorize the actors according to specific criteria. Two examples:
    - Ecosystem services actor analysis: this actor analysis is useful to develop measures to organize targeted ecosystem service differently.
    - Power Dependency Matrix: Divide the players according to their interest in the change / focus of the project and the extent to which they can influence the decision making proces. This categorization may help to design the participatory process.

Relevante ecosysteemdiensten (ESD) in studiegebied	Rol van belanghebbenden in relatie tot ESD				
	Eigenaar	Beheerder	Lusten	Lasten	Invloed
ESD 1: Extensieve begrazing	NV	Lb ⇑ NV	Lb ⇘ NV	-	
ESD 2: Gewenste natuurlandschap				-	
ESD 3: Zicht op groen		NV ⇔	HE, VG	-	

Figure: Example of a synergy and a (potential) conflict on the basis of an ecosystem services interest analysis for the alluvium of the Dijle.
Legend:
· Synergy indicated by green arrows, (potential) conflicts marked with red arrow.
· Nt = Nature NGO, Lb = Farmer, HE = Home owner , VG = Real Estate industry)

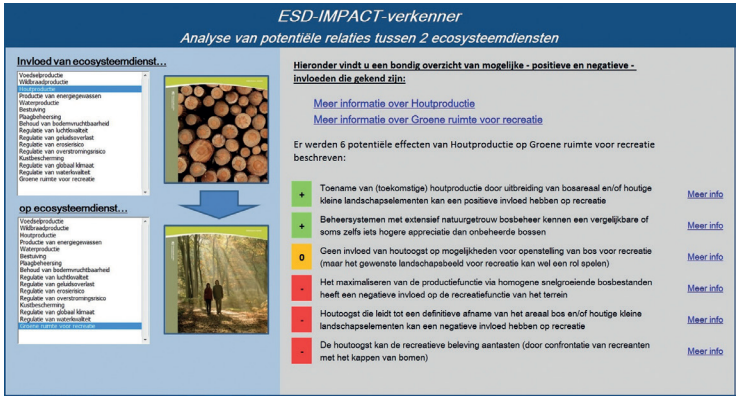
2. IMPACT Explorer - Integration of measures for the planning of actions in function of ecosystem services.

What is the use of the impact explorer for your project?

Multifunctionality is a common objective for many spatial planning projects. But what does this mean in terms of interdependent ecosystem services? What relationship exists between the two services? Other ecosystem services go well together, but how can one achieve such a "win-win" and strengthen it? Which services oppose each other, and how can we mitigate such potential conflicts? The IMPACT explorer allows you to investigate.

How does the IMPACT-explorer work?

The core of the IMPACT explorer consists of a comprehensive Excel database where relationships are established between measures (spatial configuration, management practices, etc..) and ecosystem services. In addition, the linkages are also made to all kinds of background information (map layers, reports, studies, ..) and to the other ECOPLAN tools. The IMPACT Explorer allows to provide an overview of the possible relationships between two services and provides insight into the potential impact of measures on these ecosystem services. The basis of the IMPACT Explorer consists of 16 individual reports from the Flanders Nature Report (see www.nara.be). For these reports, an extensive collection of gray and scientific literature was screened for information on the interaction between services and the possible measures to achieve "win-win's" or reduce conflicts between services.



When can the IMPACT-explorer be applied?

In the exploration phase, the IMPACT explorer can provide an overview of the relationships between interventions and ecosystem services for a project (e.g. potential impact of flood plain development on other services). During the vision building you can use this tool to analyze the effects of planned measures. You can also examine how the measures may reinforce or counteract. By using this tool in workshops, stakeholders can gain a better understanding of the interactions between all kinds of services. In that way, the IMPACT - explorer can help in the selection of measures to strengthen "win-win's" or mitigate conflicts.

The ESD Impact Explorer can be downloaded as an Excel file at www.ecosysteemdiensten.be.

3. Social Appreciation - Identifying and valuing local ecosystem services

What is the added value of social appreciation for your project?

The perception and appreciation of nature and landscape and its associated ecosystem services is often very personal and context-dependent. In general classifications of ecosystem services are quite universal and are framed in the perspective of (large-scale) societal benefits. It is not unlikely that local users of open space have little feeling for such ecosystem services and appreciate the area from a different perspective. However, it is important to engage with local actors when using the ecosystem service discourse and so to take these local and context-specific services into account. Social appreciation identifies these services. Local actors rank these services in terms of importance.

