Interreg
Alpine Space
EUROPEAN UNION

Links4Soils
EUROPEAN REGIONAL DEVELOPMENT FUND

Soil Ecosystem Services and changing land use

An estimation sheet for the use in the field
at the soil profile

Imprint

What this is about?

This report consists of a 'Soil Ecosystem Service Estimation Sheet'. It can be used in the field at a soil profile to estimate the contribution of soils to eleven selected Ecosystem Services depending on key soil properties, which may change under changing land uses and management strategies.

Project and funding

Links4Soils (ASP399); EU Interreg Alpine Space

WP, Task and Deliverable

WPT1 AT3.2 (Module of D.T1.3.2)

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How to cite

Geitner, C. and Schaber, E. (2020). Soil Ecosystem Services and changing land use. An estimation sheet for the use in the field at the soil profile.

Date

April 2020

Introduction and estimation sheet

Soils support a myriad of ecosystem services that benefit humans in many ways, e.g. the regulation of climate, water cycle and nutrient cycle, the provision of food, fibre and fuel, and the filtration and purification of water. With a special focus on the Alps, the most important so-called 'Soil Ecosystem Services' are explained in detail in Links4Soils (2019)*.

The 'Soil Ecosystem Service Estimation Sheet', which is provided in this report, is supposed to be used in the field, directly at the soil profile. It shall support the discussion between soil experts and stakeholders about soil phenomena and ecosystem services, in particular about how key soil properties, which may alter under changing land uses and management strategies, impact on eleven individual ecosystem services.

The estimation sheet was developed during the AlpineSpace Links4Soils Project (2016-2020). It was tested on several occasions with stakeholders in Austria, Germany, Italy and Slovenia and was constantly improved. The feedback from stakeholders and soil-experts was very positive as the sheet is seen as a tool to make the evaluation of ecosystem services more tangible. Furthermore, it is proved to be a good starting point to discuss the effects of changing land use or management on the soil properties and respective services. The approach to estimate Soil Ecosystem Services in the field cannot replace a professional soil description but is rather a communication tool to give non-experts an impression and understanding of soils and their diversity. In addition to the ability of soils to provide ecosystem services, the discussion should also include the aspect of the societal demand for those services.

This short report consists of three pages estimation sheet followed by a short user's guide that explained each component of the estimation sheet as well as an example.

*Links4Soils (2019). Soil Ecosystem Services in the Alps. An introduction for decision-makers. Project report.

location		reviser	

Key site characteristics

elevation	
slope	
aspect	
relief position	
morphodynamics	
geology	

Climatic characteristics

mean annual temperature	
mean annual precipitation	

Additional remarks disturbance, degradation, melioration

Ecosystem and management type

original		current	
past		planned	

	Key soil properties	level: 0 (low) - 5 (high) current	scenarios planned	...	...	comments
inherent	total soil depth					
	stone content					
	clay content					
	sand content					
manageable	soil organic matter content*					
	bulk density					
	pH					
	nutrient level					
	biological activity					type and thickness of organic layers:

* in mineral soil

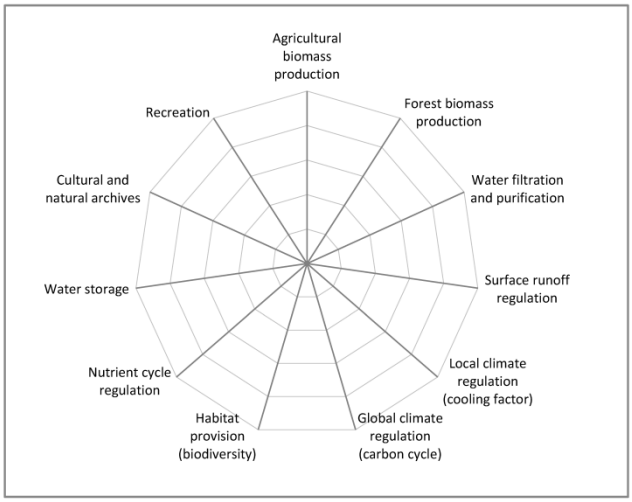
Estimating the provision of Soil Ecosystem Services for different ecosystem and management types

level: 0 (low) - 5 (high)

