



ALPENKONVENTION
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CONVENZIONE DELLE ALPI

Economical and prudent use of soil in the Alps

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1. Why is it crucial to use our soil economically and prudently?

We need our soil for producing food, for growing forests, for filtering, storing, transforming and purifying water, nutrients and substances, for regulating the water household, for local climate regulation and for global climate regulation by playing a crucial role in the carbon cycle. Biodiversity in soils is the basis for biodiversity above soils. Soils store history: one can find puzzle pieces of natural events, human history and ancient climate changes in soils. We enjoy walking on soil: on mountain pathways, in mountain forests, thorough meadows and yet rarely think about, that it is all there only because of soils. The reason is simple: we often do not think about things we cannot see, and this is valid for soil: it is only recognized, where it lays open. But it is time for realizing that we need to do more to preserve our soils. This is not only needed for preserving a good quality of our soils, but also common efforts by everyone are necessary to ensure, that enough healthy soils will be left to guarantee that also our children will have enough food, clean water, diverse species of animals and plants around them and will be able to walk through mountain forests, green meadows and along vivid streams.

“A nation that destroys its soil destroys itself.”
(Franklin D. Roosevelt, 1937)

Soil is the basis for life on Earth - the living skin of the Earth. In constant interaction between earth, air, water, and living organisms, it is a place for the exchange of matter and energy. It is considered a non-renewable resource because of the long times required for its formation. Soils are at the heart of major environmental issues, such as the availability of quality water, the preservation of biodiversity, food security, natural risks mitigation. Soils can also help against or contribute to climate change, depending on how we treat them.

Soil protection is climate protection and nature protection!

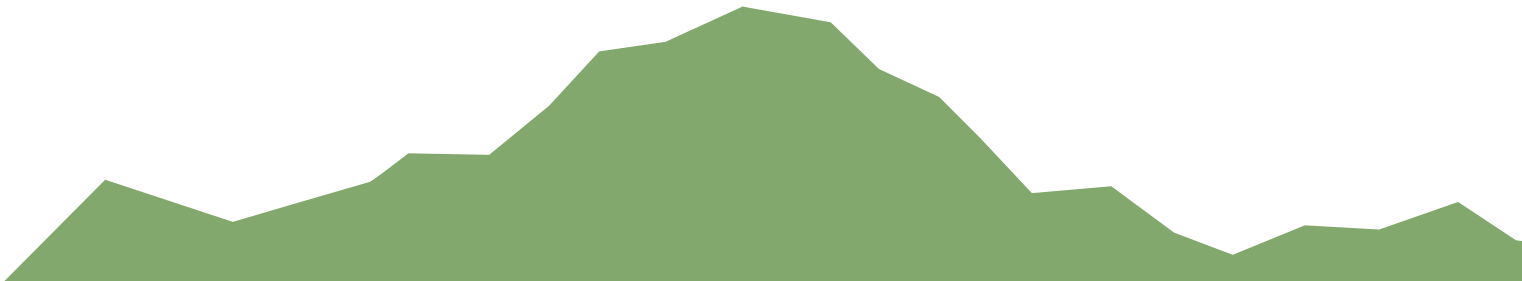
Because of its essential role, soils are subject to multiple land use demands for human activities, which can cause soil degradations, such as soil pollution, soil compaction and the mostly permanent degradation of soils for buildings and infrastructure.

What is special in the Alps?

Looking at landscape and settlement systems in the Alps it is easy to identify patterns: most constructions are located, where it is suitable to build them. Flat areas, which are suitable spaces for settlements and other intensive land uses, are more limited in the mountains than in other regions. At the same time, the identic locations are often those with the most productive soils.

Comparable to the melting Alpine glaciers visualising global climate change, the fast growth of consumed land in many Alpine valleys visualises the rapid loss of soils by human activities.

But it is possible to act! Preserving soil means acting on one of the main challenges, humanity is facing.



2. How is soil “consumed”?

The definition of soil consumption and soil sealing is complex and differs in the Alpine Countries. Thus, the Compliance Committee of the Alpine Convention (Compliance Committee of the Alpine Convention 2019) has defined the terms as follows:

- *“Soil/ land consumption (land take) means the loss of mainly agricultural and biologically productive soils through building, for example for settlement, traffic and leisure purposes. Approximately 40% of these areas are sealed and thus lose all their biological functions.*
- *Soil sealing means covering the ground by an impermeable layer. Thus, the soil is reduced to its function as platform for man-made structures and loses its natural functions. Buildings, but also areas that are covered by concrete, asphalt, or paving stones (pathways, parking lots, driveways, company premises etc.) are considered as completely sealed areas.”*

2.1 Main drivers for soil consumption in the perimeter of the Alpine Convention

The need of soil and land from multiple different perspectives makes it an issue on which many players must work together. Thus, there are different drivers of soil and land consumption and they are connected to each other. As non-exhaustive aspects of important drivers for soil consumption in the Alps can be considered:

Residential building and construction

Extensions of settlements are important drivers of land consumption. Urban sprawl, detached housing and a lack of regional and supra-municipal planning coordination and control in spatial planning are drivers of the growing demand for land. The growing number of small households, raising living standards and by this the desire for larger apartments lead to increased living space requirements and to an increasing land consumption. Whereas high land prices can often result in high building density, comparably low land prices can lead to higher land take per person. However, in the densification of urban settlements, care must be taken to ensure sufficient green spaces to adapt to climate change. As another driver of land take can be considered declining stock market returns since investors turn towards the real estate market. Depending on the region different demographic developments with population growth in dynamic regions on the one hand, and on the other population decline in less favoured and peripheral regions need to be considered.

Industrial and commercial and logistics purposes

Growth focused economic development in general is associated with a high demand for limited open spaces. Trade and commerce compete for locations and municipalities for residents. This can result in a high demand for building plots in the outskirts.

Transport infrastructures

Improving road standards and building new roads also presents a constant land demand. Despite generally rising land prices, strong price differences exist between rural and urban areas. Consequently, increasing commuter movements and increasing freight transport lead to an increased need for mobility and transport infrastructure.

Touristic and leisure time facilities

Tourism and leisure time facilities also entail spatial demands. Furthermore, some tourist activities take up large areas, which are only used seasonally. In most Alpine Countries, like in Austria, this applies especially to regions inside of the perimeter of the Alpine Convention since they are strongly influenced by tourism.

Renewable energy

There is a high demand for spaces for photovoltaic, large-scale solar power plants as well as for hydropower reservoirs in order to achieve the climate targets. This objective is in competition with e.g. the conservation of valuable agricultural or natural land and needs to be handled with care.



3. Facts and figures

It is important to know, that even though a definition of soil consumption and soil sealing has been defined by the Compliance Committee of the Alpine Convention in 2019, the issue has been researched for a long time and very different data sets have been developed. Thus, the methods behind data sources and the definitions behind the topic differ significantly between states, regions, municipalities, and even different sectors. It must be considered that against this background the data displayed from the single Alpine States are mostly not directly comparable but can only be considered as tendencies.

There are different programs based on remote sensing to enable gaining data not only for supporting the nations in facing this issue but also to allow a comparison by generating harmonious data. However, the topic of soil consumption and sealing comprises very detailed spatial patterns thus, all approaches entail both, advantages and disadvantages.

The CORINE (Coordination of Information on the Environment) research programme was launched on a proposal from the European Commission in order to collect and bring together data on the state of the environment and natural resources. This database was initiated in 1985 and the datasets from 1990, 2000, 2006, 2012 and 2018 have been completed. The **CORINE Land Cover** database is based on the interpretation of remotely sensed images whose analysis is cross-referenced with existing maps and aerial photographs. Amongst others the European Environmental Agency (EEA) takes CORINE Land Cover data for informing about land take (EEA 2020a). But *"while the level of detail provided by the CORINE Land Cover project has allowed largescale international comparisons and helped raise awareness of the extent of landscape changes across the EU, it cannot provide a meaningful database for local approaches (Decoville & Schneider 2015). It can also lead to a high error rate in terms of interpretations (Batista et al. 2013). So while it can be useful for general comparisons and observing trends, it is not ideal for measuring the evolution of land take within nations. Any figures based on the data should be considered a conservative estimate."* (Science for Environment Policy 2016). This is also valid for the specific orographic and land use patterns in the Alps.

The **Copernicus** mission developed **high resolution imperviousness data** available for 2006-2015, which can supplement the land take indicator with its information with a higher spatial resolution and a more direct measurement of imperviousness (EEA 2020b). With this high resolution of 20-100m pixel size and the new method this data marks a significant improvement (Copernicus Land Monitoring Service 2020). The data is still not sufficiently exact for the use on a regional or local level, since soil sealing patterns are often smaller than the used resolution of 20-100m. But keeping this in mind, the data allows comparison between the Alpine States.

Table 1 gives an impression of the percentage of sealed area of the total State's territory in 2006 and in 2015. The map in figure 1 displays the average annual change in soil sealing between 2006 – 2015 in the EU. Differences between these data and following national data are caused by different methods, sources, different data acquisition and processing as well as differing definitions of soil consumption and soil sealing as explained above.