How does social appreciation work?

The social appreciation includes 5 steps:

1. Analysis of documents and interviews with content analysis: the text is coded to look for functions or services. It produces a set of quotes and data fragments that underpins the importance of particular categories of services. This analysis is preferably done independently by different researchers.
2. The various researchers compare their lists with each other. Afterwards, the comparison is made with the literature (CICES, IPBES) and from stakeholders. The result is a list of locally recognized functions or services.
3. Relevant actors or groups carry out an individual appreciation. This can be done through questionnaires or interviews. Thus, the different social interest is expressed by scores, which allows to rank services according to the mean scores.
4. The actors can discuss the given appreciations (especially those with the largest variation in scores) in focus groups.
5. The groups seek consensus: what features or services are the most/least important and why? Also interdependencies and other linkages between services/features are discussed.

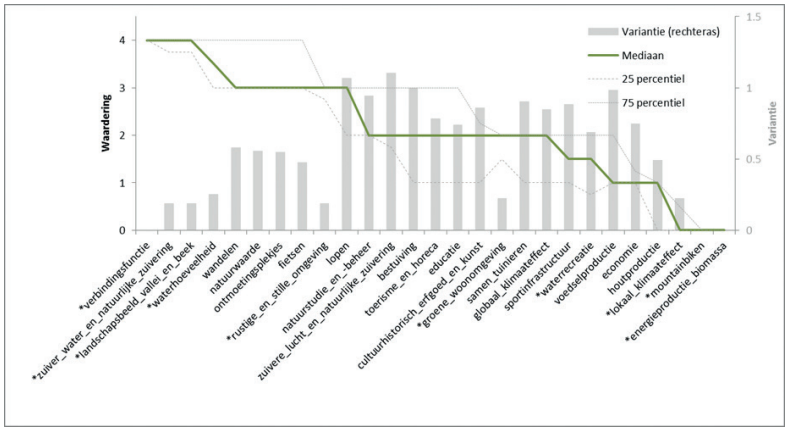


Figure: Example of the social appreciation: The relative value (from 0: unimportant to 4: essential service) varies greatly between services. In addition, there also may be a big difference in scoring between stakeholders (bars): for some services, there is a broad consensus, but some services are only valuable to particular stakeholders. These results are used for prioritization and to determine potential conflicts or win-win's.

When can Social Appreciation be applied?

This tool can be used in different phases of a project. If you apply it at the beginning of a project, one can expand the scope of the ecosystem service analysis, with those services that are of particular importance to local actors. Through this tool, you can determine the 'local interest' and 'local consensus'. These aspects can be taken into account throughout the planning process.

This tool is aimed at project managers who want to make relevant the theoretical concept to a local scale or a specific theme.

4. Monitor Geoportal - Exploring and visualizing ecosystem services in Flanders

How useful is the monitor in your project?

The Monitor is a portal to the knowledge, map layers and tools that were developed within the project ECOPLAN. With the Monitor, you can find the latest versions of the tools, map layers and methods.

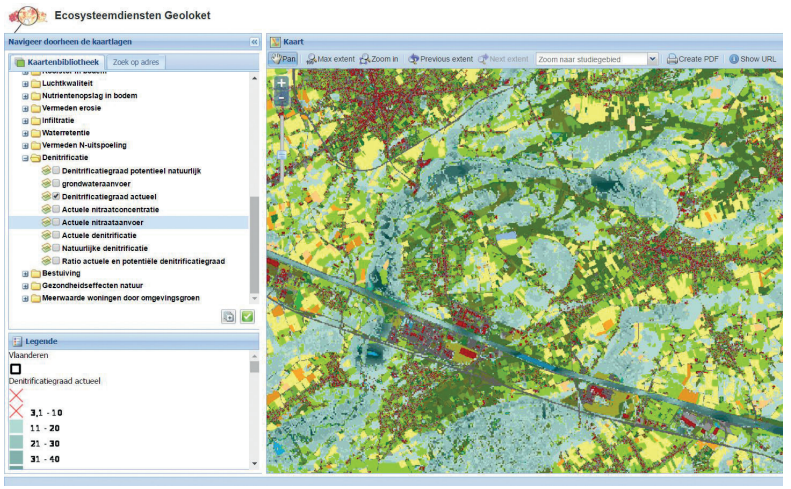
The "Geoportal" is primarily intended for planners and policy makers. But any citizen can obtain information without any special technical knowledge about the supply of ecosystem services in Flanders. The information on the geoportal is particularly relevant for planning processes with a strong spatial component. In the Geoportal we visualize which ecosystem services are provided, where in Flanders and to what extent. In combination with the QuickScan, this information can be an ideal starting point for a debate on supply and demand for ecosystem services in a project area. Which areas have a high supply of services? How does the project area compare to its wider surroundings? Where is potential for ecosystem services currently not realized?

