PROGRESS
Interreg Europe

European Union
European Regional
Development Fund

PROmoting the Governance of Regional Ecosystem ServiceS

FIRST HANDBOOK OF GOOD PRACTICES

Policy theme:

Promote the measurement of the costs and benefits of ecosystem services derived from land use.

anci toscana

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I. Introduction

The objective of the Progress project First Handbook of Good Practices is to present the best 5 good practices of project partners during the 1st Interregional Thematic Seminar (ITS) that was supposed to take place in Barcelona, Spain, but, because of the impact of Covid19, was organized on-line on 31st March 2020. The policy theme of the 1st ITS was "Promote the measurement of the costs and benefits of ecosystem services derived from land use."

The best 5 selected Progress good practices:

1. All-Ireland Pollinator Plan (AIPP) Framework, Ireland;
2. National Ecosystem and Ecosystem Service Mapping Pilot for a Suite of Prioritised Services (NEES Mapping Pilot), Ireland;
3. SITxell: Territorial Information System for the Network of Open Areas in the province of Barcelona, Spain;
4. LIFE EcosystemServices: Ecosystem Services Assessment Methodology (ESAM), Latvia;
5. Guidelines for assessing soil ecosystem services in urban environment and their management, Italy.

The IE definition of a good practice (GP) provides that

"The good practice is defined as an initiative (e.g. methodology, projects, processes, techniques) undertaken in one of the programmes thematic priorities[1] which has already proved successful and which has the potential to be transferred to a different geographic area. Proved successful is where the good practice has already provided tangible and measurable results in achieving a specific objective."

Therefore, identification, analysis and sharing of good practices is a part of the Progress mutual policy learning process to achieve the improvement of policy capacity or capitalization of its partners and regions. In addition, transferring of good practices from one partner region to another can be included in the regional action plan if it can result in a policy change.

In line with the above capitalisation objective, the PROGRESS project aims to:

"*initiate a process of policy change in the partners' regions improving the implementation of the policy instruments under Structural Funds programmes and other regional strategies dedicated to the conservation of biodiversity and the maintaining nature's capacity to deliver the goods and services that we all need, through policy learning and capacity building activities*".

[1] In the case of the IE program, the thematic priorities are four policy topics related to the regional development:
1. Research, technological development and innovation
2. Competitiveness of SMEs
3. Low-carbon economy
4. Environment and resource efficiency.

The idea of the Handbook of Good Practices is to further extend the capitalization and achieve spill-over effects outside the Progress partners' territories to those interested parties, which might wish to transfer and implement good practices developed by other regions in their own area. In addition, information on the selected good practices will also be shared on the Interreg Europe Policy Learning Platform.

This First Handbook of Good Practices is one of four handbooks describing the best good practices of Progress partners under the four policy themes:

1. Promote the measurement of the costs and benefits of ecosystem services derived from land use.
2. Support the horizontal integration of the ecosystem concerns into the sectoral policies and plans at regional and/or national level.
3. Explore innovative financial and marketing mechanisms for payment for ecosystem services.
4. Improve landscape governance for economic and environmental sustainability.

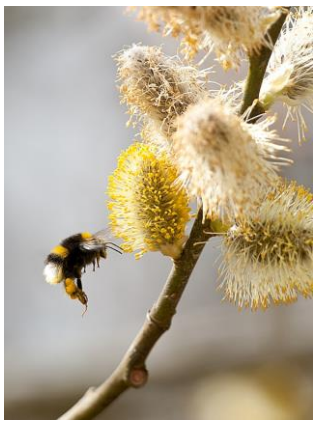
The Second Handbook of Good Practices on the policy theme "Support the horizontal integration of the ecosystem concerns into the sectoral policies and plans at regional and/or national level" is expected in the beginning of 2021.

II. Descriptions of Good Practices

1. All-Ireland Pollinator Plan (AIPP) Framework

Summary:

- **The All-Ireland Pollinator Plan (AIPP) and its framework is an island-wide (Ireland and Northern Ireland) attempt to reverse declines in pollinating insects (primarily bees and hoverflies).**
- **It has been developed in recognition that the decline of pollinators is a serious problem which requires immediate attention to ensure the sustainability of food production, avoid additional economic impact on the agricultural sector and protect the health of the environment.**
- **The AIPP was developed on a voluntary basis and *without funding* by a fifteen-member steering group comprising experts from universities, relevant government departments, local authorities and interest groups.**
- **The AIPP framework is an exemplary resource which can be easily transferred to other jurisdictions with a view to raising awareness of the economic, environmental and social value of the regulating services provided by pollinators.**



Bombus lucorum 'the white-tailed bumblebee'
Photo by Mr. Tom Cuffe

Ballinabranna National School, Milford, Co. Donegal
Photo by Green Bee Education

Perennial planting for pollinators

Photo by Mr. Peter Cuthbert

Good practice general information	
Title of the practice	**All-Ireland Pollinator Plan (AIPP) Framework**
Organisation in charge of the good practice	National Biodiversity Data Centre (IE)
Description	
Short summary of the practice	The loss of natural and semi-natural habitats has been a key driver in pollinator declines. However, in an era of increased agricultural mechanisation & intensification, urbanisation and commercialisation, this is often not a clearly communicated message. Despite this, a recent survey has revealed that 88% of the Irish public want the Government to do more to help bees (iReach Insights survey, Sept 2018). The All-Ireland Pollinator Plan (AIPP) and its framework is an island-wide (Ireland and Northern Ireland) attempt to reverse declines in pollinating insects (primarily bees and hoverflies). In providing targeted and actionable information that can be used to sell a biodiversity message to a very wide audience, it has been developed in recognition that the decline of pollinators is a serious problem which requires immediate attention to ensure the sustainability of our food production, avoid additional economic impact on the agricultural sector and protect the health of the environment.
Category of the good practice	Information dissemination and awareness raising
Resources needed	The AIPP was developed *without funding* by a fifteen-member steering group comprising experts from universities, relevant government departments, local authorities and interest groups. The National Biodiversity Data Centre contributed €2,000 for document (graphic) design and a limited print run. There is no fixed implementation budget for the AIPP. In 2020, the Department of Agriculture Food and the Marine provided a small budget to develop resources (€15,000), while 100+ partners fund their own actions. Others (mainly partnering local authorities) fund print runs and dedicated activities e.g. awards and videos. There is no dedicated permanent staff for the AIPP, with the steering group chair (project manager) dedicating 1.25 days/week within their existing role, while a dedicated project officer position is subject to external funding. In 2020, funding for a project officer was secured from a partner organisation - SuperValu (a supermarket chain) - to the value of €55,000 including travel and subsistence. Funding for implementation of this GP in 2020 is approximately €70,000.

Timescale (start/end date)	The first Plan covers the period 2015-2020 and a new version is currently under development to cover the 2021-2025 period.
Strategic relevance (long term impact)	In Ireland, pollinators are estimated to contribute €59 million/annum to the economy. Within the last 10 years, the value of soft fruit, field vegetable, and apple production has increased by 17%, 21% and 24% respectively with most pollination of crops and wild plants carried out by bees. Despite this, due to biodiversity loss, one third of Ireland's 98 wild bee species are threatened with extinction. At its core, the AIPP is about providing food and shelter across all types of land so that pollinators can survive and thrive. It creates a framework to bring together pollinator initiatives across borders (Ireland and Northern Ireland) through coordination and cooperation. Without the pollination service freely provided by bees and hoverflies, it would be increasingly difficult and expensive for farmers to produce some crops at current scales and could result in a loss of consumer choice for locally grown products. The beauty of the landscape would also be affected without pollinators to maintain the diversity of wild plants and support healthy ecosystems. The AIPP has 5 strategic objectives: 1) **Making Ireland pollinator friendly** by focusing on actions that can be taken on farmland (4 targets & 12 actions), public land (3 targets & 22 actions) and private land (2 targets & 5 actions), to achieve a joined-up network of diverse and flower-rich habitats to support pollinators across Ireland (1 target & 3 actions); 2) **Raising awareness of pollinators** and how to protect them (3 targets & 11 actions); 3) **Managed pollinators – supporting beekeepers and growers** to achieve healthy, sustainable populations of managed pollinators that can play a full role in delivering pollination services (4 targets & 7 actions); **Expanding our knowledge of pollinators and pollination services** (4 targets & 11 actions). On 1 June 2018, the European Commission adopted a Communication on the first-ever EU initiative on pollinators. The Initiative sets strategic objectives and a set of actions to be taken by the EU and its Member States to address the decline of pollinators in the EU and contribute to global conservation efforts. It sets the framework for an integrated approach to the problem and a more effective use of existing tools and policies. Drawing directly on the AIPP, the initiative sets actions under three priorities: 1) Improving knowledge of pollinator decline, its causes and consequences; 2) Tackling the causes of pollinator decline, and; 3) Raising awareness, engaging society-at-large and promoting collaboration. In this way the AIPP framework has provided a basis for the strategic abatement of pollinator decline in Europe.

