SOS4LIFE
SAVE OUR SOIL FOR LIFE

PROGRESS
Interreg Europe

European Union
European Regional
Development Fund

SOS4LIFE: Guidelines for assessing soil ecosystem services in urban environment and their management

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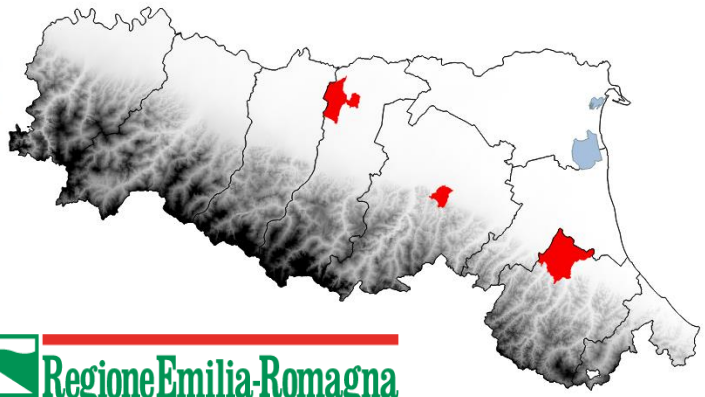
SOS4LIFE – Save Our Soil for LIFE

Project Acronym**: SOS4LIFE** ID: **LIFE15 ENV/IT/000225**
Start date: **01/07/2016** Expected end date**: 31/10/2019**
Total Budget: **€ 1.788.749,00** EU Financing: **€ 1.060.551,00**
Coordinating beneficiary**: COMUNE DI FORLI' (FC)**

SOS4LIFE is a demonstration project that aims to contribute to the enforcement at the municipal scale of European orientations about **soil protection** and **urban regeneration**, 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 this project are aimed to implement (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].



SOS4LIFE – Save Our Soil for LIFE

Objectives

The project intends to produce a viable framework on no net land take" suitable for the three municipalities involved in the project and for others local authorities in Italy and Europe, based on the following specific objectives:

- **Definition of urban regulations and implementation tools**, applicable at municipal level, aimed to ensure the balance of no net land take in newly urbanized areas
- **Definition of rules and incentives to support the urban regeneration** of existing settlements through actions that aim to the energy and seismic re-qualification;
- **Definition of procedures for the monitoring and evaluation of land take and its impacts on the eco-system** ;
- **Definition of a methodology for the detection, evaluation and mapping of ecosystem services** provided by (urban) soils;
- **Implementation of three de-sealing interventions** in three urban areas";
- **Effective and large-scale promotion of knowledge and awareness about the social and economic consequences of the processes of land take** addressed to public authorities, businesses, schools, and citizenship.

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Actions

A1 – Preparatory phase to identify tools to limit land take

B1 – Measuring on municipal scale of **costs** and **impacts** regarding the land take

B1.3 Guidelines for assessing soil ecosystem services in urban environment and their management

B2 – Demonstration **actions of de-sealing** through soil reinstatement

B 2.4 Guidelines for the removal, management and re-use of topsoil at construction sites

B3 – Rules and tools to limit, mitigate and compensate land take and soil sealing

B4 – Informative system for evaluation and monitoring of land take and its impacts

C1 – Monitoring of the project actions and socio-economic impact

D1 – Communication, dissemination and networking with other projects

E1 – Project management

E2 – After Life plan

Land use change in Italy

Four major fluxes: **1.** agricultural land -> artificial, **2.** agric. land -> natural,

3. natural -> artificial, **4.** natural. -> agricultural land

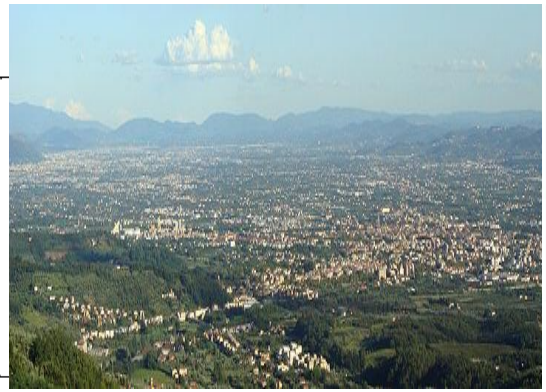
	da agricolo verso artificiale	da agricolo verso naturale	da naturale verso artificiale	da naturale verso agricolo
1960-1990	13,3	39,3	2,8	44,6
1990-2000	50,4	43,4	2,5	3,7
2000-2006	83,9	4,0	5,3	6,9
2006-2012	62,3	12,0	4,4	21,4
2012-2017	56,3	15,6	4,0	24,1

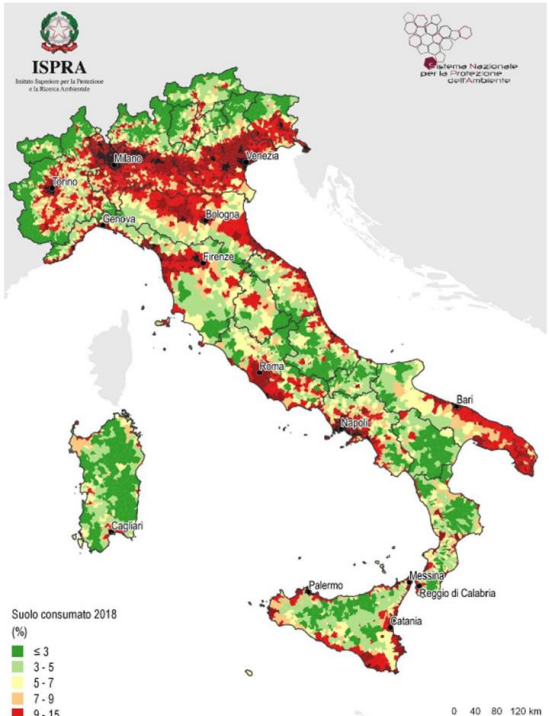
urbanization

Abandonment

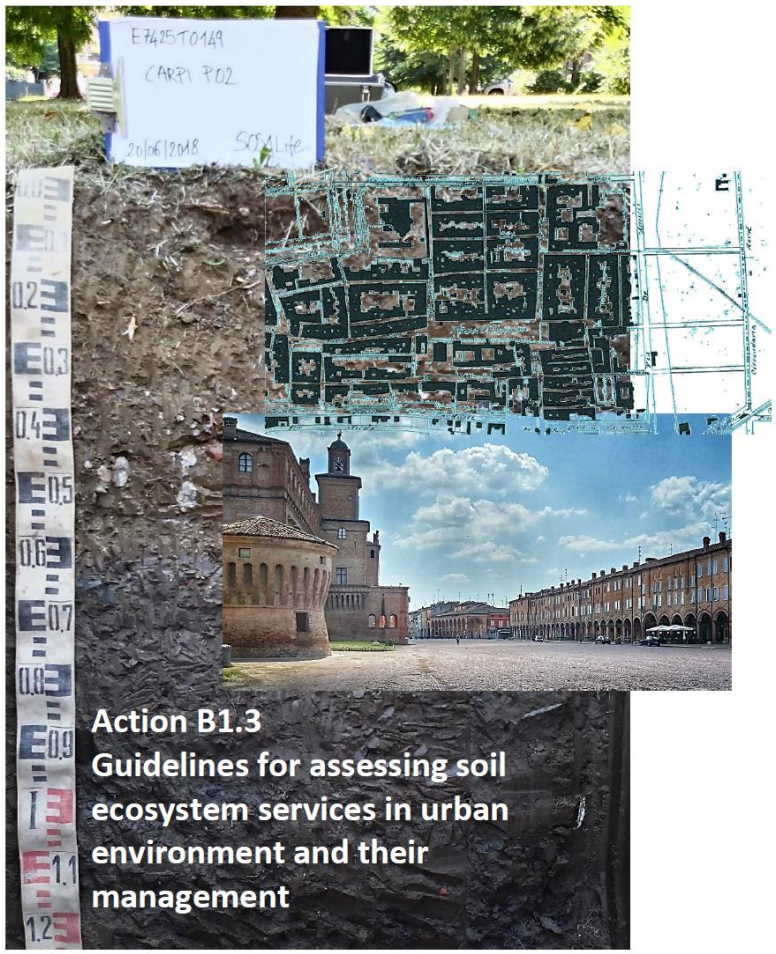
Intensification

Classi di copertura	Superficie (ha)	Superficie (%)
Superfici artificiali e costruzioni	2.306.253	7,65
Superfici naturali non vegetate	490.455	1,63
Alberi	13.845.858	45,94
Arbusti	1.390.127	4,61
Vegetazione erbacea	11.663.525	38,70
Acque e zone umide	443.507	1,47