State	Share of sealed land of the total State's territory	
	2006	2015
Germany	4,18 %	4,31 %
Slovenia	1,62 %	1,68 %
Austria	1,72 %	1,78 %
Italy	2,66 %	2,74 %
France	2,09 %	2,19 %
Switzerland	2,69 %	2,79 %
Liechtenstein	4,43 %	4,51 %

Table 1: Share of sealed land of the total State's territory. Data source: EEA 2020c.

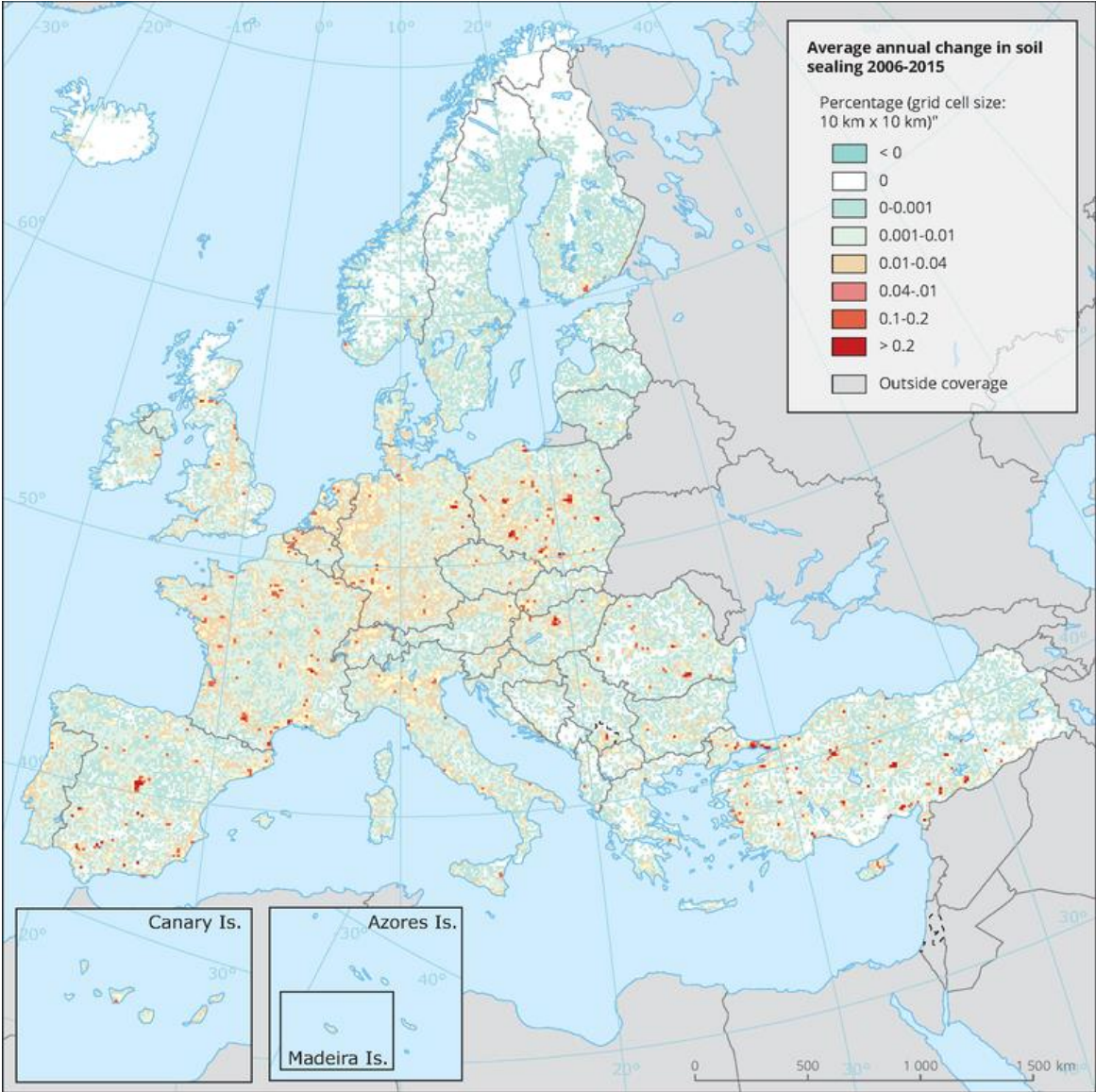


Figure 1: Average annual change in soil sealing in the EU 2006-2015. Source: EEA 2020d.

In total numbers soil consumption in the Alpine area tends to be lower than in surrounding flatter land which can result from a lower share of population and settlements. But at the same time the part of the Alpine area which is suitable for constructions and agricultural use is much less compared to the surrounding flatter areas like figure 2 shows. The soil sealing rates thus need to be contrasted by the area of land, which is suitable to provide a platform for most human activities.

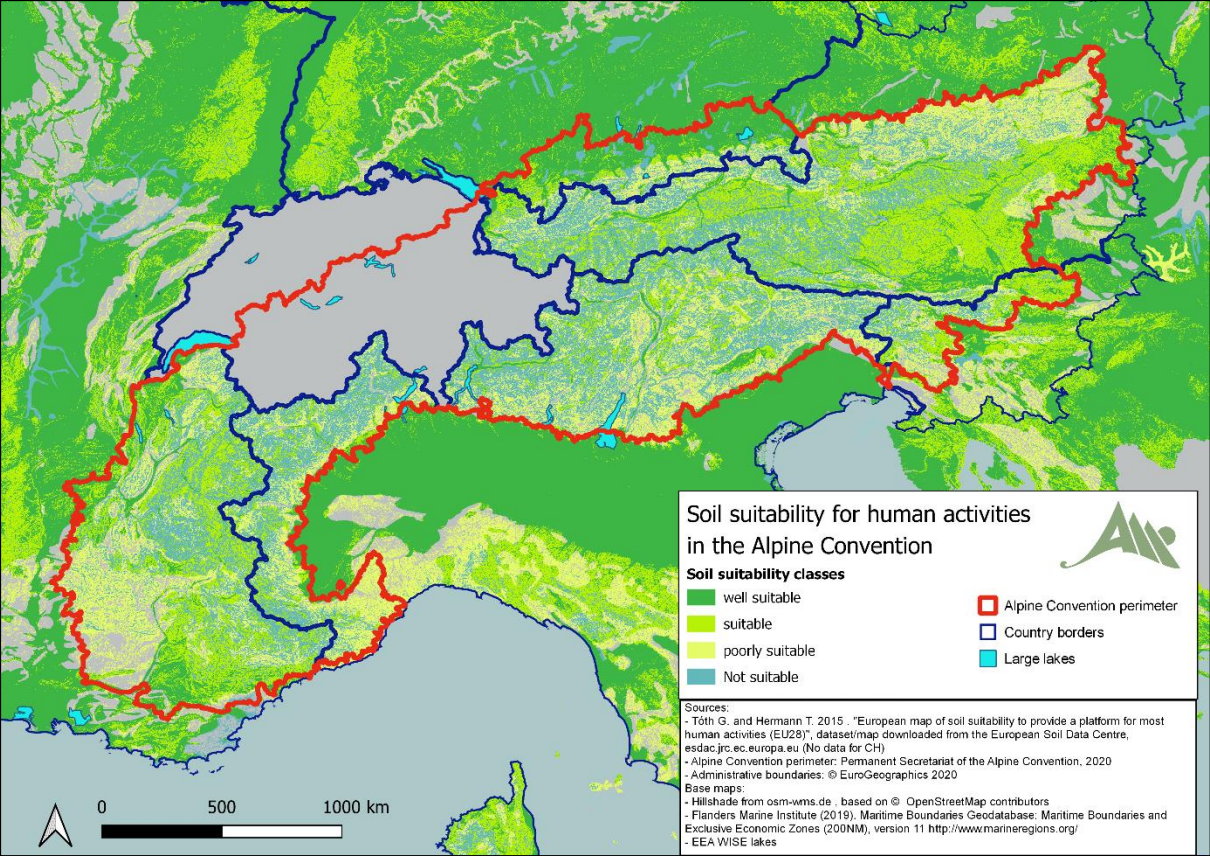


Figure 2: Soil suitability for human activities in the Alpine Convention.

3.1 Figures from the Alpine States

In **Austria** 5.729 km² soil was consumed (taken land) until 2019, this accounts to ca. 7 % of the Austrian territory and to ca. 18% of the permanent settlement area (Environment Agency Austria 2020). The permanent settlement area in Austria comprises 37% on average, with a wide range from 12% in Tyrol to 74% in Vienna. It should be noted that currently 20% of the permanent settlement area is covered by settlement and traffic areas. In 2011 it was only 15%. Figure 3 compares the shares of different land use categories in Austria, Tyrol, Lower Austria and the part of Lower Austria laying within the Alpine Convention perimeter (ALP). Defined as "consumed land" are the categories "buildings and side areas, industrial and commercial areas, mines, dumps and landfill areas", "gardens, leisure areas, cemeteries" as well as "traffic areas". The example of Lower Austria, that lies only partly inside the ALP, visualised that significant land use differences between the whole territory and the ALP territory do exist. With a similar share of "consumed land" the agricultural used area is reduced by almost half to 26 %. Differences in land use are even more significant in comparison with Tyrol, which lays completely within the ALP.