Evidence of success (results achieved)	According to the AIPP Year 4 Progress Report (10th December 2019), the AIPP is supported by 108 governmental and non-governmental organisations and over 230 businesses across the island of Ireland. Of the 81 actions in the Plan, 96% are now either completed or ongoing through collaboration with wide-ranging project partners. The AIPP has directly influenced the development of pollinator strategies published in Scotland (2017), Norway (2018) and the Netherlands (2018), and the AIPP team continues to collaborate with the Institute for European Environmental Policy (IEEP) to provide free resources to EU regions and states who are developing pollinator strategies in line with the EU Pollinator Initiative (2018): https://ec.europa.eu/environment/nature/conservation/species/pollinators/index_en.htm.
Tangibility	In March 2019, a structured framework where Councils (local authorities) sign-up as formal partners of the Plan was established. In so-doing, they agree to support the core ethos; take at least four pollinator friendly actions within the following five years (one in the first year) and report annually on the positive pollinator actions planned, implemented or maintained. This allows for the measurement of concrete results. More broadly, full adoption of the online mapping system - 'Actions for Pollinators' which is designed to track actions for pollinators and record pollinator sightings and monitor known populations - is facilitating the quantification of wider concrete results.
Durability	The AIPP was developed without funding, with all Steering Group members (15) participating through their current work remits or in a voluntary capacity. Limited funding for publication of the Plan was provided by the National Biodiversity Data Centre within their budget in 2015. Since then, funding has been variously obtained from a variety of national sources including the Heritage Council, Bord Bía (the Irish food board) and the Department of Agriculture, Food and the Marine. Across all sectors (farmers, councils, transport authorities, local communities, faith communities, businesses, schools, gardeners), the number of individuals and organisations engaging with the Plan and taking actions to help pollinators continues to increase. Voluntary management is directly linked to data and monitoring, making management easier. Indeed, there is an argument that the voluntary nature of management and the lack of funding has promoted efficiency in the GP. The AIPP framework thereby presents itself as a potentially durable model for similar or complimentary initiatives in different regional contexts. Key challenges include the lack of security of funding for the project officer position

	and lack of resources to capitalise on momentum to engender real societal change. In a recent presentation, the project manager identified the need for greater knowledge sharing at the European level. Inclusion of this GP on the Interreg Policy Learning Platform would help to address these challenges.
Visibility	Pollinators are an element of biodiversity that people understand and relate to. Their role can be communicated as a clean and simple message. Since its publication, the AIPP has been promoted in this manner via more than 450 published articles, interviews, and other events. In 2019, this included: - 38 published newspaper articles - 15 radio interviews - 3 TV interviews - 37 articles (blogs, websites, newsletters, magazines) - 22 presentations at events - 9 presentations at conferences - 10 Events (panel events/stands at 3rd party events, including Bloom in the Park, Electric Picnic, etc.) Resulting from the AIPP, there has been substantial media coverage on how to make places pollinator-friendly and positive engagement through events. Additional funding would enhance the potential for even greater visibility.
Added Value	When the Plan was first published in September 2015, it was supported by 69 governmental and non-governmental organisations. Across all sectors (farmers, councils, transport authorities, local communities, faith communities, businesses, schools, gardens) the number of organisations engaging with the Plan and taking actions to help pollinators continues to increase. According to the 4th Annual Progress Report, this figure had increased by over 55% to 108 supporting organisations (Dec. 2019). The number of companies who have signed up as business supporters of the AIPP has far exceeded the original target set in the 2015 Plan (230+). By raising awareness of the importance of pollinators in both the public and private sectors, opportunities for funding for pollinator related research have increased. As a result, there is now much better coordination of researchers at the national level and between universities, as well as government departments. The "Actions for Pollinators" mapping system has become an innovative spin-off from other work undertaken in the National Biodiversity Data Centre, which adds further value to this good practice at a minimal cost.
Effectiveness	As of May 2020, 24 local authorities had signed-up as formal partners. Regional policy explicitly supports the plan, including the Regional Spatial and Economic Strategy for the Eastern and

	Midland Region, demonstrating potential for transferability to the local level through regional policy. At the national level, three government departments and multiple semi-state organisations have also become formal partners. Key challenges for implementation are: 1) reluctance to change – planting regimes, pesticide use, mowing etc. Partnership by local councils doesn't necessarily mean that external contractors will operate according to the GP. Furthermore, there are some parts of society who disagree with a new (less tidy) management approach, thereby, highlighting the need for continued awareness raising; 2) Despite the many successes, limited resourcing for implementation of the GP (funding and personnel) has, to some extent, negatively impacted upon its overall effectiveness.
Innovation	The AIPP framework has been highly innovative in terms of the nature of solutions/resources included and the scope of target users and partners. In addition to the plan itself, there is a Junior All-Ireland Pollinator Plan (published in English and Irish), guidelines for wide-ranging users, how-to-guides, signage templates and wide-ranging resources such as pollinator-friendly plant lists, posters, presentations and videos. There is also the "Actions for Pollinators" online mapping system. The innovative nature of the framework has been recognised by the EU Pollinator Initiative (2018) which has adopted the AIPP as *the* template for the development of pollinator strategies across the EU.
Efficiency	The AIPP was developed on a voluntary basis without funding. The full range of resources are publicly (and freely) available on the AIPP website (www.pollinators.ie), thereby facilitating the potential adoption, replication or adaptation at a low cost and in a highly efficient manner. Since April 2016, a dedicated AIPP project officer position has been established in the National Biodiversity Data Centre. Subject to external funding, the role (when occupied) is focussed on developing full resources and support materials for all sectors, raising awareness of the AIPP and supporting the partner organisations. In 2019, it was run as a job share between two people. Funding by SuperValu (a supermarket chain) was secured in late February 2020 for the rest of the year (€55k p/a). SuperValu also funds a schools campaign - Save the Bees https://supervalu.ie/real-people/save-the-bees (launched 12th March 2020). In 2020, the Department of Agriculture Food and the Marine provided a small budget to develop resources (€15,000), while 100+ partners fund their own actions. The financial resources required to implement a practice similar to the AIPP in other regions will therefore depend on the level of implementation and the nature of partnership/s established in the region. Scope of implementation could range from direct

	adoption/translation of the AIPP and existing resources (low cost option) to adaptation/tailoring to different regional/ecosystem contexts, the establishment of an online mapping system similar to the 'Actions for Pollinators' platform or the appointment of dedicated staff.
Externality	Inspired by the AIPP, the Irish Heritage and Biodiversity Officer Network came together to sponsor a special Pollinator Award in the Tidy Towns competition (www.tidytowns.ie) beginning in 2016. Over the period 2016-2020, 162 different local communities have entered this competition and made their local areas more pollinator friendly. This shows how local communities can lead the way in addressing national (and global) issues within a structure like Tidy Towns. Run by *An Taisce* (the Irish Heritage Trust), a special Pollinator Award was also introduced into the Green Flag for Parks competition in 2017. In compiling the 4th Annual Progress Report, partner organisations who were not associated with a specific action in the AIPP (including businesses, 3rd level campuses, church representative bodies and other groups) were invited to provide a short update of their 2019 activities. This Progress Report includes **multiple external and additional effects** of the AIPP recorded by these partner organisations including organised programmes of planting and biodiversity improvement, awareness raising and the development of research and enterprise activities that align with the AIPP (see: https://pollinators.ie/wp-content/uploads/2019/12/All-Ireland-Pollinator-Plan_progress-report-year-4.pdf).
Intra-regional coordination	A core feature of the AIPP is the achievement of progress through the building of partnerships. As of May 2020, 24 local authorities had signed-up as formal partners, representing approximately 65% of local authorities in the Republic of Ireland (20 of 31) and about 36% of local authorities in Northern Ireland (4 of 11). In addition, 4 transport authorities and multiple charities, NGOs and community groups are AIPP partners. The number of companies who have signed up as business supporters of the AIPP also continues to rise and has now far exceeded the original target set in the 2015 Plan (230+). This progress has been possible through the support of 'Bord Bia' (Origin Green) and 'Business in the Community'. An annual report outlining actions taken by each of the business supporters has also been published: https://pollinators.ie/wp-content/uploads/2019/12/AIPP-Business-Supporters-Annual-Review-2019.pdf. On the basis of the GP, the AIPP team has successfully secured funding for a five-year European Innovation Partnership (EIP) project to test pollinator measures on farmland. This is being implemented with 40

	farmers of different types in County Kildare (2019-2023), a county in the Eastern Region of Ireland.
Extra regional impact	One of the actions of the recent EU Pollinator Initiative (2018) is to encourage all member states to develop national pollinator strategies and the AIPP has been selected as *the* template for this activity. Having successfully informed pollinator strategies in three European jurisdictions (Scotland, Norway and the Netherlands), the AIPP team is working with the Institute for European Environmental Policy (IEEP) to develop an updated template and have agreed to add a toolkit section to the AIPP website (www.pollinators.ie) in 2020 that will provide relevant resources for other EU member states.
Quality	With the launch of the AIPP in 2015, Ireland, North and South, joined a small number of countries in Europe who have developed a strategy to address pollinator decline and protect pollination services. The AIPP framework is an innovative, rich and accessible resource which facilitates positive steps by multiple users to protect pollinators and the ecosystem services they provide. According to the criteria set out in this assessment, the AIPP has proven itself to be strategically relevant and highly effective with ongoing intra- and extra-regional impact with local, regional, national and international recognition and adoption.
Potential for learning or transfer	The AIPP framework is potentially interesting for other regions since it applies a bottom-up, non-threatening approach to address the degradation of European ecosystems and the service they provide as recognised by the EU Biodiversity Strategy. Pollination is one of the regulating services of ecosystem processes. Section 4.1 of the *Roadmap to a Resource Efficient Europe* (www.eea.europa.eu/policy-documents/com-2011-571-roadmap-to) sets the 2020 milestone for public authorities and businesses to properly value natural capital and ecosystem services. The AIPP framework is an exemplary resource which can be easily transferred to other jurisdictions with a view to raising awareness of the economic, environmental and social value of the regulating services provided by pollinators and transferring the AIPP good practice. The AIPP itself was initially developed with minimal resources and continues to operate without a permanent or full-time dedicated staff. Despite this, it has been identified and applied as an appropriate template for the development of pollinator strategies in the EU Pollinator Initiative (2018). Indeed, transfer has already taken place with the AIPP directly informing pollinator strategies published in three European jurisdictions: 1. Scotland - Scottish Government (2017) – All 4 NUTS 2 Regions

	2. Norway – National Government – 8 Ministries (2018) – All 7 NUTS 2 Regions 3. The Netherlands – National Government and 35 initial partners (2018) – All 12 NUTS 2 Regions
Further information	All AIPP resources available at: https://pollinators.ie/