Figure: Overview of tabs and ecosystem services in the ECOPLAN Monitor

How does the Monitor work?

The Monitor provides a clear definition for the ecosystem services and associated maps. Users can through the Geoportal to view the ecosystem service maps in combination with various thematic background maps (aerial photographs, land cover, soil maps, ground water depth). Users can zoom from the Flemish level to field level. Users can easily search by address to find a specific location.

The geoportal is designed as an online "map catalog", displaying the following aspects for each ecosystem service (actual supply, potential supply, valuation, indicators). Via standardized codes and specifications, users are informed about the method of calculation and precision of these maps. All map layers in the geoportal can be loaded into GIS software through Web Map Service (WMS) or be downloaded via the download tab.



Example of a visualization in the Geoportal: the "ECOPLAN land cover map" in the background with the "nitrate removal from shallow groundwater" in overlay.

When can the Monitor be applied?

The ECOPLAN Monitor and Geoportal are very useful in the early stages of spatial planning processes. After all, they provide information about the existing bio-geophysical conditions and assess the current provision of ecosystem services. They can also be used to support the social appreciation and analysis of planned measures. The map layers themselves can (after download) also be used in GIS for the preparation of spatial scenarios which can be evaluated by the ECOPLAN - SE.

Additional information can be found on the website www.ecosysteemdiensten.be, via the tabs "Welcome" and "About the Monitor".

5. Participatory mapping - Mapping ecosystem services with experts and local stakeholder

What may be the added value of participatory mapping in your project?

Maps are by definition a snapshot and static representation of reality. Supply maps sometimes miss local detail and local knowledge which may be very important to take into account. Local expertise is an important, reliable source of information for mapping the current use of ecosystem services. Participatory mapping is a collective term for methods aimed at establishing maps of ecosystem services as perceived by local stakeholders.

How does participatory mapping work?

There is a wide variety of techniques available, that one can select and adapt depending on the context of the project. The basis of participatory mapping is a well-considered selection of experts and/or stakeholders. This choice can be justified by the "**actor analysis**". The mapping itself can be done individually or in a focus group. Depending on the objectives, this can be done starting from scratch on a blank map or with supporting information from the Monitor.

Participatory mapping can focus on the spatial inventory of ecosystem services (supply and demand), mapping of opportunities or the validation of the modeled maps from the Monitor. Following the actor analysis and social appreciation, this tool can translate this local context to a spatial explicit output. A well-elaborated spatial inventory of the local context, can be a help in taking decisions.

Available maps are printed and experts can make improvements and additions on tracing paper. Often there is also use of additional, supporting information from the "ECOPLAN Monitor". The presence of the creators of the original models and maps can be of added value. Sometimes this tool also works with 'blank' maps where experts can draw the landscape in a more conceptual manner. Locations with, for example, supply and demand of services, bottlenecks, opportunities, etc. can be described by using points, lines, shading and shapes. Depending on the objectives (inventory, validation, expert mapping), this tool could easily be developed into more technical applications.

Picture: Detail of an ecosystem services use map resulting from participatory mapping. Residents of the river valley were asked to map different uses and characteristics for which no quantitative data was available.

When can participatory mapping be applied?

During the initial phase of a project, participatory mapping can provide valuable information that can clarify a further thematic and spatial focus of the project. This tool can also be used in combination with the "**Social Appreciation"** that allows involving a broader group of stakeholders. The spatial information from the "P**articipatory Mapping"** can be used together with the information of the geoportal (monitor) to develop spatially explicit scenarios, which can then be assessed using the "**ECOPLAN -SE"**.