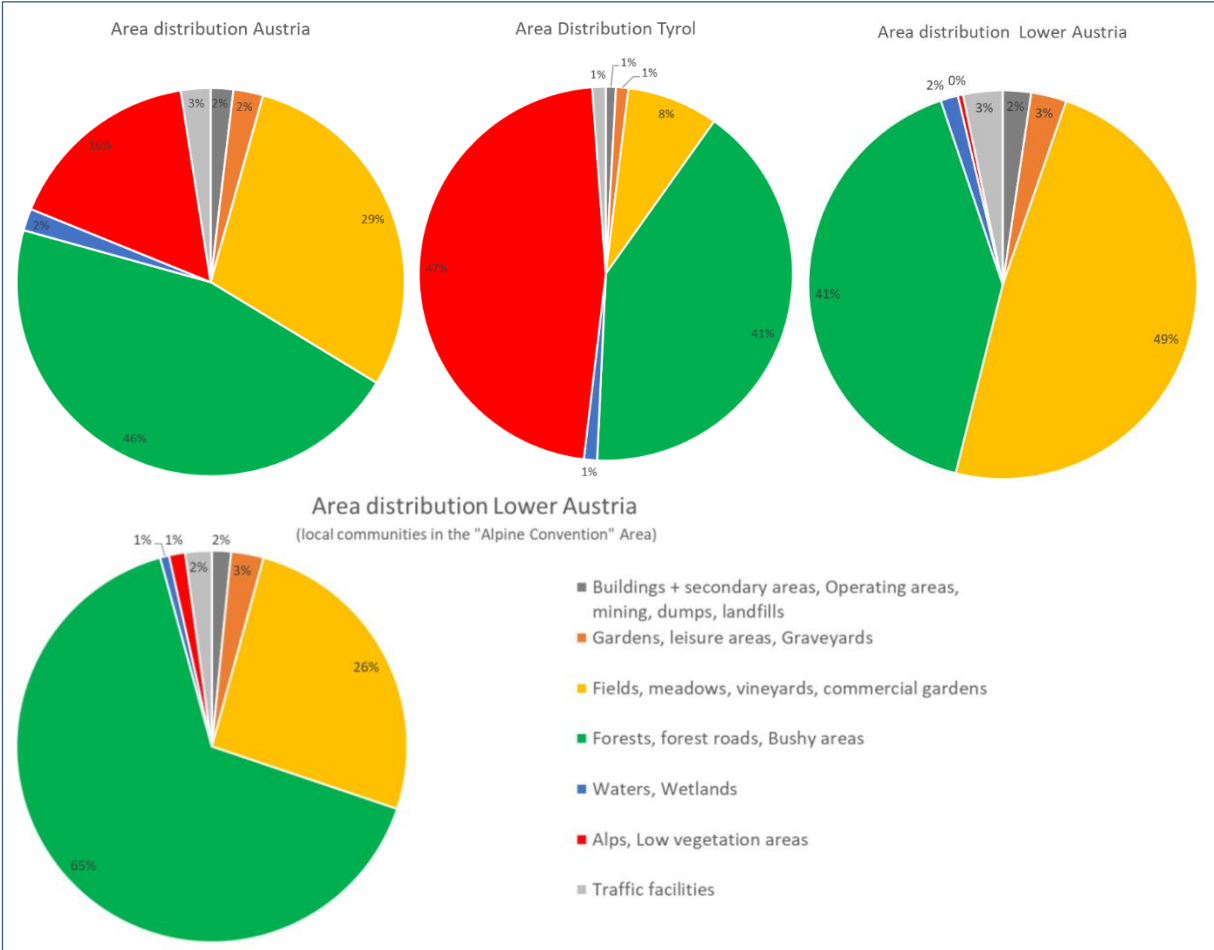


Figure 3: Share of land use categories in Austria, Tyrol, Lower Austria and in the Alpine Convention perimeter of Lower Austria.

Based on the above-mentioned Copernicus high resolution layer imperviousness the ÖROK atlas for spatial observation provides overviews on the soil sealing in Austria. The Alps are highly visible in figure 4, which is displaying the share of sealed areas in 2015 in a 1 km grid. While on first sight the Alpine area looks less affected by sealing a closer look reveals a high percentage of sealing in the Alpine valleys.

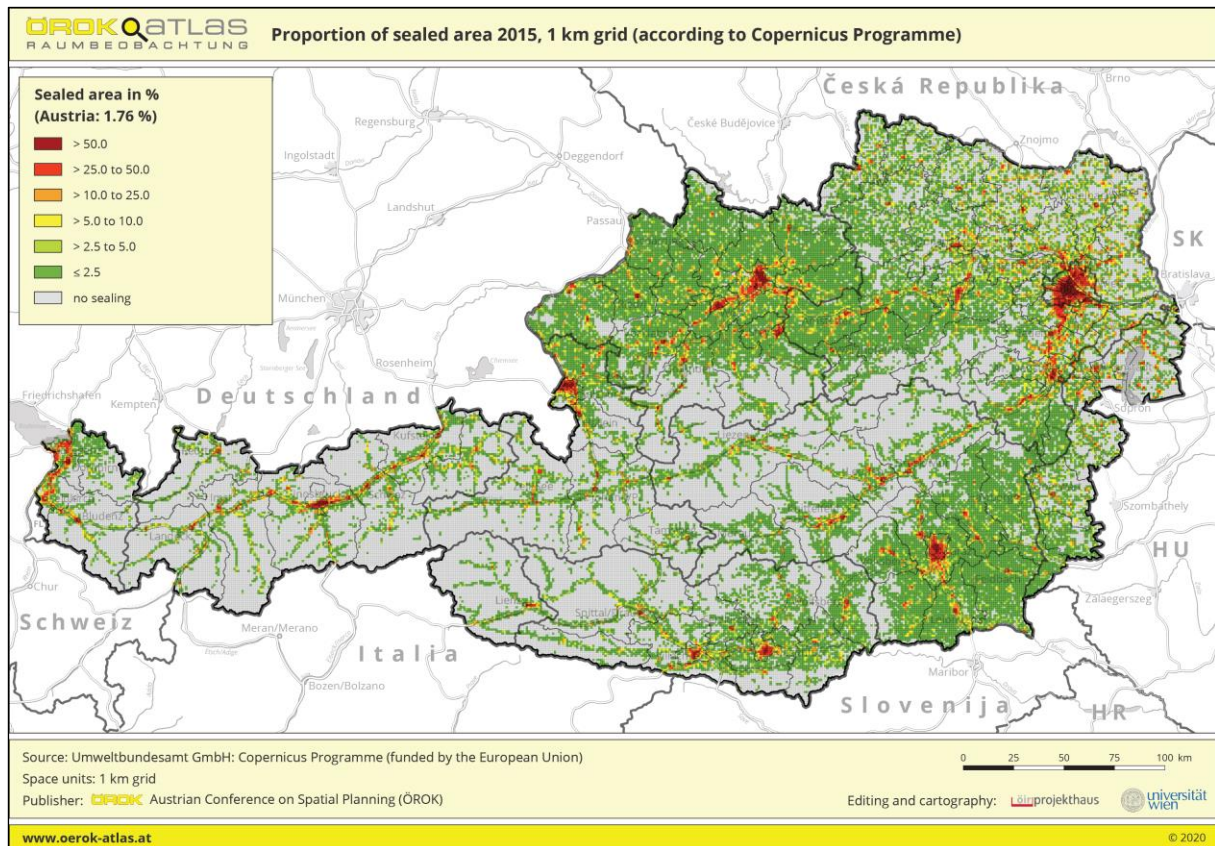


Figure 4: Share of sealed areas 2015 in a 1 km raster (according to the Copernicus High Resolution Layer Imperviousness). Source: ÖROK Atlas 2020.

In Bavaria 10 hectares per day were additionally consumed for settlement and traffic areas in 2018. In the overview in figure 5 a direct comparison between the data before and after 2013 is not possible due to changes in the nationwide uniform statistics of the surveying administrations. The Bavarian State Planning Act plans to introduce a benchmark of a maximum of 5 ha for additional land use for settlement and transport purposes. The area of the Alpine Convention perimeter in Bavaria comprises around 11.127 km² and thus around 15.8% of the total areal extend of Bavaria.