AIPP Stakeholders, County Cork. Source: Dr Úna Fitzpatrick, AIPP Co-Ordinator

2. National Ecosystem and Ecosystem Service Mapping Pilot for a Suite of Prioritised Services (NEES Mapping Pilot)

Summary

- **The NEES Mapping Pilot was commissioned by the National Parks and Wildlife Service (NPWS) of the Department of Arts Heritage Regional, Rural and Gaeltacht Affairs of Ireland to establish a framework for a National Ecosystem Assessment for country within the context of the EU's Biodiversity Strategy and, specifically, to assist implementation of MAES (Mapping and Assessment of Ecosystems and their Services) in Ireland.**
- **The information generated under the MAES process could be used to 1) value ecosystems and their services in the entire EU, and 2) promote the recognition of the economic value of ecosystems and their services on national and EU level accounting and reporting systems for environmental resources.**
- **As a key output, the project used pre-existing data to create a Habitat Asset Register for Ireland, a national scale habitat map conflating all nationally relevant habitat data into one dataset.**
- **This methodology uses a stepped approach for building a representation of the whole or a part of a complex ecosystem interaction. The rule-base assessment is based on indicators which interact in different ways for the services under consideration. The approach is iterative in nature which can be applied using standardised parameters or can be adapted using local knowledge. These factors make the model highly transferrable between contexts in different regions and countries.**

Brandon Bay, County Kerry	Inis Mór, Aran Islands, County Galway	Three Castle Head, County Cork

Photos by Ms. Gemma Weir NPWS Project Officer, NEES Mapping Pilot

Good practice general information	
Title of the practice	**National Ecosystem and Ecosystem Service Mapping Pilot for a Suite of Prioritised Services (NEES Mapping Pilot)**
Organisation in charge of the good practice	National Parks and Wildlife Service (NPWS) of the Department of Arts Heritage Regional, Rural and Gaeltacht Affairs, Ireland.
Description	
Short summary of the practice	The importance of natural ecosystems and ecosystem services has been widely acknowledged as a way of communicating the contribution that biodiversity makes to human well-being (economic & socio-cultural). Despite this, there are considerable practical challenges in applying the idea for policy and management purposes. This GP has drawn on existing tools, approaches and data to develop and demonstrate a mapping approach for ecosystem services. The dataset contains ecosystem service maps at the national scale for a set of services prioritised through stakeholder consultation.
Category of the good practice	Empowering tools
Resources needed	The NEES Mapping Pilot was funded by the Department of Arts Heritage Regional, Rural and Gaeltacht Affairs (a central Government Department) at a cost of €106,000 including VAT and developed over an 11-month period. The project was commissioned and managed by the NPWS. The contracted team were international leaders in the development of the Common International Classification of Ecosystem Services (CICES) - Marion B. Potschin and Roy H. Haynes-Young - and spatial data management systems (Environment Systems Ltd.). In addition to the contracted team, there were 2 NPWS staff members working on the project on roughly a 50% basis for much of the duration of the pilot, plus additional supports involved in steering and review activities. NPWS coordinated a number of workshops, with valuable input received from other public sector bodies and academia.
Timescale (start/end date)	The project ran for a period of approximately 11 months (July 2015 to June 2016) and the mapping tool, project report and further resources remain publicly available online. The original project manager continues to maintain a watching brief, subject to other priorities.
Strategic relevance (long term impact)	The NEES Mapping Pilot was commissioned by the NPWS to establish a framework for a National Ecosystem Assessment for Ireland within the context of the EU's Biodiversity Strategy. More specifically, the pilot was designed to assist

	implementation of MAES (Mapping and Assessment of Ecosystems and their Services) in Ireland. The MAES Working Group was set up under the EU Common Implementation Framework (CIF), the governance structure to underpin the effective delivery of Target 2 Action 5 of the EU Biodiversity Strategy 'to map and assess in its national territory the state of ecosystems and the services they supply'. The intention was that information generated under the MAES process would be used to 1) value ecosystems and their services in the entire EU, and 2) promote the recognition of the economic value of ecosystems and their services on national and EU level accounting and reporting systems for environmental resources. In terms of its long-term impact, the NEES Mapping Pilot provides a 'National Ecosystem and Ecosystem Services' map for a suite of prioritised services in pursuance of these strategic objectives
Evidence of success (results achieved)	In operationalising the MAES and the CICES, the mapping pilot has been an important resource for national, regional and local governments as they begin to quantify and account for ecosystem services within their authority areas. At the local level, various councils have started to use the National Habitat Asset Register (developed by the pilot) to quantify, map and value their ecosystem services. At the regional level, the Eastern and Midland Regional Assembly (EMRA) has used the NEES Mapping Pilot to demonstrate how ecosystem services can contribute to regional development for healthy living, climate action and economic opportunity, the key principles of the Regional Spatial and Economic Strategy (RSES) for the region. Therefore, it provided the basis for regional uptake and co-ordination of ecosystem services mapping across 12 local authority areas. At the national level, the NEES has directly influenced the National Biodiversity Action Plan (2017-2021) for Ireland. In terms of an extra-regional impact, this national level mapping pilot has been included as a GP for the implementation of MAES on the Biodiversity Information System for Europe (BISE). By means of the NEES, the Irish experience of the implementation of MAES was shared through the Horizon 2020 Coordinated Action 'ESMERALDA' http://www.esmeralda-project.eu/ (see intra-regional coordination and extra-regional impact sections for further information).
Tangibility	As a key output, the project used pre-existing data to create a Habitat Asset Register for Ireland, a national scale habitat map conflating all nationally relevant habitat data into one dataset. The dataset was derived through an additive analysis of relevant spatial data from a conflation of 46 datasets. The datasets were combined to produce a single habitat data layer or "habitat asset register". Intermediate layers were created for

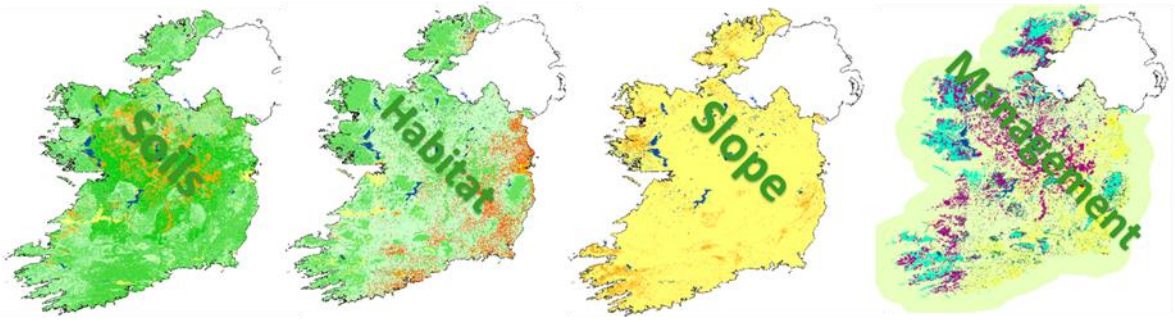
	some of the datasets, as they required manipulation in order to be used in the data conflation to create the Habitat Asset Register. A final project report with a full methodology for all resources created and analysis of results is available. This includes policy background and creation of CICES sub-classes for Ireland, as well as recommendations to further ecosystem service work in Ireland.
Durability	The ecosystem service "cascade" provides the conceptual framework for this project, and the basis for classifying ecosystem services using the CICES. The CICES has been used widely for supporting mapping and assessment projects. Its standardised nomenclature enables regional comparisons to be made and it has been adopted as a framework for MAES. The mapping tool chosen for this project was SENCE (Spatial Evidence for Natural Capital Evaluation: https://ecosystemsknowledge.net/sence-spatial-evidence-natural-capital-evaluation), selected primarily for its ability to be manipulated to accept a wide range of data sources at different scales, and its ability to deliver outputs for a variety of ecosystem services. It is a GIS system, which allows for stakeholder weighting to be applied and, therefore, local knowledge to be included. Where necessary, the project developed bespoke classifications for ecosystem services mapping in Ireland. This classification approach could be adopted for similar and complimentary initiatives in other regions (subject to data suitability).
Visibility	During the NEES project, there were 3 main opportunities for stakeholder input - two stakeholder workshops and a review of modelling data and rules during mapping. Stakeholders included representatives of organisations likely to be involved in implementing projects to restore ecosystems in Ireland, people with existing knowledge of environmental and societal issues and policy in Ireland, as well as technical experts and other stakeholders with knowledge of relevant data and projects. Not only did this engagement help to identify prioritised services, it also made the project highly visible to key stakeholders. After the NEES project period there was a Press Release published on May 8, 2017 (https://www.npws.ie/news/national-ecosystem-and-ecosystem-services-mapping-pilot-ireland). The Full Report and supporting documents are publicly available on the NPWS website: https://www.npws.ie/research-projects/ecosystems-services-mapping-and-assessment. There is also an Interactive ESRI Story Map viewer and GIS Raster data with full metadata publicly available for download: https://www.npws.ie/research-projects/ecosystems-services-mapping-and-assessment/story-map-viewer-and-data-downloads. Finally, the NPWS team has engaged with local

	and regional authorities, particularly for developing green infrastructure strategies in city and county development plans, as well as local area plans (see intra-regional co-ordination section), in addition to visibility achieved through European Union (EU) structures (see extra-regional impact section).
Added Value	The assessment of regional and national policy priorities by means of stakeholder engagement helped to identify principal areas of economic activity, including sectors and markets utilising living natural resources, which could be linked to the benefits from, or status and trends in, ecosystem services. In many areas, consultation also revealed a number of important cross-cutting issues. For example, participants in the consultation workshops identified the cultural heritage significance of landscape elements and unique uses of land as priority issues, particularly for tourism and its importance for rural economies. Similarly, the review of policies related to recreation, which was also highlighted by the stakeholder workshop, identified connections to national public health priorities associated with physical activity and social engagement. As such, broader uses of the NEES Mapping Pilot were identified compared to those initially envisaged.
Effectiveness	The stakeholder workshops resulted in the identification of prioritised ecosystem services for Ireland which became the focus of the mapping work. Using the outputs of the stakeholder consultation workshops as a starting point, the project team examined the relevance of ecosystem services to stakeholder concerns within Ireland, and to policy areas that are the focus of current concern. This enabled the team to identify which of the many ecosystem services should be prioritised for consideration by the project, and which, given currently available data, could be analysed and mapped. An assessment was made of national and regional policy priorities and related work programmes. In order to bring together the many different policy drivers and ecosystem themes, an interactive table was created to define areas of interest for the development of CICES sub-classes for Ireland.
Innovation	Rather than being prescriptive, the project team worked with local stakeholders to 1) identify which ecosystem services should be prioritised for the pilot, and 2) identify what needs to be mapped and what can be mapped, taking into consideration existing national spatial data sources and developing indicators for national ecosystem services mapping. Through this innovation, specific indicators that are appropriate for quantifying ecosystem service supply and demand were more efficiently identified. The GP also developed and extended the CICES framework through the development of sub-classes for Ireland.