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



LIFE15 ENV/IT/000225

Summary

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

Prior knowledge of soils, of their properties and distribution in the space is required in order to assess and eventually map their ecosystem services (ESs). Depending on the goal of the investigation and on resources availability, the necessary soil data can results from *ad hoc* urban soil surveys or from existing soil databases and maps.

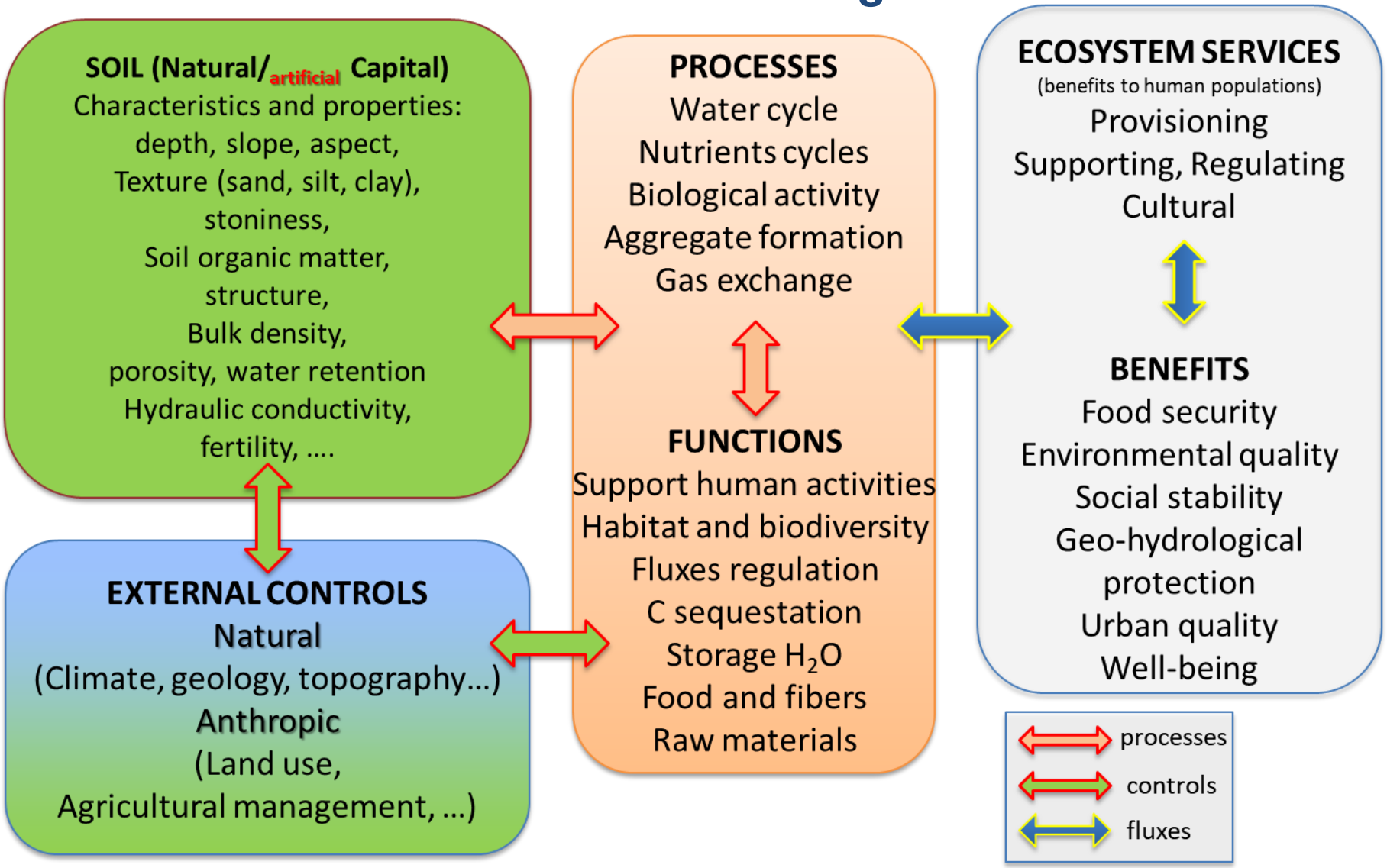
Three approaches are possible depending on resources and data availability

1. Ad hoc soil survey: sampling -> analyses -> mapping -> ESs assessment
2. Use existing soil data base and maps (vector format): benchmark soil profiles and analytical data -> ESs assessment
3. Use existing soil properties/functions maps (raster format) -> ESs assessment

In all cases soil data are at the base of the assessment and are use to build indicators of ecosystem service provision.

Furthermore the approach must be coherent with the scale of investigation and implementation.

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



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

ESs categories[a]	Soil contribution to ESs [b]	Soil function[c]	Indicator	Input data	Code
Supporting	Habitat for soil organisms	Biodiversity pool	Potential habitat for soil organisms	Land use Bulk density Organic C	**BIO**
Regulation	Nutrient and pollutants retention and release; Natural attenuation (potential)	Storing filtering and transforming nutrient, substances and water	Cation exchange capacity Soil reaction Rooting depth	Organic C Clay content pH (0-30) Average shallow groundwater depth	**BUF**
Regulation	Microclimate regulation (potential)	Storing filtering and transforming nutrient, substances and water	Soil evaporation potential	Available water capacity Average shallow groundwater depth	**CLI**
Regulation	Carbon sequestration (potential)	Carbon pool	Carbon sequestration actual	Organic C and bulk density (0-30 cm)	**CST**
Provisioning	Food provision (potential)	Biomass production	Land capability (LC) map	LC classes and intergrades	**PRO**
Regulation	Water regulation /Runoff -flood control (potential)	Storing filtering and transforming nutrient, substances and water	Infiltration capacity	Hydraulic saturated conductivity Air entry point	**WAR**
Regulation (Provisioning)	Water regulation - Water storage (potential)	Storing filtering and transforming nutrient, substances and water	Water content at field capacity Presence of water table	Field Capacity (-33 kPa) Average shallow groundwater depth	**WAS**

Table 3. Ecosystem services (ESs), underpinning soil functions, indicators and input data. [a]MEA 2005; [b]Dominati et al. 2010; [c]European Commission (EC), 2006.