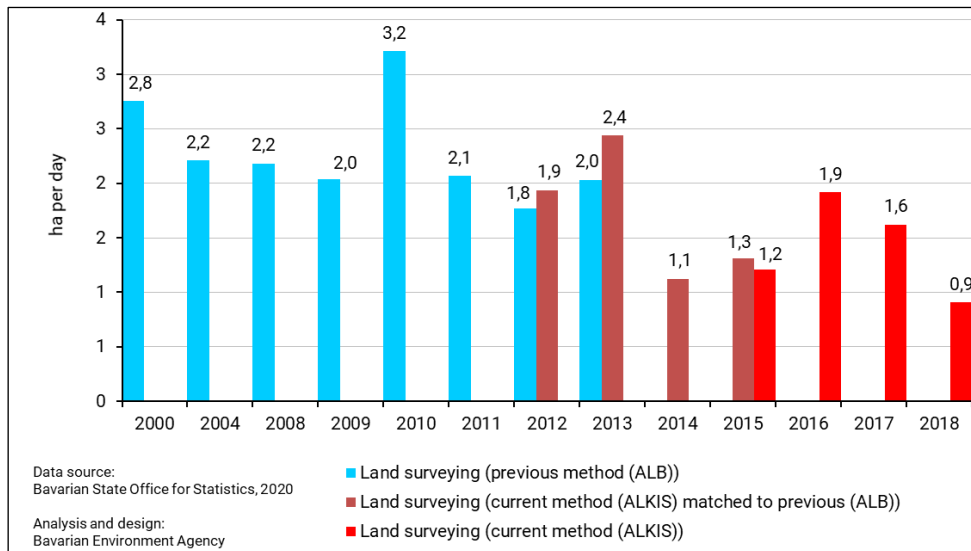


Figure 5: Land consumption in the Bavarian area inside the Alpine Convention perimeter.

Bavaria examined the degree of surface sealing of all designated settlement and traffic areas in the municipalities in detail in 2007 by using satellite images from 2000. This study was then repeated using data from 2015. In 2015 the average degree of surface sealing of designated settlement and traffic areas on the municipal level for the perimeter of the Alpine Convention was around 49.5% and 50.9% for the whole area of Bavaria. The "Landsat" images used had a 30 m resolution and were classified with a total accuracy between 70 and 84%. The study considered streets and railroads with a likely width below 30 m with additional vector datasets.

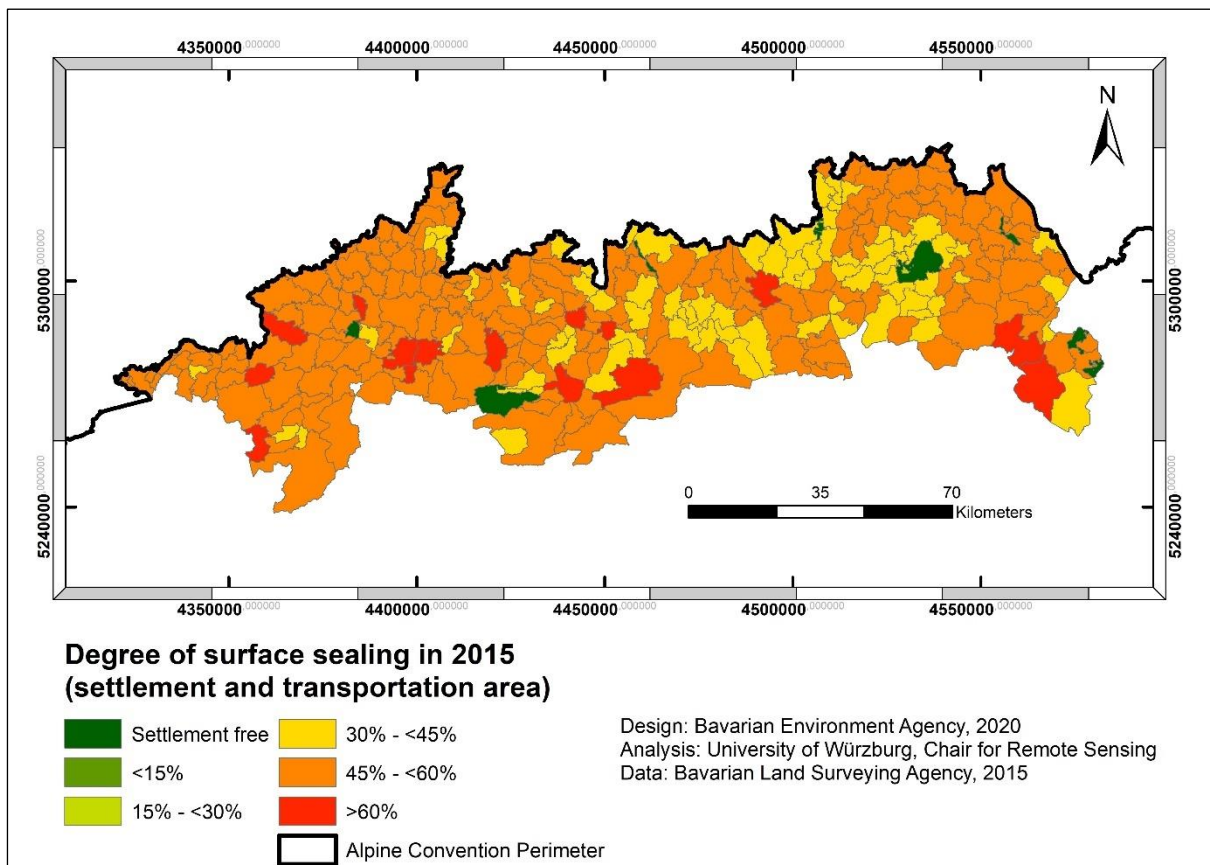


Figure 6: Degree of surface sealing in Bavaria in 2015 (settlement and transportation area).

As mentioned before the type of data source used is significant for being able to display meaningful data on soil consumption. Three main sources of data are available to measure soil uses and artificialisation in **France**. Each of these sources entails biases for an accurate measurement of artificialisation, defined by non-natural, agricultural and forest areas:

- CORINE Land Cover (CLC) covers the exhaustiveness of the territory, but the results are obtained by extrapolation, and the survey is carried out only once every six years (see also above).
- Teruti-Lucas (TL) is a survey and the results are also obtained by extrapolation from measured points on the territory. It therefore does not provide an accurate measure of artificialisation over the whole territory more than CLC does.
- The land files (LF) do not include land that is not included in the cadastre (such as the public domain, which includes all roads). Conversely, as soon as a plot of land is classified as "*to be built on*", it is counted as artificial, whereas it may remain unbuilt for years or even decades.

As they are not based on the same methods of analysis, particularly in terms of spatial resolution and nomenclature of accounted land, these sources are at the origin of various estimates of the artificialisation processes. Data from land files, recorded at the scale of the cadastral parcel, present the finest level of analysis and therefore allow precise measurement of the dynamics of land use change. The following key data (France Stratégie 2019) are comparing these 3 sources and express the extend of differences. This can result in looking e.g. at the increase in artificial surfaces:

- CLC: 16,000 ha / year for 2006-2012,
- TL: 61,200 ha / year between 2006 and 2014,
- LF: 23,000 ha / year between 2006 and 2016.

Only the Teruti-Lucas data allow a long-term analysis of artificialisation and thus of the evolution of land use via this indicator. Since 1981, the increase in artificialized land has averaged around 60.000 hectares per year. Artificialized land has thus increased from 3 million to 5,1 million hectares, which represents a growth of 70%. This represents a much higher growth than that of the population (+19%) in the same period.

Data based on the Teruti-Lucas surveys conducted between 2000 and 2019 on the topic of soil consumption for the French Departments which lay completely or partly inside the French perimeter of the Alpine Convention are given in table 2.

Department inside or partly inside of the AC perimeter & France	Newly artificialized soils 2000-2019 (ha)	Newly artificialized soils 2000-2019 (%)	Sum of artificialized soils 2019 (%)	Artificialized soils difference 2000-2019 (ha/day)	Artificialized soils per inhabitant (m ² 2019/inhabitant in 2020)
Drôme	12.706	1,94%	8,93%	1,74	1.100
Isère	9.825	1,25%	9,50%	1,35	600
Savoy	4.481	0,71%	5,11%	0,61	700
Upper Savoy	9.444	1,95%	11,06%	1,29	600
Alpes of Upper Provence	8.033	1,15%	2,87%	1,10	1.200
Upper Alps	3.321	0,58%	2,67%	0,45	1.100
Maritime Alps	7.861	1,83%	9,15%	1,08	400
Var	32.170	5,33%	12,81%	4,40	700
Vaucluse	15.705	4,39%	15,28%	2,15	1.000
Sum Departments	103.546	2,13%	8,16%	14,17	700
France	1.008.263	1,84%	9,71%	138,04	800

Table 2: Artificialized soils in French departments inside or partly inside of the French AC perimeter and France. Source: Agreste - Statistique Agricole Annuelle (SAA) 2020.

While the share of artificialized soils in 2019 in the departments which lay inside or partly inside of the AC perimeter is not much lower than in the whole French territory, the percentage of additional artificialized soils between 2000 and 2019 was even higher in the Alpine departments than compared to the whole area of France.

According to the land records available since 2006, the increase in artificial land was lower in the timespan 2006-2016, however, still higher than the population growth. In the period 2006-2014 Teruti-Lucas and the land files are consistent in identifying a strong acceleration of artificialisation just before a crisis in 2008 and then returned to a value below the long-term average.

Inside of the perimeter of the **Italian** Alps lay 1.645 municipalities, 24 provinces and 7 regions, adding up to an area of over 5.200 hectares.