Efficiency	Ireland currently has no standardised national terrestrial habitat mapping. This means that although there is a widespread range of habitat data available, these data are collected by different organisations for differing purposes. Numerous habitat datasets were made available for the NEES Mapping Pilot. However, each of these datasets had varying characteristics in terms of coverage (whole or partial), age, scale, nomenclature, quality and resolution. Therefore, a significant proportion of the project resources were required to address this deficit in order to create a seamless and comprehensive terrestrial habitat dataset, known as a 'Habitat Asset Register' as an indicator of the underpinning living systems that support ecosystem services. The Habitat Asset Register is suitable for re-use by the NPWS and has very few licence restrictions. However, given time (11 months project period) and resource (€106,000 including taxes) limitations of the NEES Mapping Pilot, only a subset of the potential policy relevant indicators at sub-class level identified were used for quantification and mapping. The selection was made on the basis of data availability and where policy priorities were identified through consultation. In order to continue the dialogue with stakeholders, as initiated through this project, identification of the next set of indicators that can be quantified and mapped would be beneficial. This task would require additional funding to be secured.
Externality	In terms of an already tangible externality/spill over effect, stakeholders are using the NEES Pilot as the basis for ecosystem services mapping at various scales. For example, the Dún Laoghaire-Rathdown local authority is using the NEES as the basis for implementing the ecosystem services approach at the local authority level: "Developing a wildlife corridor plan and evaluating their Ecosystem Services (ESS)". The project team is currently working on Phase II of that project and the evaluation data and the ESS will be utilised to inform management decisions for individual wildlife corridors and the network as a whole. This project builds on the NEES Mapping pilot by establishing a more local level dataset.
Intra-regional coordination	At the regional level, the Eastern and Midland Regional Assembly (EMRA) via the EP/JRC EnRoute project (Enhancing Resilience of Urban Ecosystems through Green Infrastructure: https://oppla.eu/groups/enroute) has used the NEES to demonstrate how ecosystem services can contribute to regional development. More specifically, the NEES Pilot was used to identify areas of importance for conservation and nature-based recreation. This activity provided the basis for regional uptake and co-ordination of ecosystem services mapping across the 12 constituent local authority areas of

	EMRA. At the national level, the NEES has directly informed the National Biodiversity Action Plan for Ireland (2017-2021).
Extra regional impact	In terms of the extra-regional impact, this national level mapping pilot has been included on the Biodiversity Information System for Europe (BISE). On this platform, it is set out as a GP for the implementation of MAES. The NEES Mapping pilot formed the basis for NPWS joining the Horizon 2020 Coordinated Action 'ESMERALDA' (Enhancing ecoSysteM sERvices mApping for poLicy and Decision mAking) (http://www.esmeralda-project.eu/). ESMERALDA brought together scientists, practitioners and policy makers to identify and demonstrate key scientific results and practical resources designed to assist and guide EU Member States in Mapping and Assessment of Ecosystems and their Services (MAES) in their respective local, national and pan-national contexts. NPWS revealed the Irish experience by means of the NEES Mapping Pilot.
Quality	Data to be included and mapped in the NEES Pilot was chosen after an audit of over 150 habitat datasets. In order to identify the most suitable datasets, thematic suitability, metadata quality, spatial extent, and resolution were examined and an extensive process of stakeholder consultation took place. During this process, the most suitable data for mapping at the national scale and a range of data gaps and limitations were identified. The National Habitat Asset Register was created from a conflation of 46 datasets. The best data available for each habitat type was used, which, in some cases, required the creation of primary intermediate layers. Each of the datasets was subject to a data suitability review. To ensure that future users of the Habitat Asset Register could understand the dataset, a full resource catalogue of metadata was also prepared in addition to a readme crib sheet (MS Excel lookup) referenceable to the number codes in the raster dataset. This ensures that the original datasets can be identified to give the user confidence if applying future updates, or if it is used in later projects. The robust and well-documented methodology applied makes this GP highly replicable and transferable, subject to appropriate resourcing.
Potential for learning or transfer	The need for an enhanced classification of CICES sub-classes depending on local characteristics was clearly identified during the NEES Mapping Pilot. These sub-classes represent ecosystem goods and services that can actually be measured 'on the ground' and which have a particular policy or management relevance in a given regional context. Such identification provides users with the kind of flexibility they need to develop geographically specific applications. The NEES Mapping Pilot clearly demonstrates how this can be done.

	However, it must be noted that any proposed action on individual sites will need to be assessed at a site level, using available data, or by creating more detailed information which is appropriate for supporting decisions at that scale. The GP utilised a rule-based approach to map and combine individual elements of ecosystem services, i.e. different data layers. This methodology uses a stepped approach for building a representation of the whole or a part of a complex ecosystem interaction. The rule-base assessment is based on indicators which interact in different ways for the services under consideration. The methodology is designed to be transparent and transferable. It uses scientific knowledge to score each ecosystem indicator using expert interpretation of the datasets used. The weightings are retained in a tabular format and the same approach can be applied to model and map other ecosystem services, or for application at a different scale. The approach is iterative in nature which can be applied using standardised parameters or can be adapted using local knowledge. These factors make the model highly transferrable between contexts.
Further information	https://www.npws.ie/sites/default/files/publications/pdf/IWM95.pdf https://www.npws.ie/news/national-ecosystem-and-ecosystem-services-mapping-pilot-ireland



Typical key factor maps. Source: Ms Gemma Weir/NEES Mapping Pilot

3. Territorial Information System for the Network of Open Areas in the province of Barcelona (SITxell)

Summary

SITxell is a free territorial analysis system within everyone's reach, making it possible to study and evaluate open areas (non-urban) in the Province of Barcelona based on the evaluation of their ecological, landscape and socio-economic characteristics. It is a very useful tool for the territorial planning processes on both, municipal and regional scales to promote territorial balance and sustainability.

The ultimate aim of the SITxell is to provide information and criteria for supporting local administrations in their land planning and management tasks, as well as to strengthen their participation in relevant regional projects.

The SITxell is perfect for analysing large areas to ensure an ecological approach for the territorial planning.

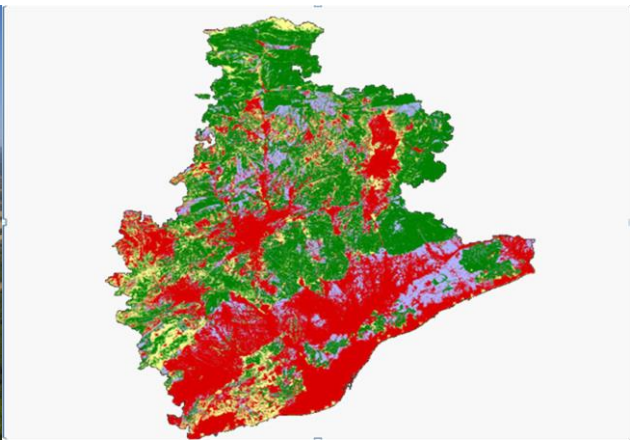
This territorial system (SITxell) has at least two unique innovative characteristics:

1) **it presents a conceptual framework (the territory as a system);**
2) **it ensures the acquisition, thanks to the collaboration with other groups of research, of diverse quality maps of the open spaces.**

The tool (SITxell):

- **could be used at different scales, from local to regional levels;**
- **is based on such available information as geographical cartography;**
- **promotes the collaboration among research groups and government, as well as with regional boards;**
- **has already been applied for specific and successful uses as the selection of natural areas for protection, territorial planning of several municipalities and cartography of ecological services at the regional level;**
- **can be and already is transferred to other European regions and beyond.**

Serra de Miralles, photo by Mr. Carles Castell



ServicesMap, CREAF, by Mr. Joan Pino and Ms. Corina Basnou

Good practice general information	
Title of the practice	**SITxell: Territorial Information System for the Network of Open Areas in the province of Barcelona**
Organisation in charge of the good practice	Barcelona Provincial Council
Description	
Short summary of the practice	SITxell is a **free territorial analysis system** within everyone's reach, making it possible to study and evaluate open areas (non-urban) in the Province of Barcelona based on the evaluation of their ecological, landscape and socio-economic characteristics. It is a very useful tool for the territorial planning processes on both, municipal and regional scales. Since 2001, Barcelona Provincial Council (BPC) has been drawing up the SITxell project as a response to one of its main objectives – promoting territorial balance and sustainability. In this context, SITxell is a result of work of the Technical Office for Planning and Territorial Analysis (Department of Territory and Sustainability) for improving knowledge about the open areas of the Province. The ultimate aim of this project is to provide information and criteria for supporting local administrations in their land planning and management tasks, as well as to strengthen their participation in relevant regional projects.
Category of the good practice	Information dissemination and awareness rising.
Resources needed	A team of 3 technicians for developing the tool and one technician for creating a local application were involved in the project implementation. The technical team running this project included Project Manager, System Administrator, team responsible for territorial analysis, Secretary and all collaborating experts that are further described in the Intra-regional coordination section below. In order to work in a greater detail (i.e. 1:10.000 in urban planning) or in more specific projects this was necessary to perform additional work to adjust a generic information to particular features of each case. In addition to steady costs of the project (experts working at the BPC, computers, licences, etc.), cost of external contracts and agreements (12 entities, from public researchers to private advisers) have been around 2M euros (during 15 years). Nowadays, update and maintenance cost of the SITxell is around 20.000 euros annually (external contracts).