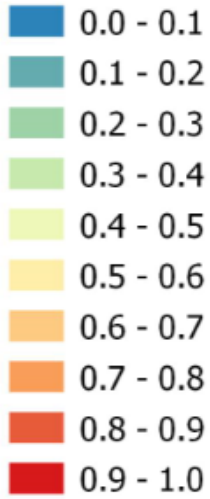
Guidelines for assessing soil ecosystem services in urban environment and their management

Code	Input data	Calculation
BIO	QBS_{ar} as a function of dominant Land use (High= 1; Medium= 0.5; Low= 0.25) Bulk density, BD (mg ha^{-1}) Organic C, OC (%)	$BIO_{0-1} = (LogOC_{0-1} - BD_{0-1}) + QBS_{ar\ 0-1}$
BUF	CSC (cmolc/kg) as a function of Organic C (%) and clay content (%) CEC = 6.332 +0.404 Clay + 1.690 OC (R^2 = 0.75) pH Average shallow groundwater depth, WT (cm)	BUF_{0-1} = Log CSC (pH; sk)$_{0-1}$ *with pH<6.5 reduction by 0.25 or 0.5 depending on CSC and skel>30% by 0.25* for water table deeper than 100 cm, and BUF_{0-1} = Log CSC (pH; sk)$_{0-1}$*WT/100 in case of occurrence of a shallow water table within the first 100 cm of soil depth, being WT the average water table depth (cm).
CLI	Available water capacity, AWC (vol/vol) AWC= WC_{FC}-WC_{WP} Average shallow groundwater depth, WT (cm)	$CLI_{0-1} = logAWC_{0-1} + WT_{0-1}$
CST	Organic C, OC (%) Bulk Density, BD (Mg m^{-3})	$CST_{0-1} = log\ (OC * BD)_{0-1}$
PRO	LC classes and intergrades	

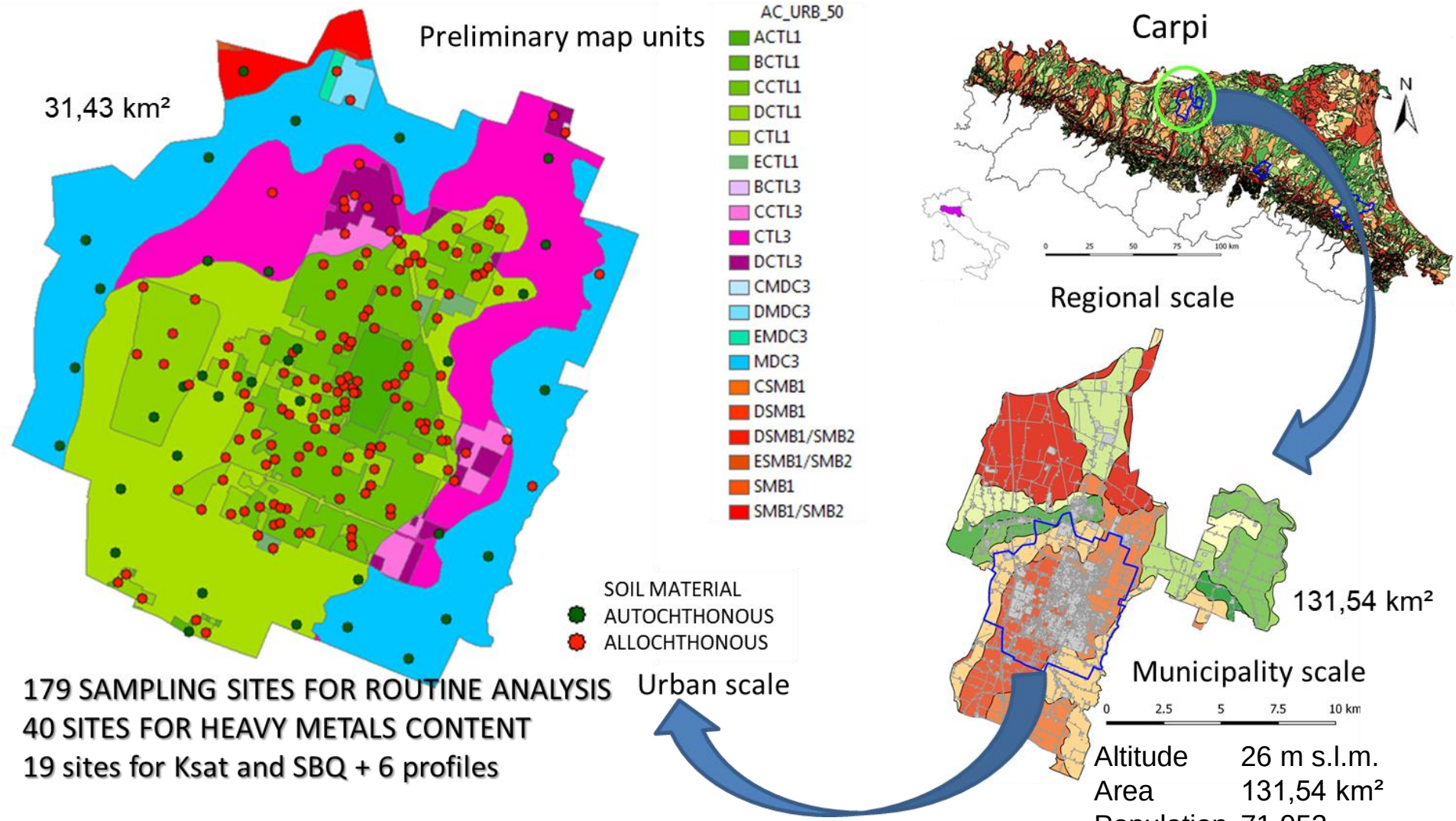
LCC	**I**	**I/II**	**II**	**II/I**	**II/III**	**II/III/IV**	**II/IV**	**III**	**III/II**	**III/II/IV**
Score	1	0.95	0.8	0.9	0.7	0.65	0.55	0.6	0.65	0.57
LCC	**III/IV**	**III/VI**	**IV**	**IV/II**	**IV/III**	**IV/VI**	**V**	**V/II**	**VI/IV**	**VIII**
Score	0.5	0.3	0.4	0.5	0.5	0.27	0.3	0.4	0.25	0

WAR	Hydraulic saturated conductivity, Ksat (mmh^{-1}) Air entry point , PSIe (cm)	$WAR_{0-1} = logKsat_{0-1} - PSIe_{0-1}$
WAS	Field Capacity (-33 kPa), WC_{FC} (vol/vol) Average shallow groundwater depth, WT (cm) Sk, coarse fragments (Ø >2 mm, vol/vol)	$WAS_{0-1} = (WC_{FC} * 1-sk)_{0-1}$ for water table deeper than 100 cm, and $WAS_{0-1} = (WC_{FC} * 1\text{-}sk)*WT/100$ for water table within the first 100 cm

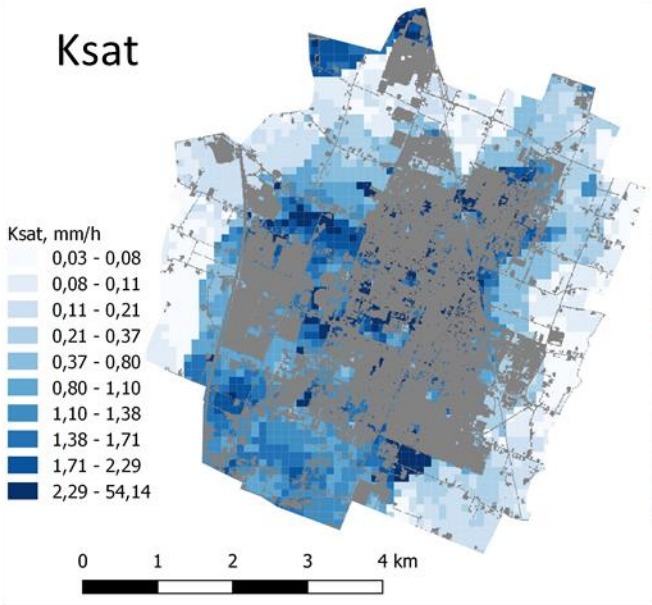
Table 4. Calculation procedures for the selected indicators of soil based ecosystem services.