Homogeneous data on land consumption in Italy are processed by the Italian Institute for Environmental Protection and Research (ISPRA), which refers to the category “*artificial land cover*”. Some Italian regions also have other data, which refer to the definitions of land consumption introduced by the respective regional laws and mostly concern the consumption on the basis of the municipal plans in force (urbanized surfaces or surfaces that can be urbanized, also classifiable on the basis of the type of residential or other settlement). ISPRA data on land consumption in Italy are available for 2012, 2015, 2016, 2017, 2018 and 2019. For each year they are assessed at municipal, provincial, regional and national level (ISPRA 2020a). The sealed part of land consumption is assessed since 2017 for all new artificial areas. The soil sealing in 2019 was about 23% of total land consumption growth but it should be considered that the 70% which is not sealed yet is classified as building site. It thus can be assumed, that most of it will be sealed in the next years.

The analysis by ISPRA and the Italian National System for the Protection of the Environment (SNPA) is based on the municipal level and considers some indicators for 2012 and 2019. As illustrated in table 3 land consumption between 2012 and 2019 has grown by 2.734 hectares (+1,44%) in the Italian part of the Alpine Convention perimeter. Trentino-Alto Adige/South Tyrol

is the region in which land consumption has increased the most (1.074 ha, +2,54%). The artificial land cover per inhabitant in the Alpine municipalities in Friuli-Venezia Giulia and Liguria are the highest - respectively 735 and 728 m² per inhabitant. Considering the whole extend of the Italian Alpine Convention perimeter 2012 - 2019 more than 1 hectare per day was lost.

Region (municipalities in the AC perimeter)	Land consumption growth 2012-2019 (ha)	Artificial land cover of total area 2019 (%)	Land consumption growth 2012-2019 (%)	Land consumption growth 2012-2019 (ha/day)	Land consumption 2019 (m ² per inhabitant)
Piedmont	426	4,42%	1,00	0,17	502
Aosta Valley	124	2,15%	1,80	0,05	557
Lombardy	333	6,15%	0,76	0,13	345
Trentino-Alto Adige/South Tyrol	1.074	3,19%	2,54	0,42	408
Veneto	566	7,16%	1,70	0,22	491
Friuli-Venezia Giulia	179	5,32%	1,17	0,07	735
Liguria	32	3,52%	0,60	0,01	728
AC perimeter	2.734	4,75%	1,44	1,07	447

Table 3: Land consumption in the Italian municipalities inside the AC perimeter displayed per Region. Data source: ISPRA - SNPA 2020.

Mountain areas are generally less artificialized than other areas in Italy, where the average artificial land cover of the total area is 7,1%. Considering the map of the land consumption in municipalities in 2019 (figure 7) it is possible to see that the distribution of the artificial areas is concentrated in the South, near Po Valley and in the valleys of Trentino-Alto Adige/South Tyrol.

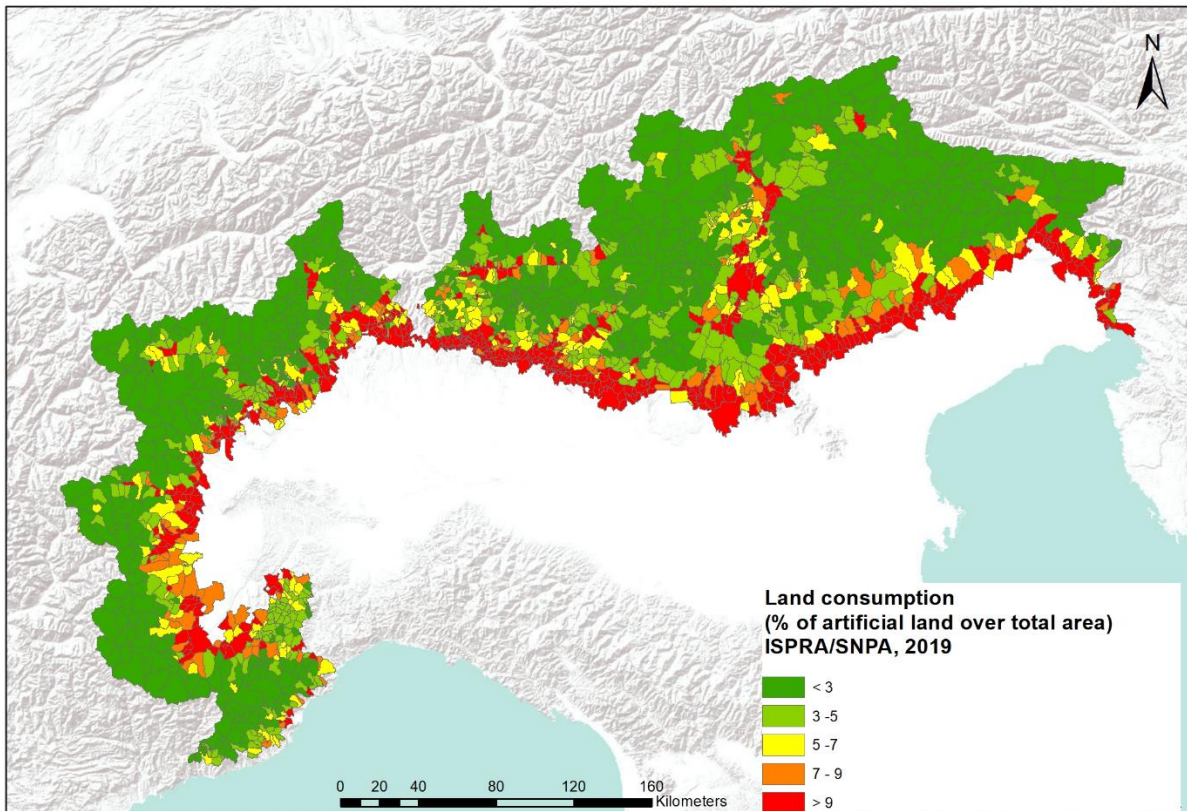


Figure 7: Artificial Land cover in the perimeter of the Alpine Convention in 2019 at municipal level. Source ISPRA - SNPA 2020.

According to the land-use statistic soil consumption in **Liechtenstein** amounts to 16,8 ha per year in the timeframe between 1984 and 2014. The settlement area made up ca. 11 % of the territory of Liechtenstein in 2014. (Amt für Statistik Fürstentum Liechtenstein 2020). According to an evaluation of the land cover mapping data soil sealing in Liechtenstein amounts to 8,37 ha per year (2015 – 2019).

	1984	1996	2002	2008	2014	2015	2019
Consumed land (in ha)	1.259	1.465	1.578	1.683	1.762		
Land consumption since previous period (in ha)		206	113	105	79		
Settlement area (m ²) per inhabitant	471,9	470,4	466,0	472,9	471,6		
Sealed land (in ha)						1.091,87	1.133,72
Land sealing since previous period (in ha)							41,85

Table 4: Land consumption in Liechtenstein. Data source: Amt für Statistik Fürstentum Liechtenstein 2020.

As explained in more detail in a following chapter **Slovenia** is currently in the process of collecting data on land consumption. There is no specific data yet on land cover and land use for Alpine Convention perimeter in Slovenia, which encompass 62 whole or part municipalities out of 212. However, for the complete territory of Slovenia data is available.

In 2018, more than half of Slovenia's land area was covered by forests (56 % or 58% including shrubland), while other mostly natural vegetation makes up 3%. Farmland occupied 34 % of land area, while slightly less than 4 % was artificial land, and less than 1 % covered by water. In the periods 1996–2000, 2000–2006 and 2006–2012, land cover and land use changes were relatively small (they occurred on 0,12 %, 0,13 % and 0,09 % of the entire territory, respectively). In the latest period 2012–2018 land cover and land use changes slightly increased as they occurred on 0,44 % of the entire territory. Most of the detected changes were related to forest management, resulting from the sleet damage in 2014.