6. QuickScan - Comparing ecosystem services on-the-fly between regions and scenarios

What is the added value of the QuickScan in a project?

The QuickScan reveals how many ecosystem services an area delivers (in biophysical units) and what values are associated with it (in monetary terms). The QuickScan was above all developed to make the impact of scenarios - that were calculated with the ECOPLAN-SE (Scenario Evaluator) – insightful and comparable (e.g. results per unit area). In order to assess whether an area delivers little or plenty of certain services, is it is useful to be able to compare to other areas. The QuickScan is also essential to frame the delivery of certain services in relation to the demand for these services. Many services are after all associated with environmental pressures such as air pollution, noise, eutrophication, urbanization … By incorporating this "demand" on area level we can express both the quantity and the quality of services provided.

	Doodebemde 2015	Kwantificering			Waardering (k€/jaar)		Waarde in € per ha niet-urbaan gebied	
	Ecosysteemdiensten	Laag	Hoog	Eenheid	Laag	Hoog	Laag	Hoog
	Voedselproductie		70	k€ toegevoegde waarde per jaar	70		263	263
Producerende	Houtproductie		291	m³ geoogst hout	8		30	30
	Energiegewassen - Landbouw	-		Gj Low Heat value	-		-	-
	Energiegewassen - Bosbouw	-		Gj Low Heat value	geen gegevens beschikbaar			
	Energiegewassen - Bermbeheer	-		Gj Low Heat value	geen gegevens beschikbaar			
	Watervoorziening		7.824	1000 m³ watervoorziening	587	1.565	2.202	5.873
	Pollinatie	-		ha afhankelijk van pollinatie	ondersteunende functie			
Ondersteunende en regulerende	Waterinfiltratie		88.797	1000 m³ infiltratiecapaciteit	ondersteunende functie			
	Waterretentie		6.737	1000 m³ waterretentie capaciteit	ondersteunende functie			
	Koolstofopslag in biomassa		108	ton C opslag biomassa/jaar	24		89	89
	Koolstofopslag in bodem		44.487	ton C voorraad bodem	98		367	367
	Stikstofopslag in bodem		2.694	kg N opslag	ondersteunende functie			
	Fosforopslag in bodem		180	kg P opslag	ondersteunende functie			
	Stikstofverwijdering		1.065.903	kg N verwijdering	5.330	78.877	20.003	296.045
	Vermeden erosie		1.600	ton bodem	geen gegevens beschikbaar			
	Luchtkwaliteit: afvang door planten		2	ton afvang PM	123		461	
	Geluidsreductie		0	aantal huizen	0	0	0	0
	Stedelijk klimaat	-		aantal inwoners	geen gegevens beschikbaar			
	Beleving recreanten en toeristen	-		1000 bezoeken per jaar	-	-	-	-
Culturele	Kwaliteit woonomgeving		569	1000 inwoners binnen 100m	183		-	-
	Gezondheidseffecten contact met natuur		6	1000 inwoners binnen 1km	2.344		8.796	8.796
	Totaal				***8.765***	***83.291***	**32.899**	**312.612**

Figure 1: Overview of ecosystem services for a study site. The various ecosystem services are expressed as totals and per unit area for both biophysical and monetary units.

How does the Quickscan work?

The spatially explicit information (map layers of the Geoloket) was summarized and expressed as a total delivery per area and per surface unit (both in biophysical units as in monetary values) for a set of commonly used delineations. The results for a selected area can easily be compared to another area that the user can select, for example municipalities, provinces, river basins, catchments,…
A basic version with data on the actual supply of ecosystem services for the municipalities, provinces, catchments and ecodistricts is available on the website www.ecosysteemdiensten.be. The information used to draw this dataset, corrseponds with the maps of the "Monitor - geoportal". Monetary valuation methods of ECOPLAN are in accordance with the Nature Value Explorer (www.natuurwaardeverkenner.be).
Evidently, one can also compare several scenarios for a particular study with the QuickScan. If one wants to add a specific area to the Quick scan, the area must first be calculated with ECOPLAN-SE. Then the resulting table can be imported in the QuickScan.