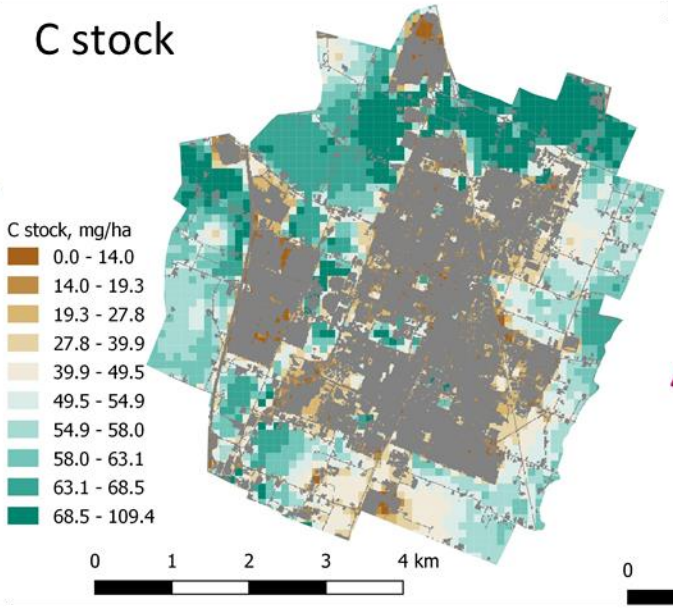


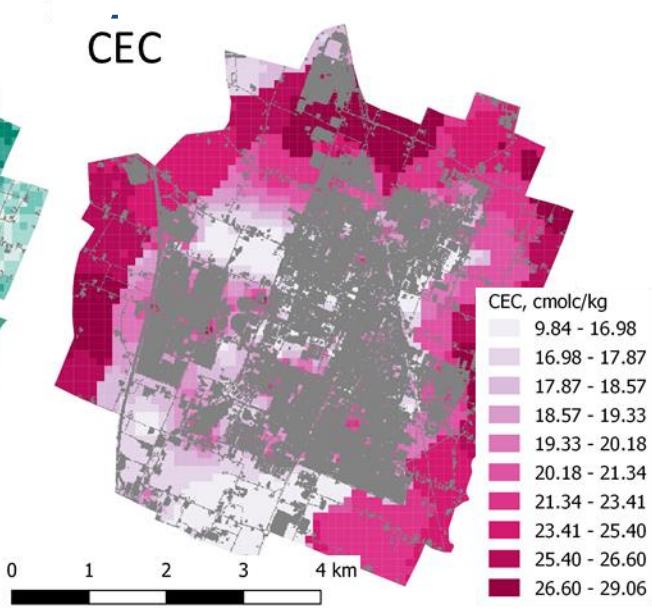
Guidelines for assessing soil ecosystem services in urban environment and their management. 1. *Ad hoc* soil survey



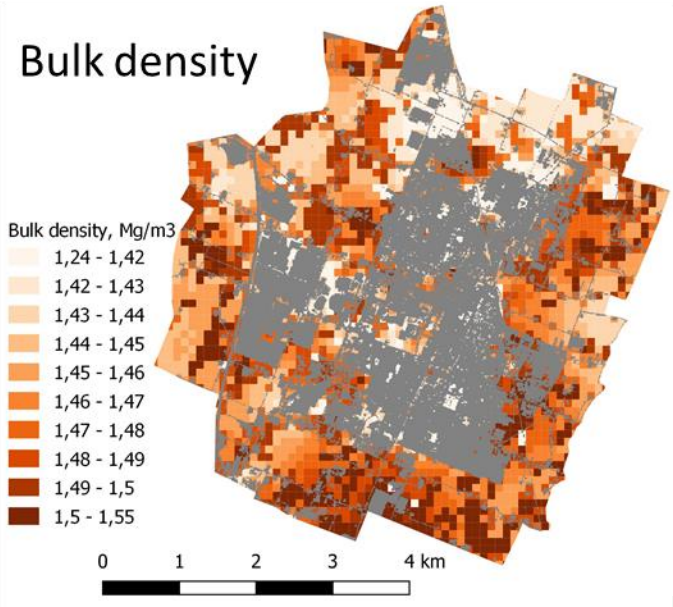
Guidelines for assessing soil ecosystem services