Timescale (start/end date)	Since 2001 and still on-going. Before 2018, the Research and Innovation Team (together with academic partners) focused on ecosystem services mapping and green infrastructure approach. During 2019, methodology and mapping were extended to the whole Catalonia Region by the Regional Government.
Strategic relevance (long term impact)	Landscape information availability is imperative for strategic spatial planning, which is the most effective way of protecting natural systems. Moreover, maintaining and improving the functionality of ecosystems, and reducing the impacts of urban settlements and infrastructure on natural systems, also requires bringing different levels and sectors of the administration together in order to work in a cooperative and coordinated way. The SITxell approach means not to work only in protected areas, but also to extend these concepts and proposals for the land use planning at both – regional and municipal levels, which is the responsibility of the Government of Catalonia and Catalonian municipalities. To this end, the information contained in the SITxell project is made available to competent authorities. The project also offers technical assistance for urban and regional spatial planning processes. So far, collaboration has been established with many municipalities and various departments of the Government of Catalonia, which has allowed application of the content of SITxell to multiple plans and projects with very satisfactory results for all parties. Beyond that, current mapping of ecosystem services has been applied to the entire Catalonian territory, which implies broader long-term objectives and consequences. One of the first observed consequences has been the classification of regions, which have a source of ecosystem services or need them. This information will be applied to the territorial planning of green infrastructure at the entire government level.
Evidence of success (results achieved)	One of the main objectives of the BPC, developed primarily by the Department of Territory and Sustainability, was to promote territorial balance and sustainability. In this context, one of the tasks of the Technical Office for Planning and Territorial Analysis was to improve the information available of the open areas in the province of Barcelona. The most notable collaboration has been shown for the development of the Barcelona Metropolitan Plan. The SITxell has been applied at various stages of developing this Plan and in all areas related to territorial analysis: definition of physical framework, land use evolution and dynamics, further challenges and planning proposals. Finally, this Plan states that 227.000 hectares and 70.4% of the area of the metropolitan

	region are under a special protection regarding their natural and agricultural value. Since the beginning of 2006, the project has carried out around 60 complete municipal diagnoses to be applied for the local urban planning. In addition, 50 partial diagnoses (including only some specific information or diagnoses conducted for a part of the municipal land) were developed to be applied for specific projects of land protection, forest management, agriculture, tourism, etc. The first ecosystem services mapping of the entire Catalonian Region has been conducted and publicly presented on December 2019. At the BPC, last 3 years (2017-2019) have been mainly devoted to offering new products to municipalities. Therefore, local administrations can apply for mapping of green infrastructure (based on the information on natural values and ecosystem services), preparing local projects of conservation, managing and/or restoring relevant local areas, as well as for funding the development of these initiatives.
Tangibility	To evaluate open areas at various planning scales, this is necessary to have a good ecological and socioeconomic knowledge. The Province of Barcelona had a very little information about its' whole territory (generally the information was limited to nature protection areas). Therefore, key experts (research centres, university departments, specialized institutions and companies, etc.) were contacted to generate both: 1) basic descriptive information, which often did not yet exist; and 2) subsequent evaluative information. The latter type of information about values of the open space is the distinguishing feature of SITxell, enabling technical users to understand and evaluate the territory, and allowing to use the application in various plans and projects. The SITxell provides a modular structure for classifying the information gathered: 1) environmental modules, which include layers covering geology, hydrology, flora, vegetation and habitats, fauna, landscape ecology, cultural heritage and landscape; and 2) land use modules including layers related to socioeconomics, specific land policies, spatial planning, transport infrastructure and technical services. Better understanding of the open space provided by the cartography of values is also linked to a greater complexity of reading them. Each layer, therefore, has an associated geographical information metadata file. The distribution of SITxell mapping is carried out by using the SITMUN Municipal Territorial Information System, which offers many maps of the Province of Barcelona. All SITxell cartographic information is publicly accessible on the

	IDEBarcelona website by using the Web Map Service (WMS) specification.
Durability	The durability has been ensured since the first SITxell concept in 2001 was designed to its current use at the entire region level. Moreover, the governmental implication (in origin, development and use) ensures a long-term durability of the tool, since the still use and will use it for the municipal diagnoses and the ecosystem services mapping.
Visibility	Technical documents were published in Spanish, Catalan and English under a title: SITxell. A tool for interpreting the territory Dissemination article: Castell, C., Dalmases, C. i Margall, M. Els espais lliures de la regió metropolitana de Barcelona. Atzavara, 17. 2008 Books: El Sistema de Información Territorial de la Red de Espacios Libres de la provincia de Barcelona (SITxell). In: "El territorio como sistema. Conceptos y herramientas de ordenación". Ramon Folch (Coord.), Diputació de Barcelona, 2004. ISBN 9788477949626 Castell, C. 2019. Ecosystem services and green infrastructure: implementation at regional and local level. In: Renaturing cities. Barcelona Provincial Council's Press and Comunication, pp. 36-56. Technical conferences: 11/05/2010. 50 anys de canvis al territori: el Mapa de cobertes del sòl de 1956 de la Regió Metropolitana de Barcelona. 25/06/2009. La cartografia ambiental territorial al servei dels municipis de la província de Barcelona. 05/12/2019. Els Serveis Ecosistèmics de Catalunya: Eines i oportunitats per a l'avaluació ambiental i la planificació de la infraestructura verda. Also, there were many presentations of SITxell methodology at international conferences in Europe (Italy, Scotland, Ireland, etc.) and beyond (Chile, Colombia, etc.).
Added Value:	Because of the territory covered and the reference scale used, the SITxell is perfect for analysing large areas. This level of analysis allows to support planning policies developed by the BPC, as well as coordinated work with the Government of Catalonia to ensure an ecological approach for the territorial planning. In the framework of the territorial planning programme under the responsibility of the Department of Territory and Sustainability of the Government of Catalonia, the BPC has

	collaborated for planning the open areas of the Province of Barcelona. Moreover, in parallel to the elaboration of the Metropolitan Plan, the SITxell has been essential for developing the Strategic Environmental Assessment of the Plan, especially for incorporating environmental sustainability criteria in parts related to the system of open areas. Finally, on the regional scale of application the SITxell is also a very useful tool for influencing, in a reactive way, large projects, mainly infrastructures projects, which are affecting extensive areas.
Effectiveness	The approach of SITxell development has been to build different features through the territorial information system from multidisciplinary (incorporating many features that converge in the definition of open spaces characteristics), flexibility (to allow global or partial analyses of the territory from different points of view), sustainability (balanced weight of the importance of diverse key aspects) and clarity (rigorous and away of the tendency to resolve matters quickly) perspective, so that results are realistic and applicable. The quantity and quality of information gathered by the SITxell is of a great interest for local administrations offering municipalities a broader regional perspective of their open spaces. Local governments have, thus, more relevant information for defining the usage of their territories. Their responsibility to administrate land uses goes beyond legal obligations related to environmental issues. The SITxell project has been one of the keys for establishing the natural areas with a special protection and conducting the Strategic Environmental Assessment of the overall Plan. In addition, the SITxell has been used to improve the integration of projects proposed by other administrations, which may not necessarily be environmental, as in the case of the implementation of several transport infrastructures. If required, The SITxell team offers to the BPC municipalities a Diagnosis Study of their Open Spaces, which is always conducted taking into account real regional conditions. The Diagnosis Study includes description and evaluation of the open spaces, as well as planning and management guidelines, as well as recommendations that can be included in the municipal planning documents.
Innovation	This territorial system (SITxell) has at least two unique characteristics: 1) it presents a conceptual framework (the territory as a system); 2) it ensures the acquisition, thanks to the collaboration with other groups of research, of diverse quality maps of the open spaces. Both previously mentioned characteristics permit SITxell to be not only a store of

	descriptive territorial data, but also ensure that stored information could be directly applied for the evaluation of open spaces. This assessment cartography, developed by expert groups and based on diverse sources of descriptive cartographies, is one of the main innovations of the system. In other words, SITxell goes beyond description to assessment.
Efficiency	As described above in the part "Resources needed", a small team could take care of maintenance and implementation once the tool becomes operative. Also, considering low maintenance costs, the tool (SITxell) can be considered as highly efficient. Moreover, the collaboration with different research teams has been based on the use of already developed maps, GIS and models. Therefore, by providing a draft version the duplication of efforts is being avoided. Because of its conceptual and technical characteristics, the territorial information contained in the SITxell can be used on different scales and at different decision-making levels. The reference scale (1:50 000) allows almost direct implementation of the assessments for plans and projects on the macro-territorial level (up to 1:25 000). At the request of municipal councils, experts from the Technical Office for Land Analysis and Planning can carry out field and office work necessary to provide information at the appropriate scale (in most cases – 1:5 000 - 1:15 000). In general, the SITxell is applied for the three broad territorial areas, and, therefore, working scales: 1) Municipal; 2) Network of Natural Parks; 3) Regional.
Externality	The most common use of the tool (SITxell) is associated with municipal urban planning, but is often linked to planning, management and/or publicising natural heritage. In addition, an advice on projects affecting municipal territories can be provided to councils. As a part of work on the Natural Parks managed by the BPC continuous reviews of the spatial plans are taking place. The information provided by the SITxell is a starting point, when considering new areas for protection and/or new criteria for protection and planning. In addition to specific principles for new spatial plans, a broad territorial view offered by using the SITxell provides a framework for protected areas of the whole network and establishes, for example, a protection for related areas for territorial connectivity. Through the SITxell, the BPC has assisted the regional planning programme of the Department of Territory and Sustainability (Government of Catalonia), in planning of the open areas of the entire Catalonia Region. In any case, the greatest involvement and use of the SITxell has been observed during the