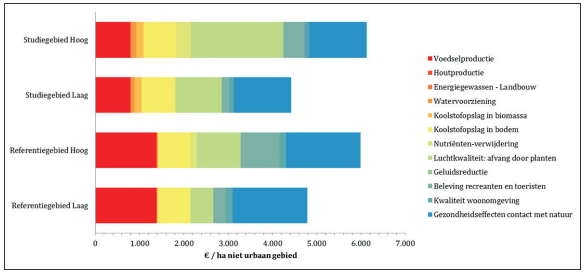


Figure 2: Overview of a monetary valuation (€/ ha non-urban), showing a high and low estimate for a study area and reference area.

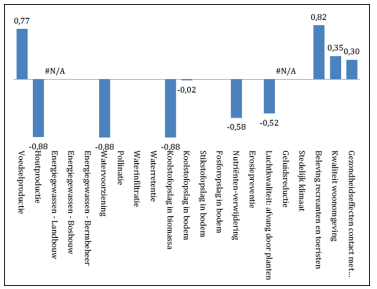


Figure 3: Mean relative change (%) in ESS-supply between an actual situation and scenario for various ecosystem services.

When can the Quickscan be used?

The QuickScan results provide an ideal starting point for a discussion on supply and demand of ecosystem services in a given area. This information can be used as input for (participatory) vision building and scenario development. In addition, different scenarios of an area can be compared with each other.

7. ECOPLAN - SE (Scenario Evaluator) - A QGIS plug-in for evaluating ecosystem services supply

What is the use of ECOPLAN -SE in your project?

Often, many alternative scenarios are considered for spatial development projects. However, these scenarios can have unexpected effects on the delivery of ecosystem services. ECOPLAN-SE calculates the associated effects and presents the results in an understandable way. The analysis can help in the development of a more multi-functional project design and with the communication to the wider public.

How does ECOPLAN-SE work?

ECOPLAN-SE is able to calculate and evaluate quantitatively the effects of spatial scenarios on 18 different ecosystem services: 4 producing, 8 regulating, 3 supporting and 3 cultural services. The user can define and then evaluate the scenarios using quantitative models, specifically developed for the Flemish Region (data and context). The tool presents the results of the calculations in several, understandable ways.

ECOPLAN-SE is available as a QGIS plug-in, including a comprehensive GIS database on the level of the Flemish Region. The plug-in consists of 3 parts that enable a complete ecosystem services analysis (Figure 3):

1. On the basis of changes in land cover, use, management and changes in hydrology, the user can select different spatial scenarios.
2. The tool calculates the effects of the scenario on 18 ecosystem services and presents the supply and delivery in figures and map layers.
3. In a last step the tool analyzes the scenarios: impact maps (changes in ES-supply) and tables are created that can be used in the QuickScan. In addition, there is the option to perform a spatial analysis of multi-functionality in the area - the 18 map layers are statistically analyzed on the occurrence of services together. These services bundles are then visualized.