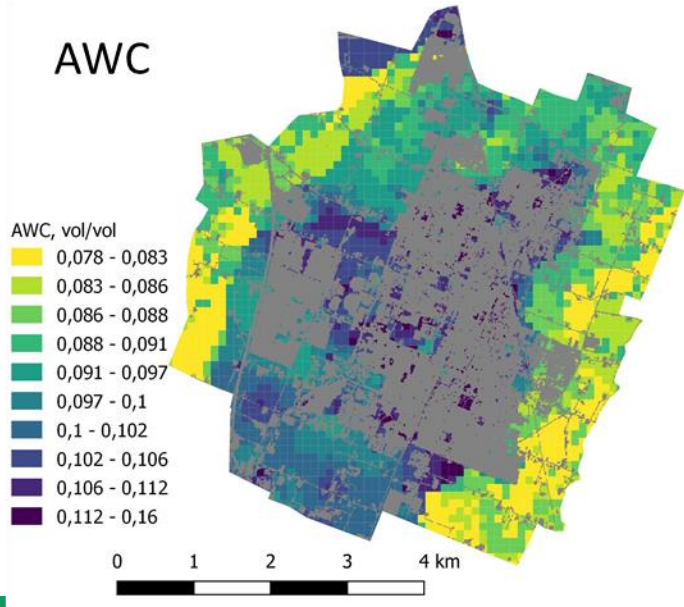






Pedotransfer functions (locally calibrated PTFs) estimations





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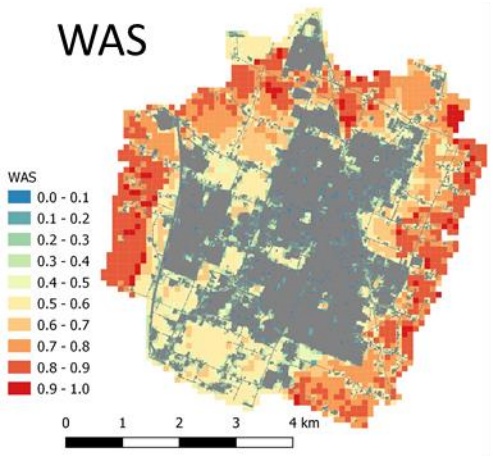
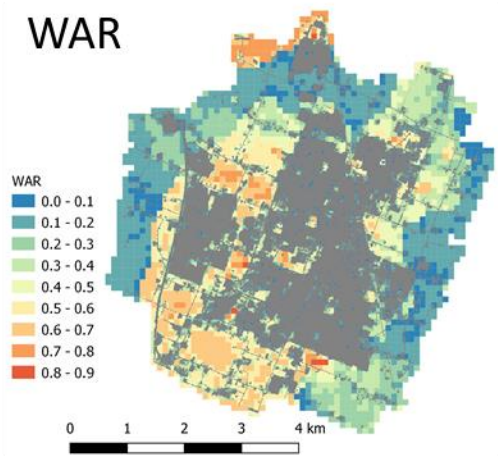
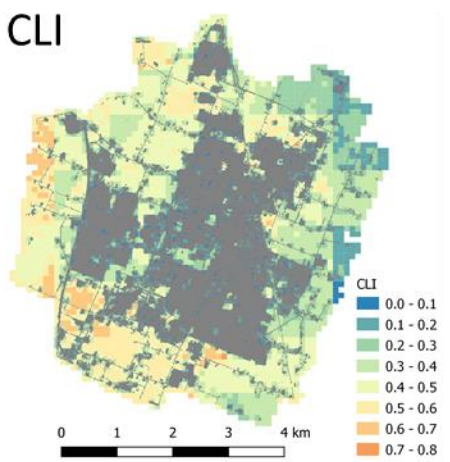
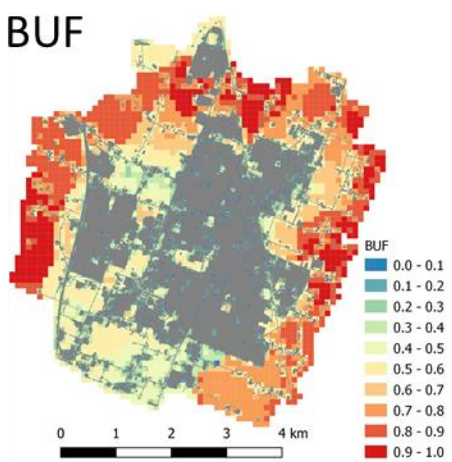
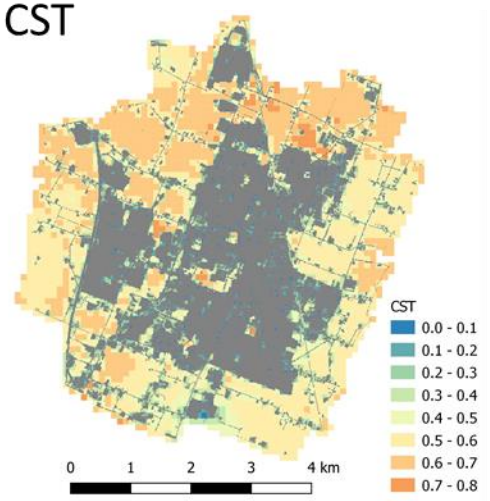
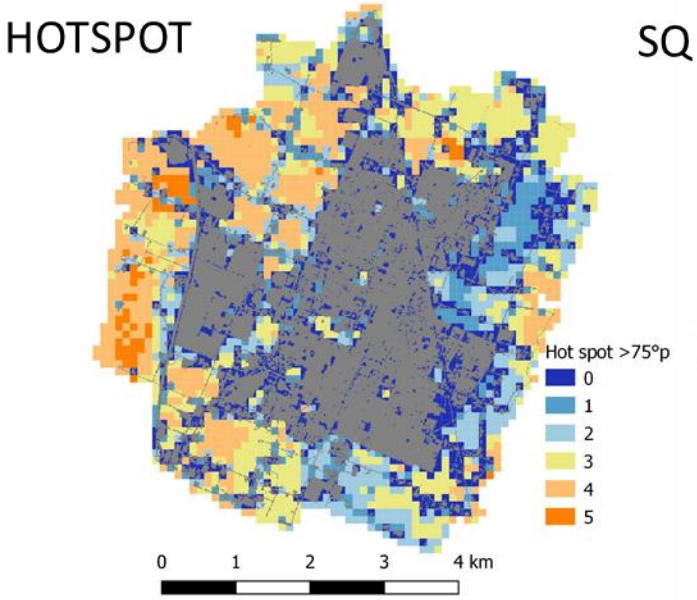


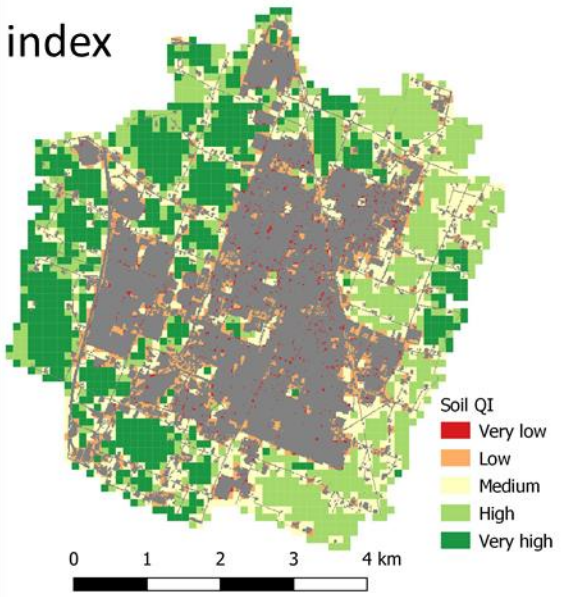




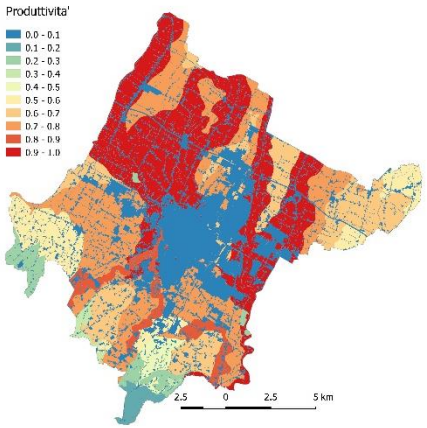


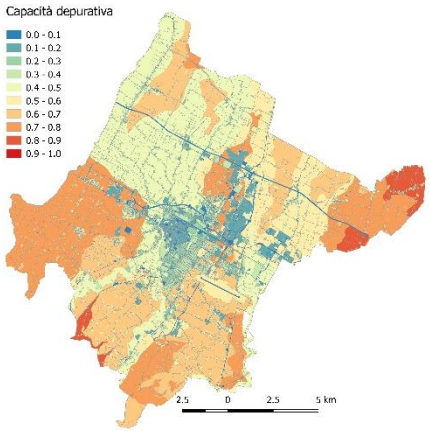


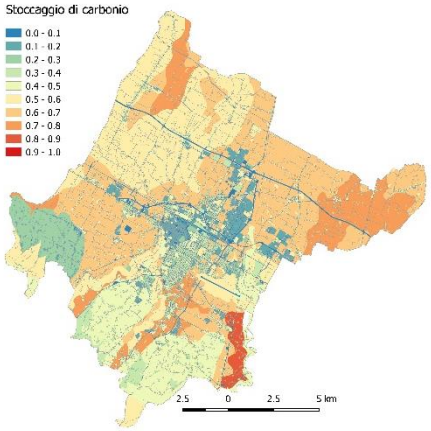


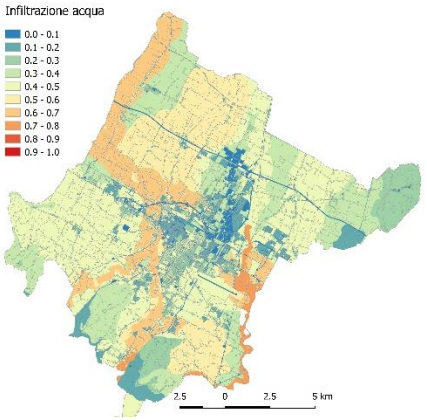


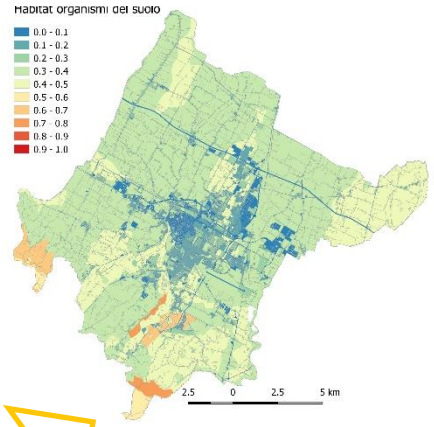
Guidelines for assessing soil ecosystem services in urban environment and their management. 2 Regional soil data bases