	development of the Plan for the Metropolitan Region of Barcelona.
Intra-regional coordination	The Land Analysis and Planning Office (Natural Areas Department, BPC) is the promoter of SITxell and technically responsible body for its operation and maintenance. Among the BPC structures, apart from the Natural Areas Department-Territorial Planning and Analysis Office, the other contributors were the Local Cartography and GIS Technical Office, and the Information System and Technologies Management Office. Also, other bodies responsible for policy administrations, such as the Environment Department of the Catalonian Government and the Regional Board of Bages have provided some basic information to be integrated in the SITxell. The following groups have cooperated under agreement: a remote Sensing and Geographic Information Laboratory (LIGIT) and Hydrogeology and External Geodynamics Department of the Autonomous University of Barcelona; Geo-botanic and Vegetation Cartography Group and Bonelli's Eagle Study Group of the Barcelona University; CREAF ; Mediterranean Rivers' Study Centre (CERM); Catalonian Ornithology Institute (ICO); Minuartia Environmental Studies; Unió de Pagesos (Agricultural labour union); and DEPANA (conservational organization).
Extra regional impact	Main pilot studies have been carried out during the Interreg IVC Project (GreenInfraNet). Three partners applied SITxell (principles, methodology, development, etc.): - County of Fingal (Ireland) applied the SITxell to urban Planning at the supra-municipal scale. - Province of Flevoland (the Netherlands) applied the SITxell to identify intensive agricultural areas to be restored for the conservation use. - Hungary – Pilot projects implemented in 2 National Parks and afterwards spread throughout the whole country. Some other initiatives to be mentioned were the ecosystem services mapping performed for Catalonia (already previously mentioned) and a pilot project performed for the region of Talca (Chile), other initiatives in different countries followed.
Quality	The rigour for development and obtaining the information about analyses have been the key drivers of the project approach. Therefore, the basis of the SITxell development was (and still is) the collaboration within main expert groups (public administrations, universities, research centres and enterprises) of every related sector, which already had relevant information before starting that ensured the quality of the tool. Also, participation of such specialized expert teams allowed to

	avoid duplicating efforts for obtaining already existing information, as well as to ensure serious, reliable and test based essential updates of the data. In 2011, the SITxell project was among finalists of the European Public Sector Awards (EPSA). In 2012, it received the United Nations Public Sector Award (UNPSA).
Potential for learning or transfer	Firstly, the tool (SITxell) could be used at different scales, from local to regional levels. Secondly, it is based on such available information as geographical cartography. Thirdly, it promotes the collaboration among research groups and government, as well as with regional boards. Fourthly, it has already been applied for specific and successful uses as the selection of natural areas for protection, territorial planning of several municipalities and cartography of ecological services at the regional level. Fifthly, it has already been transferred to other European regions and beyond (See the part "Extra regional impact".).
Further information	http://www.sitxell.eu/en/default.asp

4. LIFE EcosystemServices: Ecosystem Services Assessment Methodology (ESAM)

Summary

The Ecosystem Services Assessment Methodology (ESAM) is developed within the LIFE project. The ESAM ensures an innovative approach for the territorial planning processes in coastal areas, thus, ensuring the balance between environmental protection, biodiversity conservation, as well as social and economic aspects. The ESAM comprises 22 ecosystem services' indicators divided into 3 groups: 1) provisioning services; 2) regulating and supporting services; 3) cultural services. Based on these indicators the biophysical assessment can be carried out.

The main aim of this practice is to promote the evaluation of ecosystem services based on a sustainable decision making for the Latvian (Baltic Sea) coastal policy and planning documents.

The ESAM provides a possibility to measure ecosystem services in monetary terms. Therefore, by using the ESAM, more efficient governance of the land use can be achieved which could also be valuable for other regions. Even though this GP has a greater potential for being transferred to coastal areas, the framework of ESAM can also be adjusted for evaluating ecosystem services in non-coastal areas.

Saulkrasti Pilot territory, source:

https://ekosistemas.daba.gov.lv/public/lat/fotogalerijas1/projekta_pilotteritorijas/saulkrastu_pilotteritorija_foto_projekta_life_ekosistemu_pakalpojumi_arhivs/

Good practice general information	
Title of the practice	***LIFE EcosystemServices: Ecosystem Services Assessment Methodology (ESAM)***
Organisation in charge of the good practice	Nature Conservation Agency of Latvia
Description	
Short summary of the practice	The main aim of the "LIFE EcosystemServices" (hereinafter referred to as LIFE) project is to promote the evaluation of ecosystem services based on a sustainable decision making for the Latvian (Baltic Sea) coastal policy and planning documents, as well as to increase public awareness about ecosystem services. The Ecosystem Services Assessment Methodology (ESAM) which is developed within the LIFE project provides an innovative approach for the territorial planning processes in coastal areas, thus, ensuring the balance between environmental protection, biodiversity conservation, as well as social and economic aspects. This methodology is developed following the best EU practice (https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm) using for evaluation and mapping of ecosystem services. The ESAM comprises 22 ecosystem services' indicators divided into 3 groups: 1) provisioning services; 2) regulating and supporting services; 3) cultural services. Based on these indicators the biophysical assessment was carried out and produced possible development scenarios for piloting two Baltic Sea coastal areas (Saulkrasti – 132.86 ha; Jaunķemeri – 90.85 ha; both areas are specially protected Natura 2000 sites in coastal territories). For economic evaluation of ecosystem services, the LIFR project approbated methods, which were considered as the most suitable: Market Price Method; Travel Cost Method; Benefit Transfer Method. These methods based on 22 ecosystem services` indicators were used to determine the economic value of ecosystem services in EUR/ha.
Category of the good practice	**Empowering tools**
Resources needed	Total funding of the EU LIFE+ programme project LIFE13 ENV/LV/000839 - 753290 EUR Staff Costs: 423 300 EUR Travel Costs: 27 900 EUR

	External Assistance Costs: 171 000 EUR Biophysical Assessment Costs: 48 473 EUR (216,68 EUR/ha). Economic Evaluation Costs: 115 459 EUR (516,11 EUR/ha).
Timescale (start/end date)	June 2014 – March 2020
Strategic relevance (long term impact)	The ESAM creates an innovative approach for territorial planning strategies in coastal areas of Latvia, thus, offering a balance between environmental, social and economic aspects. This methodology is developed in accordance with the best EU practice for evaluating and mapping ecosystem services. Concept and methodology of the project is developed in an integrated holistic way, which provides better decision making opportunities for coastal municipalities and advance spatial planning processes in the Latvian coastal areas. Therefore, this GP is strategically linked to a long term advancement of ecosystem services management on all 3 levels – national, regional and local.
Evidence of success (results achieved)	Two pilot studies in coastal areas of Saulkrasti and Jaunķemeri were successfully carried out. ESAM methodology and "Toolkit for using the ecosystem services approach in planning" (http://riks.ekosistemas.daba.gov.lv/) for ecosystems evaluation in coastal areas has been developed and can be used by coastal municipalities. The following recommendations obtained during the approbation of ESAM have been developed and integrated in the Latvian coastal policy and related planning documents: • Saulkrasti municipality Development Programme 2014 – 2020 (Results will be also further used for the following planning period (2021-2027)); • Nature Management Plan for Natura 2000 site - Nature Park "Piejūra" (in the territory of Saulkrasti municipality).
Tangibility (concrete results of a GP (e.g. as measured through indicators))	It is envisaged that results of the LIFE project and recommendations for using the ecosystems services approach for developing the nature management plans for specially protected nature areas will be used for updating the Nature Management Plan of the Ķemeri National Park. The update must take place by 31 December 2023. The Nature Design Park (NDP) "White Dune – Saulkrasti" in the Saulkrasti town was developed in the framework of the LIFE project in 2016. Since then a number of visitors, as well as the value of cultural ecosystem services during the season (from May to September) have been gradually increasing. The NDP provides environmental education opportunities, as well as cognitive-oriented leisure time possibilities.

Durability (potential of a GP to become a durable model for similar or complementary initiatives for the policy theme/reference sector)	ESAM is a durable model for assessing coastal areas of Latvia from biophysical and economic perspectives. Based on the biophysical and economic assessment of the both pilot areas (Saulkrasti and Jaunķemeri) it can be stated that the ESAM is adjustable to other coastal areas of Latvia, as well as different territories around the Baltic Sea, and it has also a potential to be transferred to other European regions. Toolkit (http://riks.ekosistemas.daba.gov.lv/) of the ESAM has been developed to make applicability and transferability of the ESAM easier to interested parties. It includes 1) Video tutorial (http://riks.ekosistemas.daba.gov.lv/video-pamaciba/); 2) Theory about ecosystem services approach (http://riks.ekosistemas.daba.gov.lv/teorija/); 3) Examples and Practice using ecosystem services approach in territorial planning (http://riks.ekosistemas.daba.gov.lv/piemeri-un-prakses/), which, however, includes developed models: 1) Ecosystem Services Economic Evaluation Model aimed to determine the economic value of ecosystem services and to determine changes in the economic value of ecosystem services 2) Management Strategy Model, which shows predictable changes in the quality and supply of the ecosystem services depending on chosen type of territory management 3) Territory Planning and Modelling Model, which shows predictable changes in the value of ecosystem services by changing the areal proportions of different types of land use or ecosystems in the territory.
Visibility	The visibility of project results was ensured by using such tools as the web page: https://ekosistemas.daba.gov.lv/public/eng/, social media channels, public information and education materials (leaflets, brochures, newsletters, short films, publications), public information and educational events, such as seminars, workshops, presentations at universities, schools and municipalities, as well as during meetings, conferences and other events), experience exchange and networking. The project team has presented the ESAM to coastal municipalities of Latvia, the Latvian Ministry of Environmental Protection and Regional Development, consultancy companies and others dealing with the environmental impact assessment, spatial and nature protection planning in Latvia to encourage the application of ESAM in their decision making and planning processes. The emphasis has been put on ensuring sustainable development of coastal territories. However, none of the laws or regulations obliges coastal municipalities to use the ESAM yet.