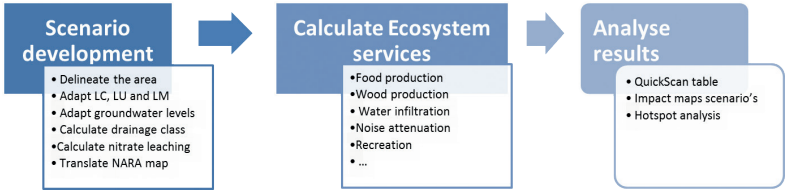


Figure: Overview of a scenario analysis with ECOPLAN-SE

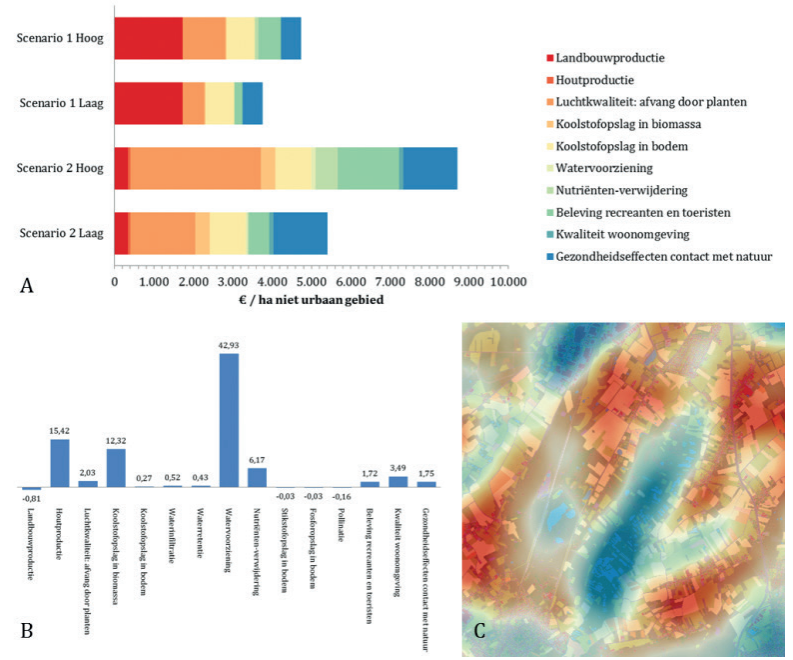


Figure: Examples of the analysis results: A) yield per hectare for 2 scenarios, B) Difference (%) between 2 scenarios, C) Hotspot (red) - coldspot (blue) mapping for infiltration.

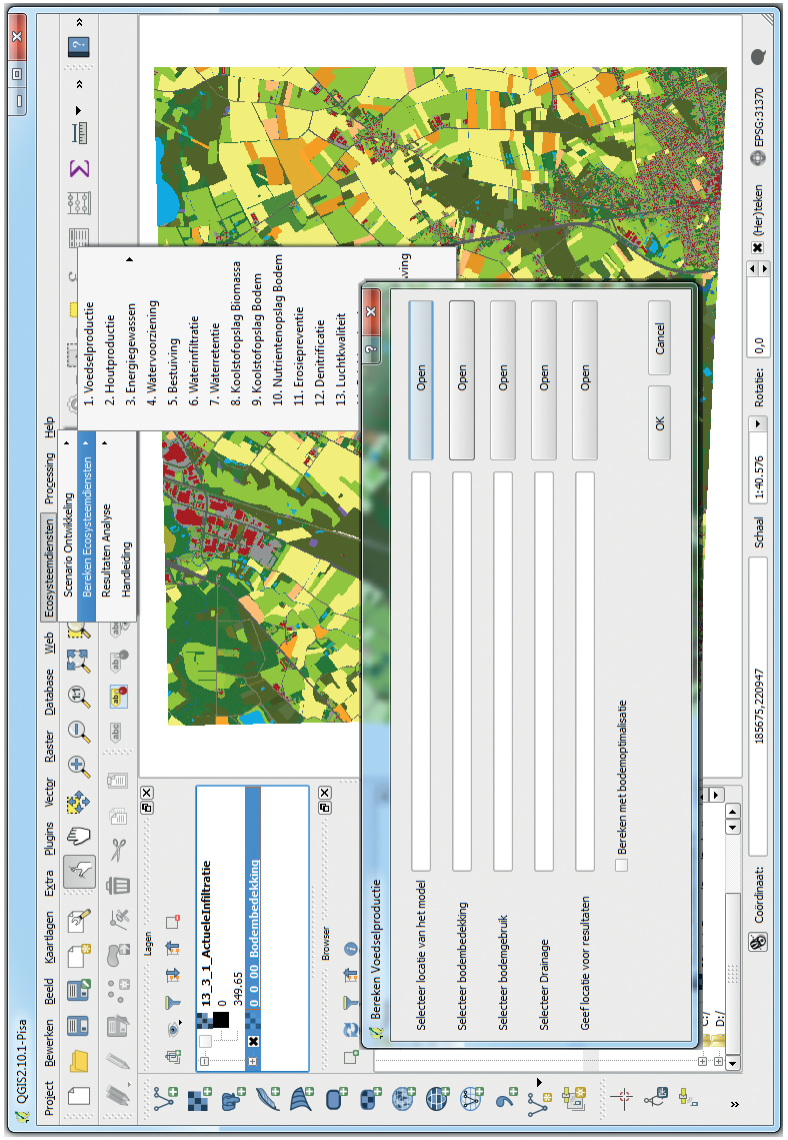


Figure: Impression of the ECOPLAN-SE plug-in in QGIS: The plug-in consists out of a drop-down menu with which the different models can be evoked.

When can the ECOPLAN-SE be used?