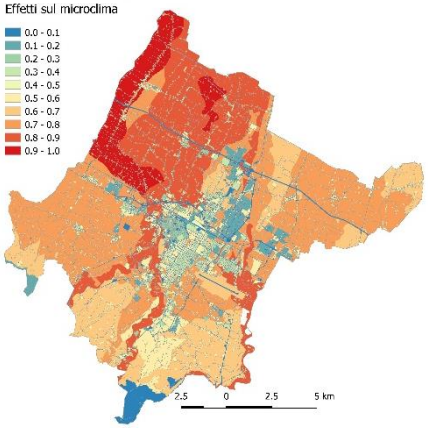


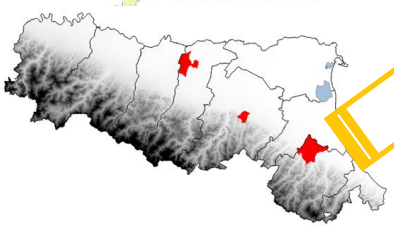




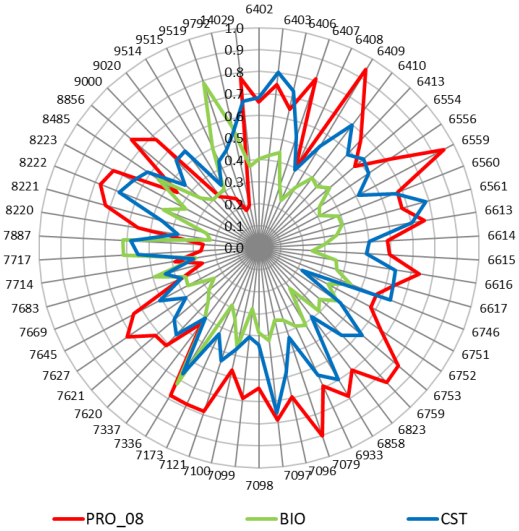


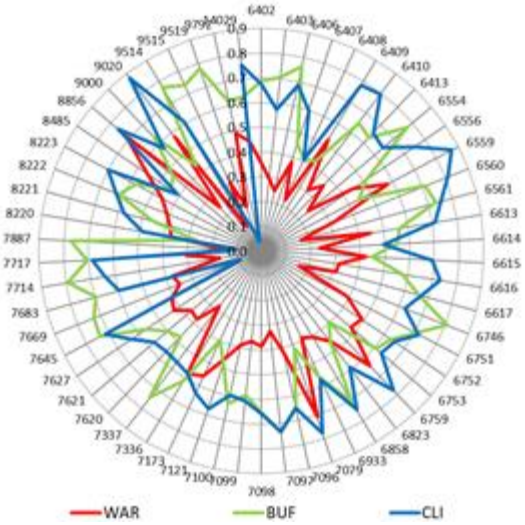






Altitude 34 m s.l.m.
Area 228,2 km²
Inhabitants 117 978 (31-10-2019)
Pop. Density 516,99 ab./km²





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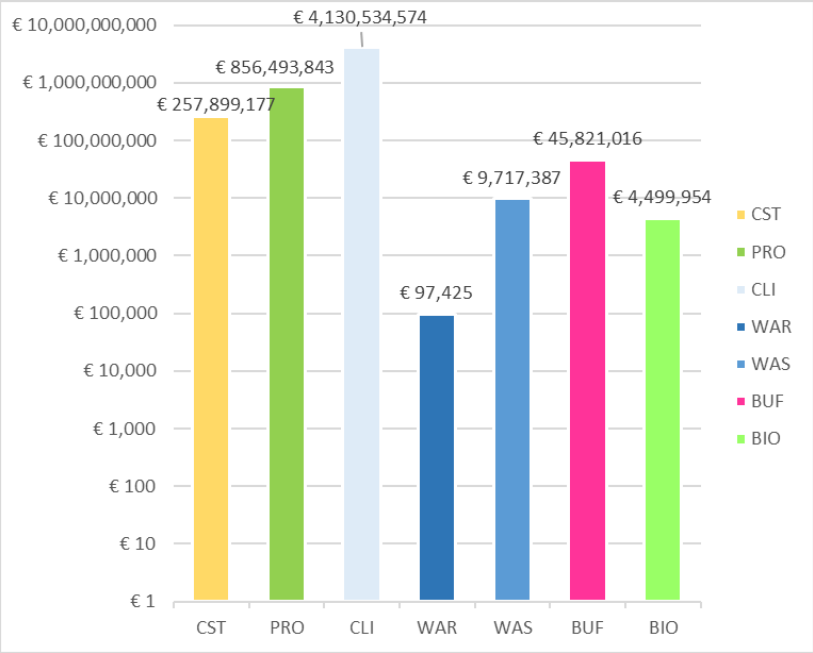
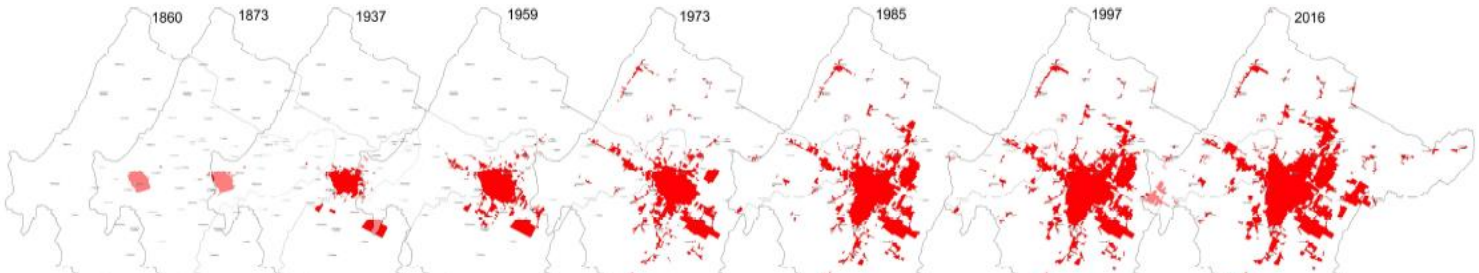


SE	Description/Units	2016	VALUE	VALUE/ha
CST	C stock (Mg) Market prize	2123500.8	€ 48,840,519.24	€ 2,479.21
CST	C stock (Mg) Social cost	2123500.8	€ 257,899,176.58	€ 13,091.33
PRO	VAM, euro	594028017.5	€ 594,028,017.49	€ 30,153.71
	Wheat, q	1274415.3	€ 262,465,825.69	€ 13,323.14
CLI	AWC, m^3	29446626	€ 4,130,534,574.35	€ 209,671.81
WAR	m^3 infiltration	11881.1	€ 97,425.22	€ 4.95
WAS	AWC, m^3	29446626	€ 9,717,386.57	€ 493.27
BUF	min	17294.2	€ 7,177,098.23	€ 364.32
	max	17294.2	€ 84,464,934.31	€ 4,287.56
BIO		17294.2	€ 4,499,954.12	€ 228.42
SUP. unsealed soil 19700 ha				
TOTAL			€ 5,353,903,895.53	€ 271,771.77

*Metodologia: *Consumo di suolo, dinamiche territoriali e servizi ecosistemici*. Edizione 2018 ISPRA.