	The project has had a positive impact on the society at large. During its implementation from 2015 to 2019, 6 seminars were organized to improve knowledge of target audience about the ecosystem services. From 2015 to 2019, 8 events for schools and universities have been held raising awareness on the importance of ecosystem services. Additionally, short promotional films: 1) "Ecosystem services" (https://www.youtube.com/watch?time_continue=19&v=RNiWe7j-c3Y&feature=emb_title); 2) "Ecosystem Services evaluation" (https://www.youtube.com/watch?time_continue=6&v=cLbO236dw_Q&feature=emb_title); and 3) "Ecosystem services assessment – a tool for spatial planning" (https://www.youtube.com/watch?v=lbNQkM0UJDg&t=2s) in Latvian with English subtitles were developed. In total, information campaigns and dissemination activities reached ~430 000 people on social networks and ~1500 people through project activities.
Added Value: (effectiveness, innovativeness, efficiency, etc.)	The added value is the developed Ecosystems Services Assessment Methodology (ESAM), which can be adjusted to other coastal areas and territories. The ESAM helps to: • calculate investment for the environmental protection; • provide different spatial development scenarios; • make better negotiation with different groups of society; • identify economic value of nature and its contribution to the society; • choose the most sustainable spatial development options; • determine and compare the economic efficiency of investment on ecosystem; • calculate costs of the environmental damage; • evaluate different ways of the ecosystem management such as the land use etc.; • raise awareness about the ecosystem services and their impact on the well-being of people.
Effectiveness (tangible achievements and results of a GP practice and the resulting benefits for the different stakeholders)	The ESAM is universal and adjustable to any municipality, but, especially, 17 coastal municipalities of Latvia. It can be used on national, regional and local levels, where developed recommendations can help to adopt policy and planning documents for ensuring sustainable development. The beneficiaries of the GP are coastal municipalities and directly – Saulkrasti (White Dune coast) and Jurmala (Jaunkemeri coastline) municipalities, where the ESAM pilots were tested. During the testing process three development scenarios were considered for each territory: 1) Zero scenario

	where situation remains unchanged; 2) Sustainable development scenario; 3) Uncontrolled development of pilot area. Results emphasized sustainable development scenario as the most suitable for gaining the maximum ecosystem services economic value. The ESAM has been approbated by using cost-benefit analysis in the Saulkrasti pilot area, which allows to evaluate the efficiency of land use. The Ministry of Agriculture of the Republic Latvia and the Ministry of Environmental Protection and Regional Development of the Republic of Latvia are also benefiting from this GP, because the ESAM provides potential monetary measurements of ecosystem services in coastal areas. Clearly, it will help to provide measurable macro level data related to the provision of ecosystem services, which can be used in the decision making processes for spatial planning related to the land use from a perspective of sustainability, where economic, environmental and social dimensions are overlapping. The Nature Conservation Agency of Latvia has submitted proposals to the Ministry of Environmental Protection and Regional Development of Latvia for amendments of the development procedures of nature protection plans (The Regulations of the Cabinet of Ministers No 686 (09.10.2007) "Regulations on content and drafting of nature protection plans for especially protected nature territories") requiring the assessment of ecosystem services to become a mandatory part of any nature protection plans.
Innovation (Innovation: degree of innovativeness of the proposed solution)	The ESAM provides an innovative approach for territorial planning processes in the coastal areas of Latvia, thus, ensuring balance between environmental protection, biodiversity conservation, as well as social and economic aspects. This innovative methodology for the Latvian coastal municipalities helps to make environmentally friendly and financially beneficial decisions related to the use of resources and ecosystem planning.
Efficiency (amount of resources (human, economic, social, technical etc. and other critical success factors) required for the implementation, and the effective and efficient use thereof)	Up to 5 project staff members and 13 external experts were involved in performing of biophysical assessment and economic evaluation. Regarding monetary resources please see the part "Resources needed".
Externality (observed external and additional effects of a GP practice, e.g. to inspire concrete actions like exchange of experience,	The ESAM was used for improving planning documents of the Saulkrasti municipality as described above. Also, it was recognised as a good practice for other Latvian projects related to the ecosystem services assessment – LIFE Restore, LIFE14 CCM/LV/001103, Latvian State Forest Research Institute

methodologies, tools, know-how, information, etc.)	Silava and JSC "Latvian State Forests" collaboration project "The impact of forest management on forest and related ecosystem services", as well as other projects and initiatives. As a result of the LIFE project, the discussion forum *"Cooperation and experience exchange about ecosystem services evaluation in Latvia" has been established. It has organized three discussion forums during the period from 2017 to 2019 and gathered more than 50 experts from state, NGOs and academic sector.*
Intra-regional coordination	*The ESAM has given an opportunity to weigh advantages and disadvantages of an intended development perspective from environmental, social and economic points of view.* Therefore, the LIFE project team has cooperated with planning practitioners and public organizations, shared and exchanged knowledge, experiences and searched for the most suitable solutions for Latvia in a successful use of the assessment of ecosystem services in an applicable planning process. During the summer season the LIFE project team participated in different local level events and organized environmental education activities to teach about ecosystem services in the project's pilot areas of Saulkrasti and Jaunkemeri. The aim of educational activities has been to inform inhabitants of Saulkrasti and Jaunķemeri about ecosystem services and benefits which they provide. The LIFE team has also created a number of environmental education materials which have been used by Nature Education Centres of the Nature Conservation Agency of Latvia: • worksheets about the ecosystem services for different age groups; • the game "Sort ecosystem services"; • the game "Three meters of ecology"; • the game "Ecosystem services approach" Materials are publicly available here: https://ekosistemas.daba.gov.lv/public/lat/rezultati_un_publikacijas1/vides_izglitibas_materiali/ During the preparation of the LIFE project recommendations for the Saulkrasti Municipality Development programme 2014-2020 nine thematic working group sessions were organised in 2017. During the elaboration of recommendations for integrating the ecosystem services approach into spatial planning of Latvia, the following key institutions – Nature Conservation Agency; Association "Baltic Coasts"; Saulkrasti Municipality; LTD "Metrum"; University of Latvia Faculty of Geography and Earth Sciences; Latvian Coastal Municipalities Association; Spatial Planning Department of Riga Planning Region; Rural Development Support Department of Ministry of Agriculture;

	Ministry of Environmental Protection and Regional Development - were involved (3 expert group meetings and online consultations with exert group members).
Extra regional impact	Results of the LIFE project have been presented in 13 international events (scientific conferences, conferences, experience exchanges, meetings) in Latvia, Estonia, Belgium and Germany. Experts contributing to the development of ESAM were also involved in the project ESMERALDA (Enhancing ecoSysteM sERvices mApping for poLicy and Decision mAking) contributing to the outputs of the project: https://biodiversity.europa.eu/countries/latvia##t-3 During the LIFE project implementation exchange visits networking activities and individual meetings with experts from other regions and projects were organised, where "LIFE EcosystemServices" project approach and results were presented and discussed. The cooperation involved the following projects: 1) LIFE Restore; 2) "The impact of forest management on forest and related ecosystem services" (Latvian State Forest Research Institute Silava and JSC "Latvian State Forests" collaboration project); 3) ESMERALDA; 4) Bonus Basmati; 5) CAP LIFE LAT; 6) LIFE CoHaBit; 7) LIFE NAT-PROGRAMME; 8) LIFE Viva Grass; 9) INTERREG CBSR - Coast4us project.
Quality	Annual External Monitoring Visits have been organised to ensure the LIFE project implementation quality. The European Commission carried out the LIFE project monitoring in collaboration with the NEEMO experts (https://neemo.eu/).
Potential for learning or transfer	The LIFE project produced the methodology (ESAM) and the ESAM toolkit for evaluating ecosystem services in coastal areas. The ESAM provides a possibility to measure ecosystem services in monetary terms. Therefore, by using the ESAM, more efficient governance of the land use can be achieved which could also be valuable for other regions. Even though this GP has a greater potential for being transferred to coastal areas, the framework of ESAM can also be adjusted for evaluating ecosystem services in non-coastal areas by using these indicators: 1) provisioning services; 2) regulating services; and 3) cultural services. The awareness raising activities, such as the development of Nature Design Park, as well as designed educational and visual materials can also serve as an inspiration for raising the awareness on environmental protection and for enhancing ecosystem services in other regions.
Further information	https://ekosistemas.daba.gov.lv/public/eng/

Ķemeri Pilot territory, source: https://ekosistemas.daba.gov.lv/public/lat/fotogalerijas1/projekta_pilotteritorijas/jaunkemeru_pilotteritorija_foto_projekta_life_ekosistemu_pakalpojumi_arhivs/

5. Guidelines for assessing soil ecosystem services in urban environment and their management.

Summary

The guidelines for assessing soil ecosystem services in urban environment and their management have been developed in the framework of the SOS4LIFE project.

The objective of these guidelines is to show that urban soils perform the same function as a natural soil contributing to the provision of Ecosystem Services. However, the degree of disturbance to which urban soils are subjected, the level of sealing and the type of coverage have an influence that needs to be described in detail and taken into account for a sound assessment of the ecosystem services they provide. Given the great variability of the urban environment and differences between different urban environments, there are no standardized references for the survey and mapping of urban soils. Therefore, these guidelines present different assessment tools for the biophysical estimation of six soil based ecosystem services based on quality and quantity of available soil data. The six ecosystem services considered in the guidelines are: habitat for organisms, buffering capacity, microclimate regulation, carbon storage, biomass production, water storage, water regulation.

The methodology provided by the SOS4LIFE project is based on standard soil data and information that are usually stored in regional databases, and, given data availability, can be fully transferred and implemented in different contexts and at different scales (region, province, and municipality).

Survey of the urban soil of Caropi: profile on allochthonous soil material (landfill)

Title of the picture: Survey of the urban soil of Carpi: profile on in situ soil material

Source: Dr. Fabrizio Ungaro, CNR IBE, Institute for BioEconomy of Italy.