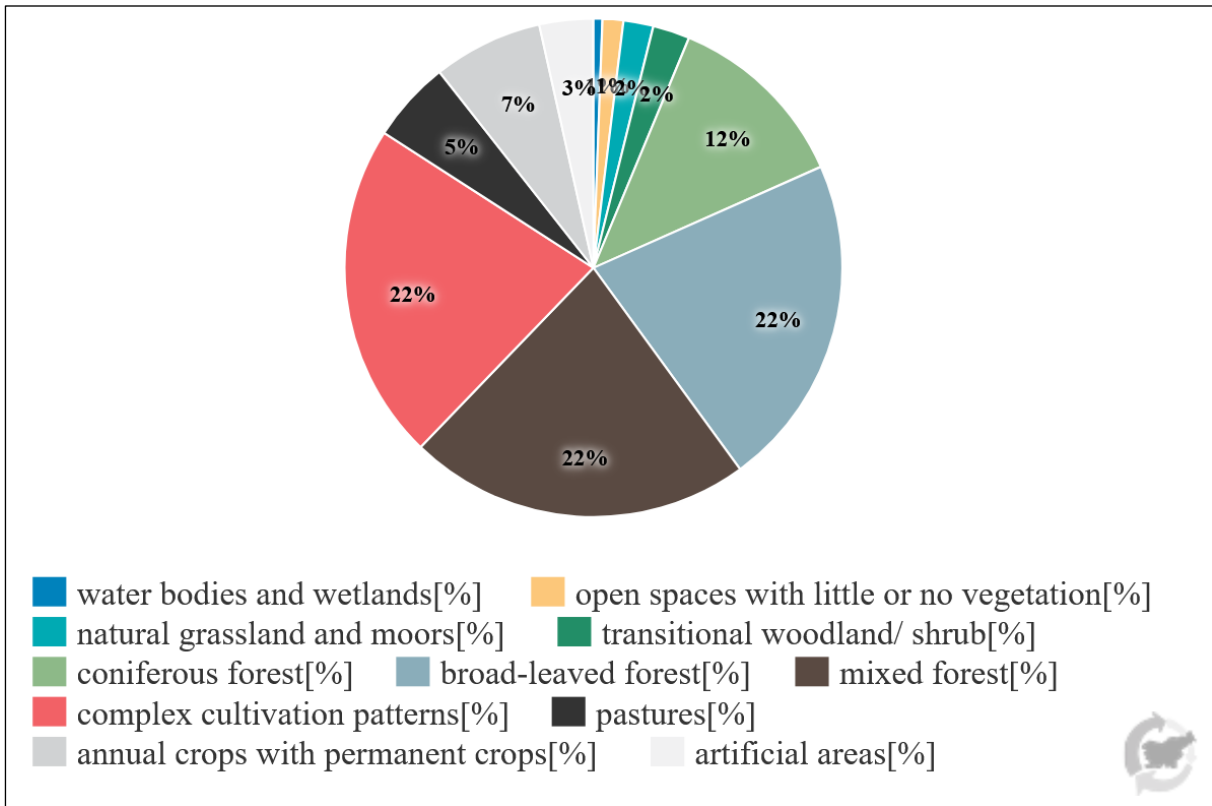


Figure 8: Structure of land cover and land use categories in Slovenia 2018. Source: ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2018. Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia, European Environment Agency (2018).

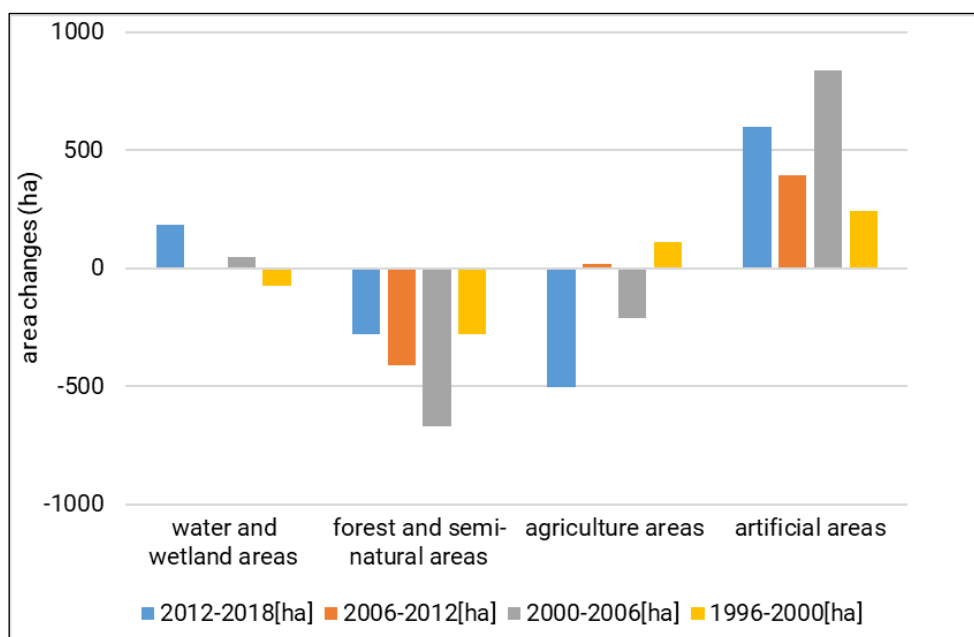


Figure 9: Changes in total area of land cover-land use categories, Slovenia, by period, 1996-2000, 2000-2006, 2006-2012, 2012-2018. Sources ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2018. Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia, European Environment Agency (2018).

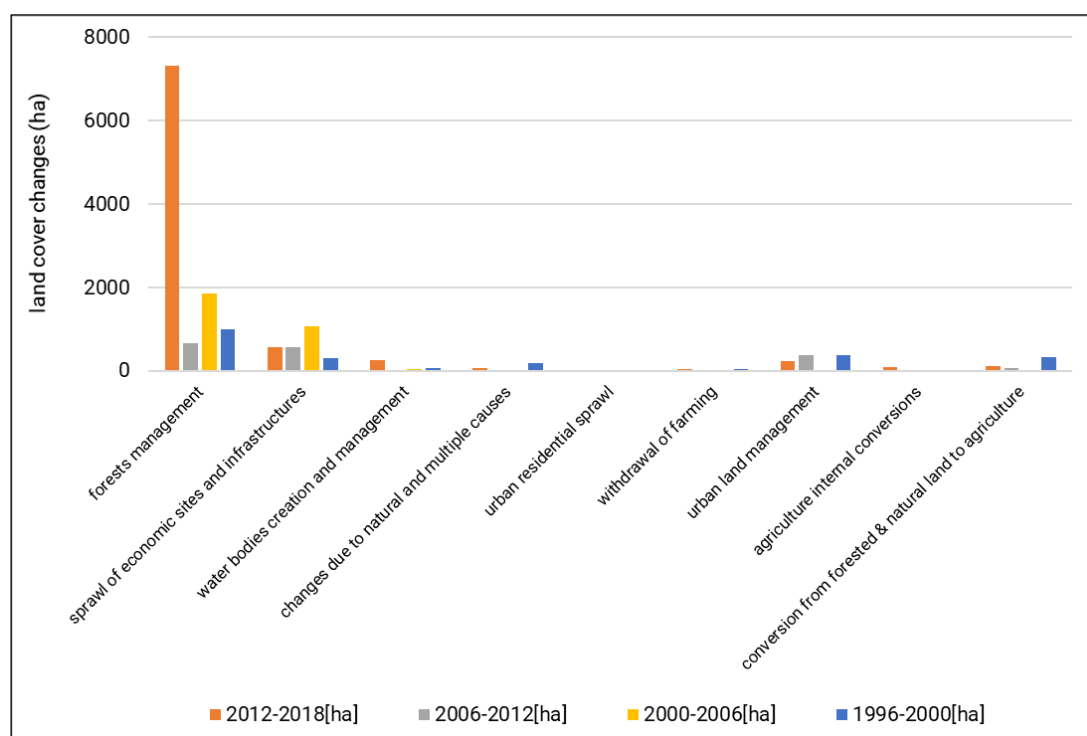


Figure 10: Flows of land cover changes, Slovenia (LEAC, EEA methodology). Sources: ARSO OKOLJE Kazalci okolja 2020 and CORINE Land Cover 2000, 2006, 2012 and 2018; European Environment Agency, Ministry of the Environment and Spatial Planning, Slovenian Environment Agency, Surveying and Mapping Authority of the Republic of Slovenia; European Environment Agency, 2007; European Environment Agency, Slovenian Environment Agency, 2012; calculations Slovenian Environment Agency (SprePok-SI); European Environment Agency, Slovenian Environment Agency, 2018; calculations Geodetic Institute of Slovenia, 2019.

In **Switzerland**, the data on land consumption is collected in the “*Arealstatistik*”, which is conducted during certain time periods. Currently, the data of the newest census is being processed and will be available in 2021. The newest national data are therefore available for the averages of the census period 2004-2009. This means the data per day indicated below are long-term averages. The total size of settlement areas is displayed as consumed land and the total size of sealed areas as sealed soil in table 5.

	1985	2004-2009
Consumed land	249.477 ha	307.898 ha
Average land consumption	6,67 ha/day	
Sealed soil	148.742 ha	192.050 ha
Average soil sealing	4,94 ha/day	

Table 5: Land consumption in Switzerland. Data source: Bundesamt für Statistik 2020.

3.2 Legally binding quantitative limitations for soil consumption and soil sealing

The need of land from multiple different perspectives makes it an issue on which many players must work together. Even though there are hardly any specific legally binding definite numbers for limiting soil consumption and soil sealing in the Alpine States on the national level, there are several regulations and instruments on different levels and from different fields. There are many regulations which are not directly targeted at soil protection as such but also help to protect the soil, like regulations regarding spatial planning or nature protection. The laws that regulate activities on the soil, are thus plural: spatial development laws (land use, management of its scarcity), civil laws (property rights, easements), rural laws (agricultural exploitation, protection against erosion), health laws (support for measures to protect drinking water catchments).

The in depth review of the Compliance Committee of the Alpine Convention of the subject “*Economical use of soil*” (Compliance Committee of the Alpine Convention 2019) displays this topic and especially the regulations in the Alpine States much more in detail. Regarding the governance in the interface of limiting soil consumption and spatial planning in the Alpine area a study has been carried out in 2018 outlining the different regulations, tools, levels and actors (Zollner, D. et al. 2018).