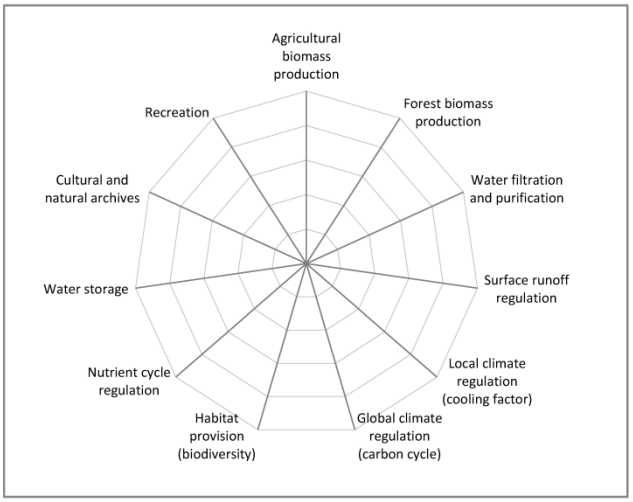
	Category**	Soil Ecosystem Service	Ecosystem and management type: current	planned	...	...	comments
Ecosystem Services	Provisioning	Agricultural biomass production					
		Forest biomass production					
	Regulating	Water filtration and purification					
		Surface runoff regulation					
		Local climate regulation (cooling factor)					
		Global climate regulation (carbon cycle)					
	Supporting	Habitat provision (biodiversity)					
		Nutrient cycle regulation					
		Water storage					
	Cultural	Cultural and natural archives					
		Recreation					