Between 1985 and 2016 we estimated an average loss in soil ESs equal to -172,085,036.185 € due to soil sealing (land take +4.61%)



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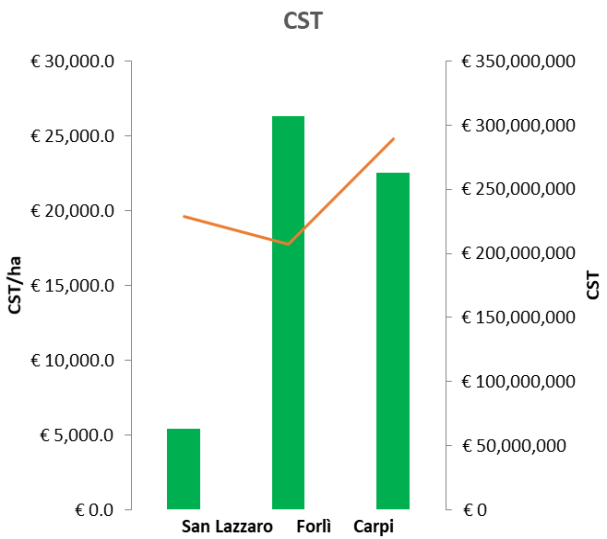
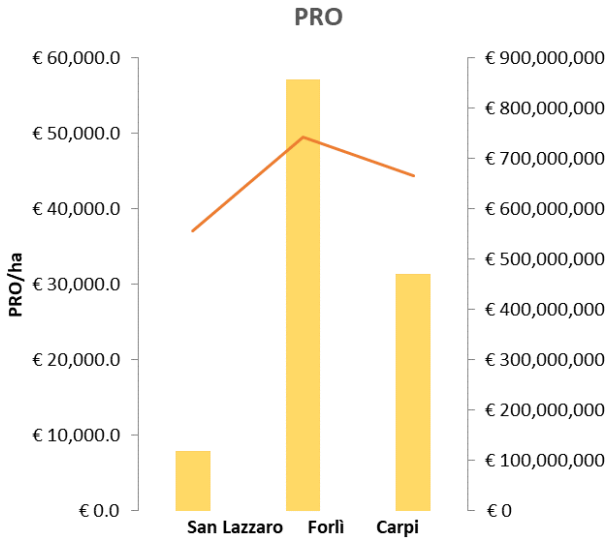
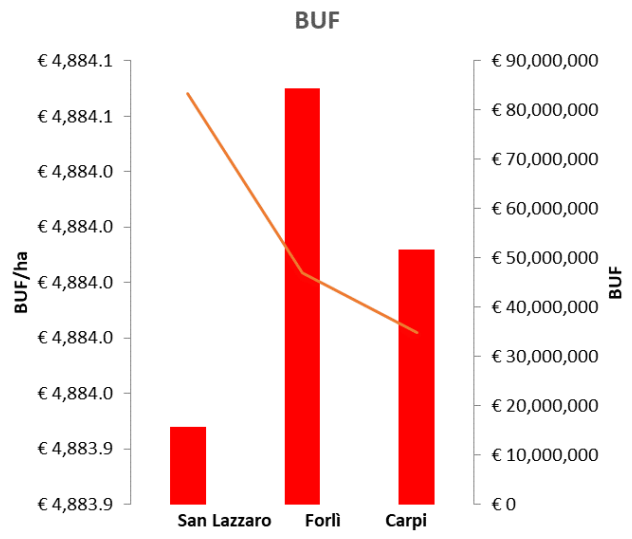
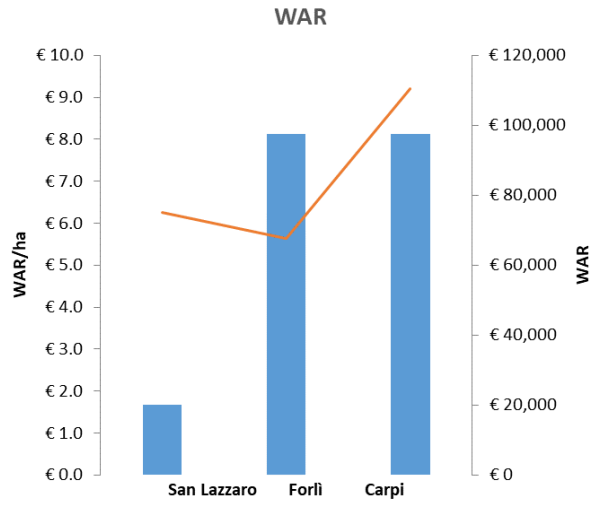




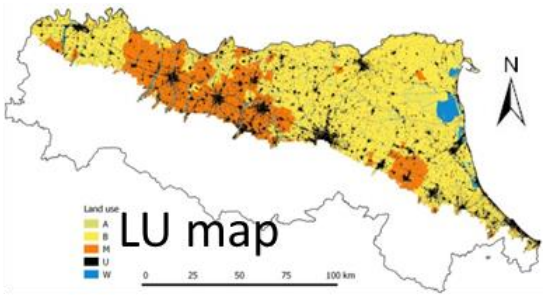


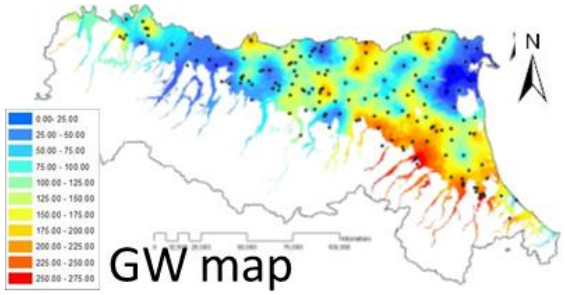
Comune	Superficie suolo	Euro/ha
S.Lazzaro	3216	268,190
Forlì	17294	312,227
Carpi	10584	293,530



Guidelines for assessing soil ecosystem services in urban environment and their management. 3 Existing maps of soil properties and functions

- C org
- C stock Texture
- Ksat
- Land capability
- Soil sealing
- Salinity
- Heavy metals
- ....





i suoli dell'Emilia-Romagna

cerca

Vai ››

https://geo.regione.emilia-romagna.it/cartpedo/

territorio regionale

Carta dei suoli alla scala:

1:1.000.000 | 1:500.000 | 1:250.000

Livello più generale della cartografia dei suoli emiliano-romagnoli. La carta dei suoli alla scala 1:1.000.000 è stata realizzata sintetizzando le informazioni provenienti dai rilevamenti effettuati per la Carta dei suoli dell'Emilia-Romagna in scala 1:250.000 (**1994**), con aggiornamenti successivi (2000). A questo livello di dettaglio vengono individuate e descritte 7 Unità cartografiche identificate da un numero (ad esempio Unità cartografica 3).

- apri la cartografia 1:1.000.000 in Google Earth
- visualizza la legenda delle unità cartografiche scala 1:1.000.000

territorio di pianura e di collina

Carta dei suoli alla scala:

1:50.000

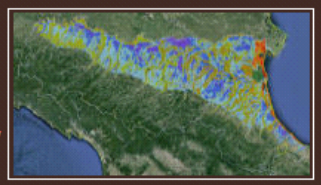
Livello di "semi-dettaglio" dei suoli della pianura e di parte della collina emiliano romagnola. La carta dei suoli alla scala 1:50.000 è stata realizzata utilizzando le informazioni provenienti dai rilevamenti effettuati dalla metà degli anni settanta fino al 2017. (ed. **2018**). La descrizione dei suoli è qui effettuata attraverso **425** diversi tipi di suolo (UTS: Unità Tipologiche di Suolo), distribuiti in **8628** delineazioni identificate da un codice numerico.