General guiding principles for the perimeter of the Alpine Convention are set in the Protocol Soil Conservation of the Alpine Convention Article 7:

- “Economical and Prudent Use of Soils*
- (1) In drawing up and implementing plans and/or programmes according to article 9 paragraph 3 of the Protocol on Spatial Planning and Sustainable Development, matters regarding soil conservation, especially the economical use of soil and land, shall be taken into consideration.*
 - (2) In order to limit soil sealing and soil consumption, the Contracting Parties shall provide for space-saving construction and an economical use of soil resources. They shall preferably seek*

to keep the development of human settlements within existing boundaries and to limit settlement growth outside these boundaries.

(3) When assessing the spatial and environmental compatibility of large-scale projects in the domains of trade and industry, construction and infrastructure, especially in the transport, energy and tourism sectors, soil conservation and the scarcity of space in the Alpine region shall be taken into account within the framework of the national procedures.

(4) Where natural conditions allow it, disused or impaired soils, especially landfills, slag heaps, infrastructures or ski runs, shall be restored to their original state or shall be recultivated.”

As well as in the Protocol Spatial Planning and Sustainable Development of the Alpine Convention article 9 paragraphs 2, 3 and 4:

“Contents of spatial and sustainable development plans and/or programmes

The spatial and sustainable development plans and/or programmes include, at the most appropriate territorial level and taking account of the specific territorial conditions:

2. Rural areas

- a) reserving lands for agriculture, forestry and pasture farming,*
- b) defining measures for the maintenance and development of mountain agriculture and forestry,*
- c) conservation and reclaiming of territories of major ecological and cultural value,*
- d) determining the areas and installations necessary for leisure activities, complying with other uses of the ground,*
- e) determining the areas subject to natural hazards, where building of structures and installations should be avoided as much as possible.*

3. Urbanised areas

- a) proper and contained delimiting of the areas for urbanising, and also measures for ensuring that the areas so defined are actually built upon,*
- b) reserving the lands necessary for economic and cultural activities, for supply services, and also for leisure activities,*
- c) determining the areas subject to natural hazards, where building of structures and installations should be avoided as much as possible.*
- d) conservation and creation of green areas in the town centres and suburban areas for leisure time,*
- e) limiting of holiday homes,*
- f) urbanisation directed and concentrated along the routes served by transport infrastructures and/or continuing on from the existing constructions,*
- g) conservation of the characteristic urban sites,*
- h) conservation and restoration of the characteristic architectural heritage.*

4. Protection of nature and the landscape

- a) delimiting of the areas for protecting nature and the landscape, and also for safeguarding the water courses and other vital natural resources,*
- b) delimiting of tranquil areas and areas in which construction of buildings and infrastructures is restrained or prohibited, as are other damaging activities.”*

Additionally, some examples of legally binding quantitative limitations for soil consumption and soil sealing in the Alpine States on different levels and from different fields are shown here.

In **Austria** municipalities and regional governments can set limits and settlement boundaries in their spatial planning programs. Most Regional State spatial planning programs use tools

of spatial planning such as the designation of protected areas, national parks or exemption of agricultural land. But those regulations are only valid on municipal and regional level and might have exceptions contradicting the goal of soil protection. The national "*Environment Impact Assessment Law*" (EIAL) accounts for large-scale infrastructure projects. The leverage for a mandatory EIA is at 10 hectares land consumption and in 5 hectares in sensitive areas.

In **Germany**, the national Building Code (BauGB § 1a (2)) regulates that land and soil should be handled economically and soil sealing should be limited to the necessary extend. To reduce the additional land use for building purposes, other development opportunities of the municipality must be used, particularly by applying measures for interior development like redevelopment, renovation and densification.

In **France**, many standards are in place whose purpose is not primarily soil protection but rather to help protect the soil. The most important ones are:

1. The impact study procedure, which precedes development works and projects likely to harm the environment, was instituted by Act No. 76-629 of 10 July 1976. In 1993, the soil component has been added to the impact study procedure.
2. Law n°2000-1208 of 13 December 2000 on Solidarity and Urban Renewal (SRU law), has profoundly modified the urban planning and housing law in France. It introduces several major changes that allow better management of building zones.
3. Law n° 2010-788 of 12 July 2010 specifies that urban planning documents must henceforth set objectives for the protection of agricultural areas and the fight against continuous urbanization.
4. Law n°2016-1087 of 8 August 2016 for the reconquest of biodiversity, nature and landscapes, recognises the protection of soils of general interest, by integrating them into the Nation's common heritage in the environment code.

The local urbanization policy relies on numerous planning instruments, including local inter-municipal urban plans (PLUI), local housing programmes (PLH), urban travel plans (PDU). Territorial Coherence Schemes (SCOT) aim to coordinate these instruments on the scale of a larger area, within the framework of a sustainable planning and development project (PADD). The State ensures legality control via urban planning documents and assists local authorities in drawing them up. In respect with the French regulations, the PLUI defines different zones according to their uses and fixes the conditions and limits of the urbanization. The PLUI builds planning and development projects aimed at making towns and cities more environmentally friendly. The PLUI has the advantage that it can be drawn up on a municipal or even inter-municipal scale. It aims at drawing a vision of the territory for 10 or 15 years. Municipalities and agglomerations will have to make an ecological transition that involves urban reorganization and the consumption of its energies, particularly the use of polluting energy sources in order to limit their CO₂ emissions, stem the problem of soil erosion and reorganize their territorial planning for environmental preservation.

Sectoral policies, which in the past were different and sometimes unconnected, are now being brought in line with each other. The PLUI makes it possible to pool know-how, skills and resources of a larger territory. It makes it possible to organize solidarity between municipalities better, and therefore to develop a more concerted approach to land management and soil protection.

In **Italy** the fundamental law on land use (D.P.R. n. 380/01) is in place, while a specific law on soil consumption is under preparation. In addition, all regions have their own laws on land use planning. In most of them land consumption is covered with specific limitations and targets for each type of land use. The respective regional laws differ from each other. Some regions, such as Lombardy, Piedmont and Veneto have a specific regulation on land consumption, while for others the matter is contained in land use laws and plans (e.g. Aosta Valley). Furthermore, in many regions, the reduction of land consumption is promoted together with urban regeneration, which is intended to be an alternative to urban sprawl. However, these laws usually do not refer to a single definition of land use and there are also some derogations, which allow for new buildings and urban sprawl.

As very positive feature for soil protection some regional laws and plans refer to quantitative targets for maximum soil consumption and to qualitative aspects of the soil. This is done by attributing scales of values to the soils to guide future planning choices of local administrations, to assess the less critical building locations and also to establish the principle of environmental compensation in case of interventions that generate land consumption. Furthermore, a monitoring system on soil consumption of the urban plans has also been activated in most regions, for example in Lombardy.

Liechtenstein has no legally binding quantitative restriction to limit soil consumption and soil sealing. In case of proven demand, the defined residential zones, which were generously set in the 1970s, can be extended. However, a minimum of 30 percent of each of the eleven municipal areas remains reserved for agriculture (primary production). The communities have developed different approaches to achieve compact settlement structures. There are communities which successfully purchase properties, to be able to exchange these properties in case of submission of building application.

As well in **Slovenia** there are no legally binding qualitative limitations in spatial planning, but legally binding principles which set a priority to inner development when settlement development is in question. The objectives, basic principles and guidelines are set out in the Spatial Management Act (Law, O.G. 61/17) and Spatial Development Strategy of Slovenia (Ordinance, O.G. 76/04) as well as in the Spatial Order of Slovenia (Decree, O.G. 102/04). The legally binding principles are used in a process of preparation of the municipal spatial plan for assessment whether the municipality's development needs are justified. If a municipality during the preparation of its spatial plan proposes the extension of the particular settlement area on an agricultural land, the ministry responsible for agriculture can demand the release of an agricultural land, which was designated for urban land use but has not been built on.

In **Switzerland** the only legally binding quantitative limitation for the consumption of soil is given by the crop rotation sectoral plan. Crop rotation areas cover a large proportion of the soils on Switzerland's central plateau. They comprise crop-sustaining arable land, primarily cropland, and temporary grassland in rotation, as well as crop-sustaining natural grasslands and are secured by measures under spatial planning legislation (Art. 26 para. 1 Spatial Planning Ordinance (SPO)). Revised between 2016 and 2020, the crop rotation area sectoral plan requires each canton to designate a specific quota of land for crop rotation areas (crop-sustaining arable land). It is currently the only spatial planning instrument which references the quality of soils and not simply their land area. Additionally, relevant legal guidelines on national Level can be found in the Federal Act on Spatial Planning (Bundesgesetz über die

Raumplanung (Raumplanungsgesetz, RPG) 22. June 1979 (Current update from 1 January 2019), AS 1979 1573). The law includes the following parts:

"1) The Federal Government, cantons and municipalities ensure that the land is used economically and that the building area is separated from the non-building area.