** Ecosystem service categories as defined in the Millenium Ecosystem Assessment

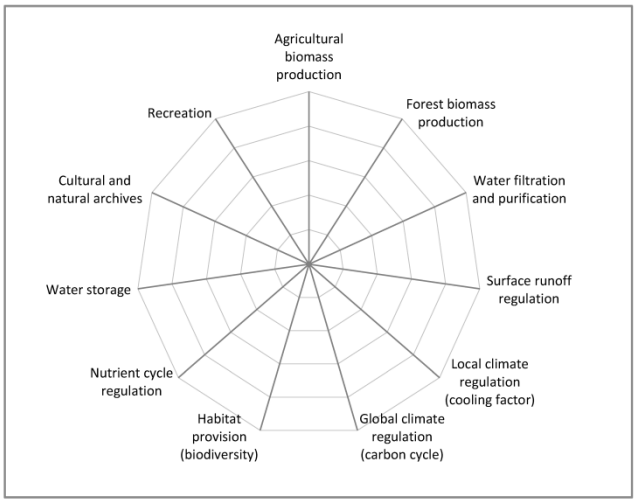
current ecosystem and management type



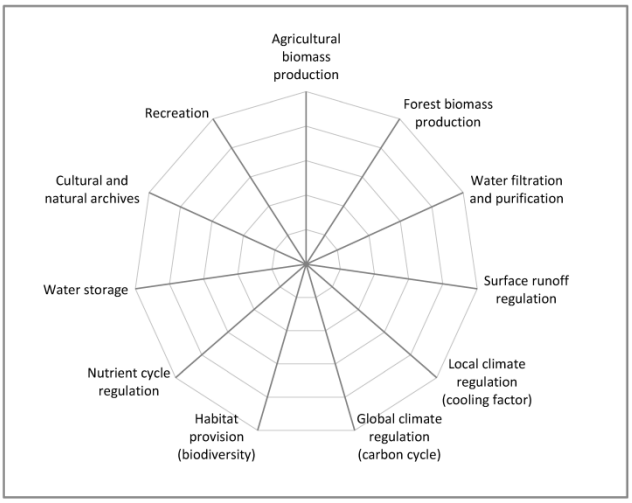
planned ecosystem and management type



ecosystem and management type: …



ecosystem and management type: …



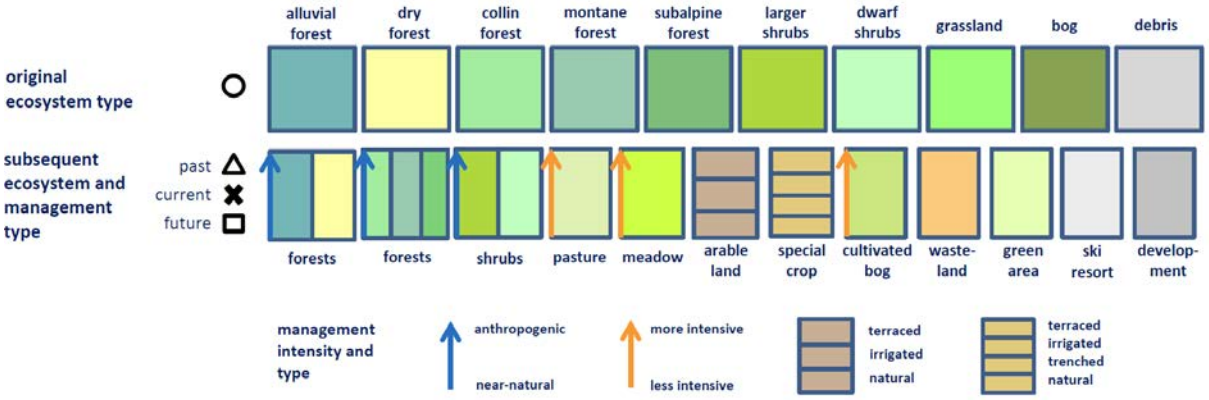


Figure 1: Orientation scheme for estimating the original ecosystem type and subsequent ecosystem and management types

			Key soil properties								
			total soil depth	stone content	clay content	sand content	soil organic content	bulk density	pH	nutrient level	biolo-gical activity
Soil Ecosystem Services	Provisioning	Agricultural biomass production									
		Forest biomass production									
	Regulating	Water filtration and purification							-	-	
		Surface runoff regulation							-	-	
		Local climate regulation							-	-	-
		Global climate regulation			-	-			-	-	
	Supporting	Habitat provision (biodiversity)									
		Nutrient cycle regulation									
		Water storage							-	-	-
	Cultural	Cultural and natural archives		-	-	-	peatsoils	-	-	-	negative impact
		Recreation							-	-	-

the higher the soil property value, the better the service provision
the lower the soil property value, the better the service provision
optimum range of the soil property regarding the service provision
\- no relevant influence of the soil property on the service provision

Background: dark green: high importance of soil property; green: medium importance of soil property; light green: low importance of soil property regarding the service provision; yellow: depends on a special aspect of service, e.g. touristic activity.

Figure 2: Supporting matrix to link key soil properties with selected Soil Ecosystem Services

A short user's guide

Page 1

Location and reviser should be named to document where and by whom the estimation sheet was filled out. Key site characteristics are important as some information, e.g. slope, will directly influence the service provision, whereas others are also important to understand the respective pedogenesis. Climatic characteristics are also relevant for some Soil Ecosystem Services. For example, the mean annual temperature can influence the demand (e.g. local climate regulation) and the provision (e.g. agricultural biomass production) of the services. Ecosystem and management types serve to collect information about the man-made history and development of the site. Thereby, 'ecosystem and management type' contains not only information on land use, but it also allows differentiating within one land use according to specific management practices. 'Original' refers to the natural ecosystem type, 'past' (if applicable) to the traditional ecosystem and management type that was maintained for a considerable time (often since the medieval settlement expansion) before the current one. 'Current' describes what we see right now and 'planned' (if applicable) refers to the most likely next ecosystem and management type. Figure 1 serves as a support to differentiate ecosystem and management types.

Key soil properties are the most important information as a basis to estimate Soil Ecosystem Services. They can be subdivided into 'inherent' (white) and 'manageable' (grey) soil properties. The latter can be influenced by humans depending on land use and management practices. The properties are either estimated or measured and directly classified on a scale from 0 (low) to 5 (high). The classification should be made at least for the current ecosystem type and management. It is also helpful to estimate the soil properties if the ecosystem and management type would be changed, e.g. for a former (original, traditional) or several planned ecosystem types of managements. In the block 'Estimating the provision of Soil Ecosystem Services for ecosystem and management types' the levels of service provision – from 0 (low) to 5 (high) – can be filled in. According to the classified key soil properties, the Soil Ecosystem Service can be estimated for several scenarios. Accordingly, figure 2 serves as a support.

Page 2

These diagrams allow depicting the estimated levels of service provision from ‘Estimating the provision of Soil Ecosystem Services for ecosystem and management types’ as rays. The length of the ray should be directly proportional to the level of service provision. All Soil Ecosystem Services are arranged clockwise but there is no special relationship between two neighbouring services.