- apri la cartografia 1:50.000 in Google Earth
- apri il Catalogo dei Suoli generale
- apri il Catalogo dei Suoli per province di terre
- apri i metadati della cartografia 1:50.000

carte tematiche I

1. Carte delle proprietà chimico-fisiche

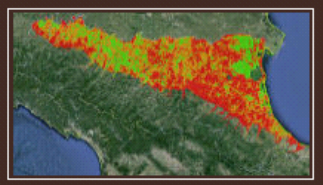
Le carte dei suoli sono documenti complessi con un elevato contenuto informativo. Per l'applicazione a fini ambientali, agricoli o di pianificazione territoriale, vengono selezionate ed elaborate carte descrittive di singoli parametri o proprietà del suolo di specifica rilevanza.



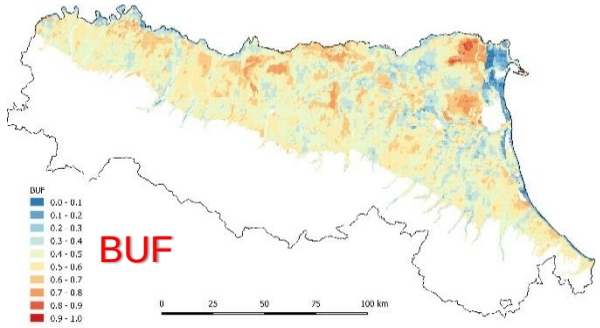
carte tematiche II

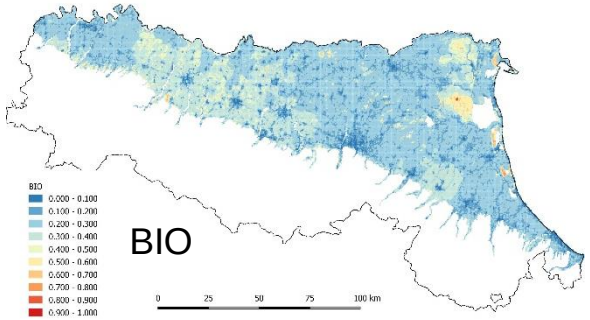
2. Carte applicative

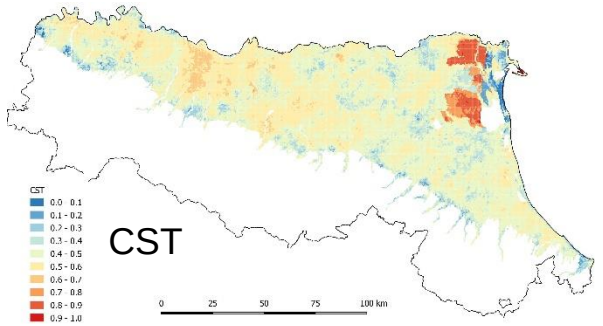
Le carte applicative, pensate a supporto della pianificazione agricola, ambientale e territoriale rappresentano valutazioni delle qualità dei suoli, basate sulla selezione e l'integrazione di più informazioni e, se necessario, mediante l'utilizzazione di diversi tipi di modelli parametrici o matematici.

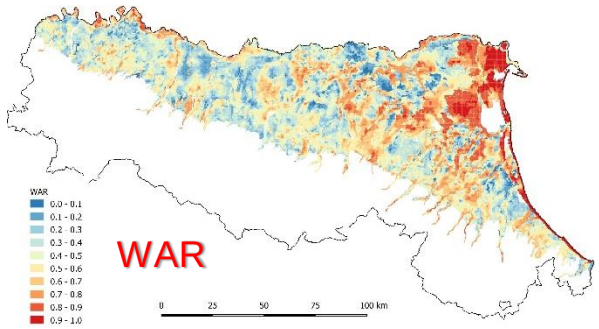


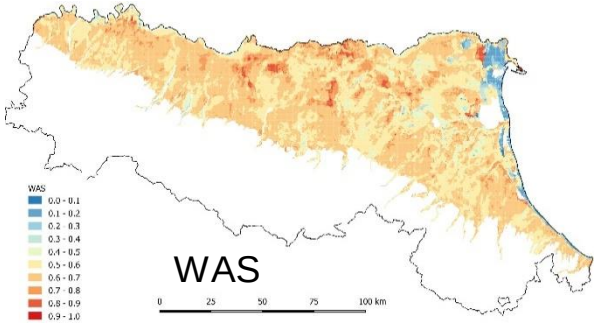
Guidelines for assessing soil ecosystem services in urban environment and their management

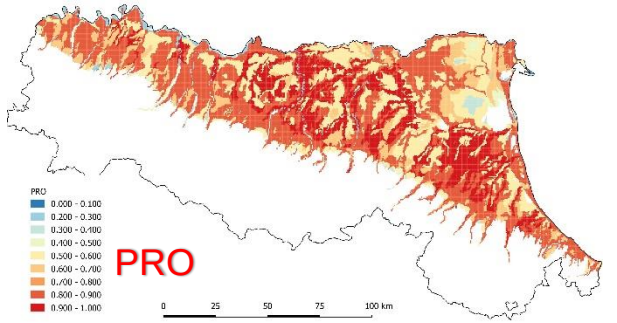






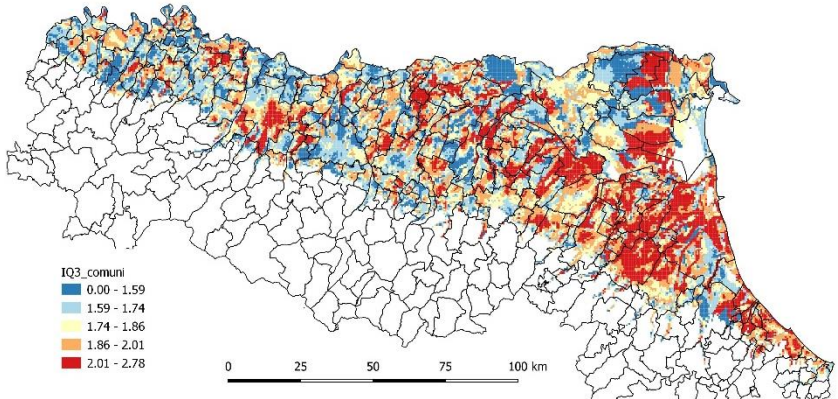






Link to action B4.1 Informative system for evaluation and monitoring of land take and its impacts at municipality scale

IQ3



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

- The guidelines highlights the **multifunctional role of soils in the (urban) environment** and the relevance of the services provided to the citizens.

- The **impact of soil sealing** in term of reduction/loss of the ecosystem services provided by soils under different uses and management options can be assessed and compared in a (semi-)quantitative way;

- The realization of new infrastructures and services can be analysed in terms of **loss** of services and **gains** resulting from new urbanizations;

- The approach provide **assessment tools to support land planning** (i.e. maps) to the aim to reduce/compensate soil sealing taking explicitly into account local land resources and the functions of different soils;

- Sustainable urban environment requires more **interactions** and **cooperation** between urban planners and soil/climate/vegetation experts.

6. BEST PRACTICES

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 has been successfully tested in the municipality of Carpi, Forli and San Lazzaro di Savena, where soil ecosystems maps have been produced, along with the economic evaluation of ecosystem services losses due to soil sealing. The methodology is currently being applied to all the municipalities of Emilia-Romagna.
Challenges encountered	The main challenge is about communication and developing a common language with the different actors and stakeholders involved (soil scientists, administrators, urban planners).
Potential for learning or transfer	The methodology 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 at in different contexts and at different scales (region, province, and municipality). So far it has been applied to the three partner municipalities and to most of Emilia Romagna region in Italy within the SOS4LIFE project life time and to the province of Reggio Emilia.

PROGRESS
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Thank you!

Questions welcome

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