Good practice general information	
Title of the practice	**Guidelines for assessing soil ecosystem services in urban environment and their management**
Organisation in charge of the good practice	Municipalities of Forlì, Carpi and San Lazzaro di Savena, Regione Emilia Romagna,
Description	
Short summary of the practice	The practice was developed within the EU funded project SOS4Life (LIFE15 ENV/IT/000225). The action was coordinated by the Institute for BioEconomy of the Italian National Research Council (CNR IBE) with the partnership of Regione Emilia-Romagna and municipalities of Forlì, Carpi, and San Lazzaro di Savena. The main idea of these guidelines is to show that urban soils perform the same function as a natural soil contributing to the provision of Ecosystem Services. However, the degree of disturbance to which urban soils are subjected, the level of sealing and the type of coverage have an influence that needs to be described in detail and taken into account for a sound assessment of the ecosystem services they provide. Given the great variability of the urban environment and differences between different urban environments, there are no standardized references for the survey and mapping of urban soils. These guidelines present different assessment tools for the biophysical estimation of six soil based ecosystem services based on quality and quantity of available soil data. The six ecosystem services considered in the guidelines are: habitat for organisms, buffering capacity, microclimate regulation, carbon storage, biomass production, water storage, water regulation.
Category of the good practice	Sustainability instruments
Resources needed	Funding/financial resources used: the budget allocated to this action (Assessment of the Ecosystem Services provided by soil, and definition of interventions for their improvement") within the SOS4LIFE project is 151,246 € (40% of which come from co-funding). Human resources required to set up and run this action: approximately 23PM (person months) Please, note that resources needed critically depend on the amount of available soil data and that the above figures refer to

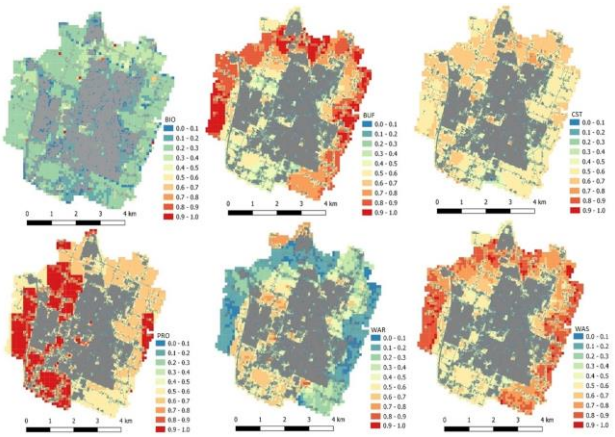
	the three different scenarios defined in terms of soil data availability: i) No soil data available at the required scale of investigation; ii) Soil maps and data available at the required scale of investigation; iii) Soil functions maps and data available at the required scale of investigation; In the project, all three scenarios were worked out to assess the provision of six ecosystem services for urban soils. As for human resources, personnel skilled in the GIS technology and pedology is required to set up and run the practice.
Timescale (start/end date)	January 2019 – September 2020
Strategic relevance (long term impact)	Considering soils not as a mere physical platform to support urban infrastructure but a natural capital at the base of the delivery of ecosystem services resulting in direct and indirect benefits to humans will represent a cultural shift and a radical change in the ordinary practice of urban planning. This would in turn result in enhanced mitigation of the effects of an ongoing climate crisis and in an increased resilience of the urban ecosystem to its effects.
Evidence of success (results achieved)	The detection, evaluation and mapping of ecosystem services provided by urban soils aims at quantifying ecosystem services and planning actions for their protection and enhancement. The methodology for assessing soil ecosystem services in urban environment and their management has been successfully tested in municipalities of Carpi, Forli and San Lazzaro di Savena, where soil ecosystem maps have been produced, along with the economic evaluation of ecosystem services losses due to soil sealing. The methodology is currently being integrated in the urban planning of the three partner municipalities and can be applied to all municipalities of Emilia-Romagna region.
Tangibility	As this practice addresses soil conservation and soil based ecosystem services enhancement in the urban context, tangible effects are related to the public perception of the effects of soil functions conservation, e.g. sustaining urban biodiversity and plant life (air quality, regulation of water infiltration (runoff decrease, water quality improvement), microclimate regulation (i.e. heat island effect reduction), occasion of recreational and social activities in the public green areas.
Durability	As the practice itself is an assessment methodology to integrate current urban planning practices, it is durable as long as it is an integral part of the urban planning design, which is successfully implemented with the goal to protect soils and enhance their ecosystem services. Its durability is actually linked to the

	decision of policy makers at any administrative level to implement this practice.
Visibility	As the practice addresses soil conservation and soil based ecosystem services enhancement in the urban context, the visual perception of its implementation by the general public takes place through the indirect effects generated by the presence of (natural) soils generating a flux of services through their functions, e.g. the presence of vegetation, the sustenance of biodiversity, the regulation of water fluxes (run-off reduction).
Added Value:	Soils are non-renewable resource as such, thus, assigning them monetary or market value is somehow reductive. Furthermore, soils provide ecosystem services that by their nature are defined as intangible and as such aren't valuable (i.e. cultural ecosystem services: sense of place, health and well-being, aesthetic values, educational values). Nevertheless, for different soil based ecosystem functions it is possible to estimate values (market value, use values), which are strictly linked to properties of soils as a natural capital. Then they vary from soil to soil being influenced by external drivers, such as land use and management practices. As an example, the following figures were estimated for the three partner municipalities: San Lazzaro di Savena: € 268,190.06/ha annually Carpi: € 312,227.28/ha annually Forlì: € 293,530.03/ha annually
Effectiveness	Including soil based ecosystem services into the practice of urban planning is one of the key issues towards sustainable and resilient cities. This good practice provides a set of conceptual and practical tools towards the production and integration of information that is fundamental for placing soils and their ecosystem services at the centre of planning process through the implementation of an overall soil quality index based on the different ecosystem services considered. The soil quality index is currently being implemented into an Informative system for evaluation and monitoring of land take and its impacts at municipal scale for the whole Emilia-Romagna region.
Innovation	The good practice introduce soils and their services as new central elements of the urban planning process, because the occupation by infrastructures of unbuilt surface must take into account inherent differences in ecosystem services provision, when considering alternative options or adopting compensation measures.
Efficiency	The good practice foresees and suggests different levels of ecosystem service assessment considering the availability of various indicators, such as soil data and information, as well as

	additional resources for ad hoc soil survey at a municipality scale. The good practice proposes to maximize the efficiency of existing information by making the best use of available data tailoring it to the actual situation of case studies addressed.
Externality	The application of this good practice, as well as public demonstrations and dissemination events implemented so far, have from one side provoked considerable interest in its potential application by other municipalities and administrative bodies (e.g. province), and on the other side attracted favour of the public, whose awareness for sustainability is constantly growing.
Intra-regional coordination	The Region of Emilia-Romagna is a partner of the SOS4Life project, which co-authored its' guidelines, provided the available soil data for realization of this good practice and coordinated the ad hoc urban soil survey in the municipality of Carpi.
Extra regional impact	Through the request received by the ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale – High Institute for Environmental Protection and Research) to contribute articles for the 2019 and 2020 annual editions of the Italian National report of the Ministry of Environment on soil consumption, territorial dynamics and ecosystem services, this good practice gained visibility and appreciation on a larger scale. Also, this good practice was awarded by the annual conference on urban planning and urban regeneration of 2019 (https://urbanpromo.it/info-en/?noredirect=en_US) edition Urban Promo in the category "Technological Innovation for Urban Management"
Quality	The methodology presented by this practice is sound and scientifically based, though, the quality of its implementation is strictly linked to the quality of available soil data.
Potential for learning or transfer	The methodology to assess and quantify the soil-based ecosystem services has been developed within the framework of the EU funded project SOS4LIFE (LIFE15 ENV/IT/000225). SOS4LIFE is a demonstration project that aims to contribute to the European level enforcement of soil protection and urban regeneration at a municipal scale with particular reference to the Guidelines on best practices to reduce, mitigate and compensate soil sealing [SWD(2012) 101]. Tools, rules and actions promoted by the SOS4LIFE project are aimed at implementing (in advance) the Community strategy "no net land take by 2050" according to the Roadmap to a resource efficient Europe [COM(2011) 571] as confirmed also by the 7th Environment Action Programme [1386/2013/EU]. The methodology provided by the SOS4LIFE project is based on standard soil data and information that are usually stored in

	regional databases, and, given data availability, can be fully transferred and implemented in different contexts and at different scales (region, province, and municipality). The soil ecosystem services considered are those, which are deemed to be the most relevant for sustainability of the urban environment and well-being of its inhabitants, During the SOS4LIFE project lifetime this good practice has been implemented in the three partner municipalities (LAU2, Forlì, Carpi and San Lazzaro di Savena), in the largest part (252 municipalities) of the Emilia Romagna region (NUTS 2), and has been recently used by the Provinces of Reggio Emilia and Bologna (NUTS 3) to support and integrate a new territorial plan.
Further information	www.sos4life.it https://www.sos4life.it/documenti/ https://www.sos4life.it/wp-content/uploads/B1.3-Guidelines-for-assessing-soil-ecosystem-services.pdf https://ec.europa.eu/environment/soil/pdf/soil_sealing_guidelines_en.pdf https://ec.europa.eu/environment/integration/research/newsalert/pdf/no_net_land_take_by_2050_FB14_en.pdf https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0571&from=EN Calzolari et al., 2016. A methodological framework to assess the multiple contributions of soils to ecosystem services delivery at regional scale. Geoderma, Volume 261, 1 January 2016, Pages 190-203 https://doi.org/10.1016/j.geoderma.2015.07.013

Recent urban expansion on agricultural peri-urban soils between Carpi city centre and A22 highway



Soil ecosystem services maps: top (from left to right) habitat for organisms, buffering capacity, carbon storage; bottom (from left to right) agricultural production, water regulation, water storage

Source: Dr. Fabrizio Ungaro, CNR IBE, Institute for BioEconomy of Italy.