Page 3

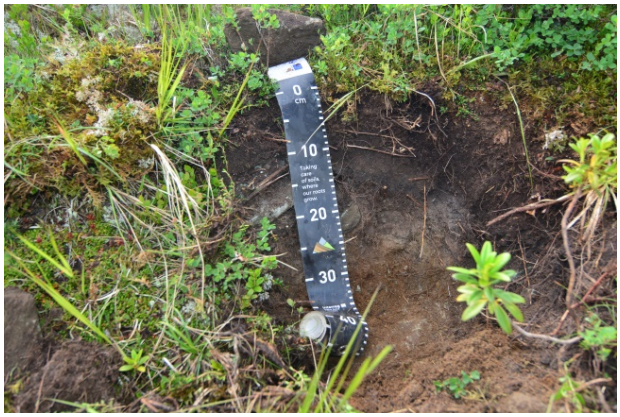
The purpose of this page is to support the decision in estimating the levels of service provision. Figure 1 illustrates how ecosystems can be managed. It helps to take into account, what the original ecosystem probably looked like and which factors must be considered in order to understand some site characteristics and their influence on the current or a potential future ecosystem and management type. Figure 2 is a support for the transformation of estimated or measured key soil properties into a level of service provision. The cross-table provides two sorts of information per 'soil property'-'Soil Ecosystem Service'-pair. Firstly, mini graph symbols show in which way the soil property is determining the service. There are three options for the maximal service provision: a) max. property value, b) min. property value, c) optimum property value. Secondly, the background colour shows how much influence the soil property has on the service provision. The darker the green, the higher the influence. A yellow background stands for the ambiguous cases, where is depends strongly on the specific aspect of a service, which soil property value would be the optimum. The cross-table serves as an orientation for the majority of cases but some special cases might show other relationships.

Example

In this example, the soil ecosystem services provided by a ski slope site and the respective original ecosystem (Rhododendron shurbs) were estimated.

Ski slope:

Original ecosystem:



location	Champoluc ski resort (Del Monte)

reviser	Elsa Musterfrau

Key site characteristics

elevation	2300 m
slope	20°
aspect	west
relief position	slope
morphodynamics	-
geology	calcschists mixed with mafic rocks

Climatic characteristics

mean annual temperature	0°C
mean annual precipitation	770 mm

Additional remarks

disturbance, degradation, melioration

Ski slope was constructed by machine-grading.
Snow grooming during winter.

Ecosystem and management type

original	near-natural: Rhododendron shrubs	current	ski slope: sparse coverage with herbs and grasses
past		planned	

	Key soil properties	level: 0 (low) - 5 (high) current	scenarios planned	original	...	comments
inherent	total soil depth	1		2		Due to the heavy impact of the ski slope construc-
	stone content	5		4		tion even usually inherent properties become
	clay content	2		2		manageble
	sand content	4		4		
manageable	soil organic matter content*	2		3		
	bulk density	3		2		
	pH	3		2		
	nutrient level	1		2		
	biological activity	1		1		type and thickness of organic layers: only at control site: raw humus, ca. 10 cm

* in mineral soil

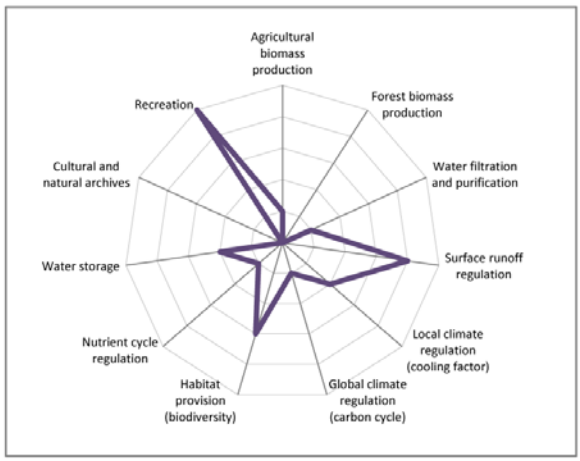
Estimating the provision of Soil Ecosystem Services for different ecosystem and management types

level: 0 (low) - 5 (high)