This tool can calculate the ecosystem services delivery in an exploratory phase of a project. Based on these results, you can determine which areas are important for certain ecosystem services and which areas offer little for some ecosystem services. This information can be one of the starting and discussion points in the development of a regional vision.

ECOPLAN-SE can also be implemented in later stages of plan development to evaluate multiple scenarios. The calculation and analysis tools enable to assess and visualize the positive and negative effects of each scenario. These results may help to further develop the regional vision and to lastly reach a final layout scenario. The calculations provide information with which one can evaluate which interventions and zones from the layout plan yields the largest ecosystem services benefits. Based on a comprehensive cost-benefit analysis you can identify which interventions should get the highest priority during the implementation of the project.

ECOPLAN-SE is developed for spatial planners working for administrations, agencies and technical offices. This tool is a simple, well -arranged software, but a basic knowledge of QGIS is required.

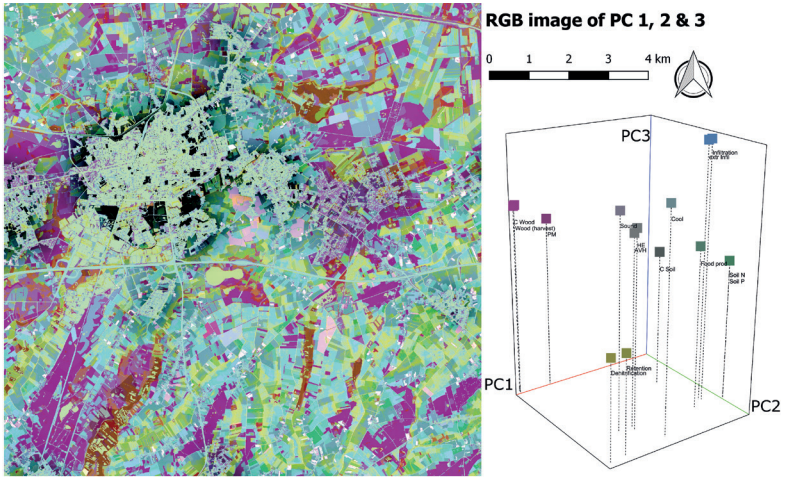


Figure: Result of the statistical multifunctionality analysis: the three most important 'bundles of ecosystem services' are mapped simultaneously using the RGB color palette (red, green or blue).

8. Trade-off Tool - A web tool to assess trade-offs between ecosystem services

What is the added value of the trade-off tool in your project?

Realizing spatial multi-functionality is an important objective for many projects. Often one looks to find an optimal balance between the delivery of two (or more) services. But the impact of certain measures on ecosystem services is not always the same. This tool allows you to quickly understand the interaction between ecosystem services for a particular situation/context. For a user defined set of boundary conditions (e.g. soil properties), the impact of alternative land use and management options on various ecosystem services can be quickly compared. (e.g. soil properties) the impact of alternative land use and management options on various ecosystem services can be quickly compared.

How does the trade-off tool work?

The tool can answer two types of questions:

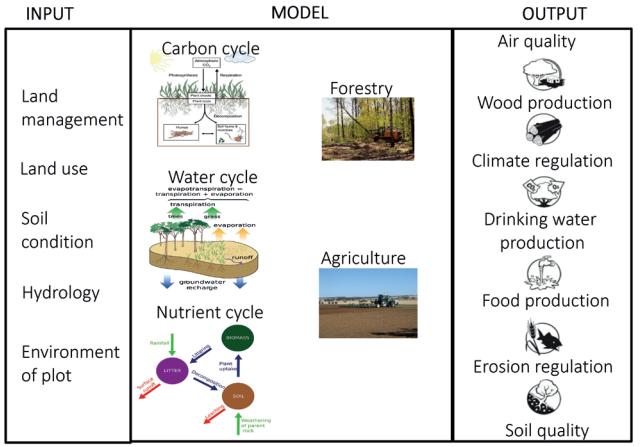
- How can the provision of ecosystem services change when a change in management occurs?
- What measures can be used to enhance the delivery of a particular ecosystem service?

The tool is non-spatial and works for a limited number of services (8). The tool uses lookup tables, which were drawn from a statistical model that takes into account the following aspects: uncertainty, missing information, quantitative and qualitative information. The user first provides information concerning the boundary conditions (e.g. Soil texture). Then alternatives (current and desired state) concerning land use and management can be added. The tool then calculates an average delivery for both situations and uncertainties on those values.