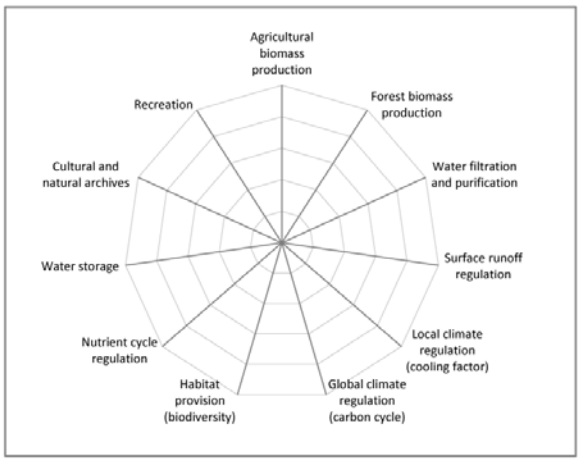
	Category**	Soil Ecosystem Service	Ecosystem and management type current	planned	original	...	comments
Ecosystem Services	Provisioning	Agricultural biomass production	1		0		
		Forest biomass production	0		1		
	Regulating	Water filtration and purification	1		1		
		Surface runoff regulation	4		3		
		Local climate regulation (cooling factor)	2		3		
		Global climate regulation (carbon cycle)	1		4		
	Supporting	Habitat provision (biodiversity)	3		3		
		Nutrient cycle regulation	1		1		
		Water storage	2		3		
	Cultural	Cultural and natural archives	0		3		
		Recreation	5		3		

** Ecosystem service categories as defined in the Millenium Ecosystem Assessment

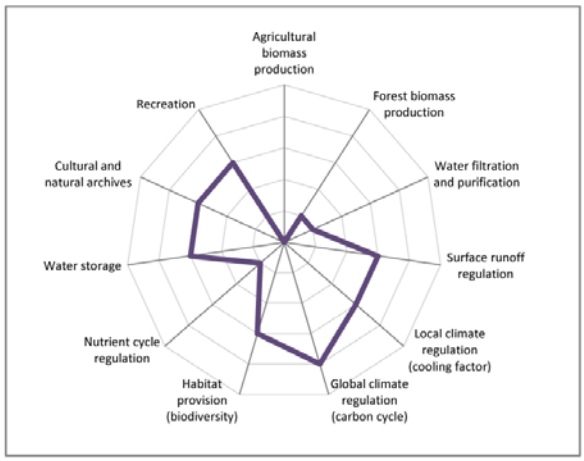
current ecosystem and management type



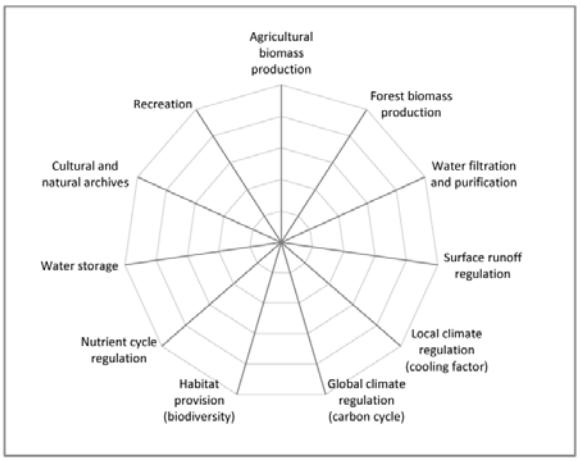
planned ecosystem and management type



ecosystem and management type: *original*



ecosystem and management type: ...



About the Links4Soils project

Web links

Links4Soils results web page: Alpine Soil Platform – www.alpinesoils.eu

Links4Soils Interreg Alpine Space project web page: www.alpine-space.eu/projects/links4soils

Links4Soils project partners

Agricultural Institute of Slovenia, SI (project leader)
Kmetijski inštitut Slovenije

Slovenian Forest Service, SI
Zavod za gozdove Slovenije

Office of the Tyrolean Provincial Government, AT
Amt der Tiroler Landesregierung

Climate Alliance Tirol, AT
Klimabündnis Tirol

Institute of Geography, University of Innsbruck, AT
Institut für Geographie, Universität Innsbruck

University of Turin, Department of Agricultural, Forest and Food Sciences, IT
Università degli Studi di Torino, Dipartimento di Scienze Agrarie, Forestali e Alimentari

Autonomous Region of Aosta Valley, IT
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National Research Institute of Science and Technology for the Environment and Agriculture, Grenoble Regional Centre, FR
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Municipality of Kaufering, DE
Markt Kaufering