Figure: Typical questions related to the impact of management on ecosystem services

When can the trade-off tool be used?

Users can quickly and interactively examine consequences of actions by testing different combinations of measures and boundary conditions. One can also consider what measures are effective to increase the supply of a particular service. It is an ideal tool to use during (participatory) vision building and plan development. The tool can be used to determine criteria for the implementation of particular measures. After allocating translating these criteria to spatial demarcations, this can be assessed using the "**ECOPLAN-SE**". This tool differs from other tools with a similar function as the uncertainty is shown on the delivery of ecosystem services. The tool provides results that are more quantitative than the "**IMPACT explorer**", but only accounts for a limited set of measures and services. The "IMPACT explorer" also indicates when a particular measure is also available in the trade-off tool.



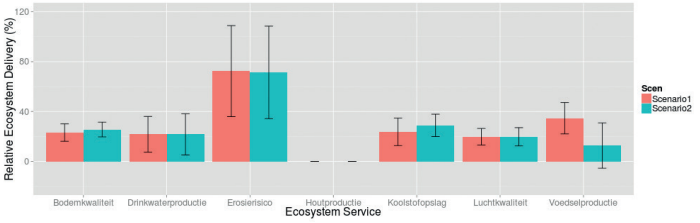


Figure: Output from the trade-off tool: predicted delivery of ESS and standard deviations for two scenarios (red and blue).

Contact en information

The ECOPLAN tools are available through the partners of the consortium ECOPLAN. Since these tools are under ongoing development and improvement, and because multiple combinations of instruments are synergetic in support of planning processes, it is advised to contact one of the contact persons before you start. More information, downloads, and references can be found on the websites www.ecosysteemdiensten.be and www.uantwerpen.be/en/rg/ecoplan.

University of Antwerp - Ecosystem Management Research Group

The Ecosystem Management Research is responsible for coordinating the ECOPLAN project. The team ecosystem services research specializes in spatially explicit modeling of ecosystem services.

Jan.staes@uantwerpen.be (coordinator), dirk.vrebos@uantwerpen.be , katrien.vanderbeist@uantwerpen.be, cedric.marsboom@uantwerpen.be, annelies.boerema@uantwerpen.be & patrick.meire@uantwerpen.be (promotor)

Flemish Institute for Technological Research - Environmental Modelling Unit

The Land and Water Management (LWM) team within the Environmental Modelling Unit conducts studies into the environmental impact of human activities in an integrated manner, with emphasis on agriculture, water management and economic valuation of ecosystems and landscapes.

Steven.broekx@vito.be & Inge.liekens@vito.be

Flemish Institute for Technological Research – Earth Observation Unit

VITO's earth observation group develops innovative, user-oriented based solutions, as well as scientific support for the collection, use and dissemination of geographic information to support sustainable land use.

Ruben.vandekerchove@vito.be & Els.knaeps@vito.be

Institute for Nature and Forest Research – the Nature & Society research group

The research group Nature and Society focuses on the social aspects of nature and ecosystems in Flanders (through, inter alia, research into the societal demand for ESD, stakeholder analysis, participatory processes, advocacy for nature, relationship between nature and wellbeing,...).

Francis.turkelboom@inbo.be; wim.verheyden@inbo.be & sander.jacobs@inbo.be

KU LEUVEN – Department of Earth and Environmental Sciences

Sam Ottoy developed the models for the ECOPLAN-SE tool to quantify the soil carbon stock and biomass production for bio-energy. Karen Gabriels developed a new method to estimate timber production and harvest. Diederik Tirry and Paul Jacxsens were responsible for the development and management of the ECOPLAN Monitor & Geoloket. Since 2015, these tasks were taken over by Anuja Dangol. Daily supervision of this research was provided by Jos Van Orshoven and Martin Hermy.

Jos.vanorshoven@kuleuven.be & sam.ottoy@kuleuven.be

Ghent University – Aquatic Ecology Research Group

The Aquatic Ecology Research Group has extensive experience with respect to the monitoring, modeling and evaluation of aquatic ecosystems.

Elina.Bennetsen@ugent.be & peter.goethals@ugent.be