2) The countryside must be preserved. In particular:

a. sufficient areas of suitable arable land, in particular crop rotation areas, should be reserved for agriculture;

b. settlements, buildings and installations should integrate well into the landscape;

c. lakesides and riverbanks should be kept free and accessible to the public;

d. natural landscapes and recreational areas should be conserved;

e. forests should be able to fulfil their functions.

3) Settlements must be arranged according to the needs of their inhabitants and their expansion must be limited."

A link between quantitative and qualitative soil protection in Switzerland can also be found regarding the recovery of removed topsoils and subsoils in Article 18 of the Ordinance on the Avoidance and the Disposal of Waste (Verordnung über die Vermeidung und die Entsorgung von Abfällen (VVEA) 4 December 2015 (Current update from 1. April 2020), AS 2015 5699).

3.3 Targets for maximum soil consumption

While the Protocol Soil Conservation of the Alpine Convention sets “*Economical and Prudent Use of Soils*” as binding provision for the perimeter of the Alpine Convention, defined targets are set in some Alpine States as well as on EU and global level.

	Target	Timeframe
Alpine Convention	-	-
Austria	2,5 ha/day (intentional target of Federal Government)	2030
Germany	30 ha/day	2030
Bavaria	5 ha/day as benchmark	2030
France	zero net artificialisation of soils	2050
Italy		-
Lombardy	25% reduction of the forecast of land consumption from 2014	2020
	45% reduction	2025
Piedmont	Max. 3% of existing urbanized area each 5 years	-
Veneto	40% reduction of the forecast of land consumption	Since 2011
Liechtenstein	-	-
Slovenia	Reduction of net growth of built-up land for 25%	2030
	Zero net growth of built-up land	2050
Switzerland	Net zero land take	2050
European Union	No net land take	2050
United Nations	Land Degradation Neutrality	2030

Table 6: Targets for maximum soil consumption.

Soil consumption in **Austria** should be kept as low as possible and the **annual land consumption** should be reduced to **9 km² (2,5 hectares per day) by 2030** according to the governmental program 2020 – 2024.

Germany is striving to reduce the use of new land for settlement and transport purposes to **30 hectares per day by 2030** according to the National Sustainability Strategy of the Federal Government. The **Bavarian** government is committed to the Federal Government's reduction target and plans to introduce a benchmark of **5 ha per day for land use for settlement and transport** purposes in the Bavarian State Planning Act. This is part of the Bavarian land-saving initiative, which has been adopted as a comprehensive catalogue of measures in 2019. One of the objectives of the Bavarian Sustainability Strategy is to achieve a significant reduction in land consumption in the long term and to establish a land-cycle economy without further land consumption.

The **French** biodiversity plan of July 2018 foresees the target to achieve "**zero net artificialisation (ZNA)**" of soils in 2030. The achievement of this goal would require in France a 70% reduction in gross artificialisation and the renaturing of 5.500 hectares of artificial land per year. In parallel, densification in urbanised areas should be encouraged with regulatory or fiscal tools. A first step towards reaching the target has been done by the PLUI initiative.

In **Italy**, targets for quantitative limitations for soil consumption are currently not established on the national level. The **regions** are responsible for setting limits and land use is regulated by the local plans, which each municipality must develop. The following Alpine regions have defined a target:

- Lombardy: the 2019 Regional Plan defines on the basis of demographic forecasts compared to forecasts of transformation areas included in the municipal plans in force, identifies the regional threshold for the reduction of soil consumption to 25% for 2020 and 45% for 2025, compared to the forecasts of the municipal plans in force since 2 December 2014 (effective date of Regional Law No. 31 on soil consumption);
- Piedmont: the 2011 Regional Plan defines maximum land consumption thresholds for categories of municipalities, which cannot exceed 3% of the existing urbanized area for each five-year period;
- Veneto: the 2018 Regional Resolution defines a reduction of at least 40% of the forecast of land consumption external to the consolidated urbanization areas of the municipalities.

Furthermore, Italy has, as first EU Member State, set up a national monitoring program integrating several soil related indicators beyond those of the UNCCD in order to assess the achievement of the Sustainable Development Goal 15.3 to reach **Land Degradation Neutrality**.

No quantitative targets are currently set in **Liechtenstein**.

Slovenia recently adopted the Environmental Protection Programme 2020-2030 (Resolution, OG No. 31/20) which foresees measures in the field of soil protection like: sustainable management of soil and land as well as the **decrease of the net growth of built-up land on 25% by 2030**. The document also sets the target of **zero net growth of built-up land from 2050 onwards**.

In May 2020, the Federal Council adopted the new Soil Strategy for **Switzerland**. It includes the target of **net zero land take until 2050**. Building on new ground is still possible. However, if soil functions are lost, they must be compensated by upgrading the soil at another location. Until a Switzerland-wide soil function map is available, soil sealing (according to the BFS areal statistics) is used as indicator.

*"The enormous loss of soil functions and ecosystem services is one of the major environmental challenges Europe is facing. To help address this global problem, the European Commission has proposed in the **EU Environment Action Programme to 2020 (7th EAP)** to have policies in place by 2020 to achieve '**no net land take**' by 2050 and has also set targets for reducing soil erosion and the loss of soil organic matter: "By 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land*

take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway.” (COM (2011) 571)” (Science for Environment Policy 2016).

In scope of the Sustainable Development Goals the **global** target (15.3) is set to “*combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a **land degradation-neutral world** by 2030* (United Nations 2020).



4. Main challenges regarding an economical and prudent use of soil

Limited space availability against multiple demands

In the Alpine area the permanent settlement space and thus resource land is especially limited. The pressure on those flat or slightly sloped areas, which are favourable for infrastructure is very high. An additional limitation exists due to (hydro-) geological risks in many areas in the Alps. Soils with its many functions and services it provides for the society, e.g. with regard to production, water retention, climate protection., is subject to massive competition from diametrically opposed user interests - such as food production for regional self-sufficiency or retention areas for water balance, space demand for residential and commercial areas as well as touristic and other infrastructure. In the Alpine region, valley floors are a rare commodity and therefore particularly affected. The main challenges regarding an economical and prudent use of soil thus arise from the different claims on the use and the cross-cutting issues that arise with it. Many different strategies address the same area from specific sectoral perspectives which can lead to contradictions and which makes it difficult to find a solution that fits everybody.

Financial/fiscal drivers

Municipalities have an overall interest in supporting the establishment of households and businesses in their territory to maintain its dynamism. Taxes are important sources of funding for local authorities. It is very difficult to measure the specific effects of these tools on the local dynamics of artificialisation of soil. These tax mechanisms were not designed to address the issue of reducing land artificialisation.

Real estate sector

In addition to fiscal instruments, there are housing support policies aimed at supporting the real estate sector, home ownership and urban renewal. These policies play a decisive role in the dynamics of construction and therefore of artificialisation by targeting specific types of housing, particular areas or specific groups of households. A main challenge, e.g. in Liechtenstein, is as well unlocking the real estate assets to better achieve a compact development of settlements.

Infrastructure construction, transport, tourism, commercial areas

European and global value chains link, the Alpine region with the surrounding metropolitan regions and beyond. This flow of goods is associated with additional issues, such as increasing motorised transit traffic. Firms play an essential role in spatial development through dynamics generated by their location and employment. The dynamics of high land prices within cities can lead companies to choose locations in the periphery to benefit from cheaper land. The existence of road infrastructure that makes it easier to move away from the centre can encourage them to locate on the edge of this axis. This is particularly valid for warehouses and logistics platforms. Furthermore, development of large-scale touristic infrastructure projects in Alpine regions like extensions of ski resorts take land in fragile high Alpine areas.

Living stiles & urban sprawl

A challenge is affection for living in the countryside, but close to an urban area. It is a widespread vision to envisage living in a family house, not attached to the other houses. This attitude prevents from implementation of compact settlement policy and fosters building processes in peri-urban areas. The choice of the location for housing is usually based on a combination of the aspects cost, accessibility, comfort and surface area. Moving to the outskirts of towns is generally encouraged by land prices generally decreasing with distance from the centres. This is contrasted by higher transport costs and time for commuting to locations further away from employment areas or places of conviviality. Urban sprawl is supported by changes in household demands and needs. The preference for individual housing is a strong underlying trend. At the same time low costs for commuting and financial support for individual commuting accelerate urban sprawl. Also changes in the household structure explain a part of the dynamics of artificialisation. The average size of households changing towards smaller or even single households due to population ageing, lower fertility, more frequent separations and differing lifestyles amplifies this increase. However, it is necessary to control the building pressure with reference to the respective demographic trends.

Inner development, redevelopment, brownfield management

Better fitting instruments at municipal level could support the spatial planning policy and the general orientation towards inner development and redevelopment e.g. in Slovenia. Inner development and redevelopment are challenges on which most of the Alpine States, many regions and municipalities actively work to face challenges like land consumption. A major challenge to preserve soil, e.g. in Italy, is to reuse soil which is sealed but currently abandoned from economic purposes. Reusing such areas is a main way to effectively reduce artificial land cover growth. Fostering specific economic investments in building renovation is an important approach.

Agricultural practice

In the Alpine regions it is also essential to encourage resilient agriculture, aimed at conserving soil biodiversity and combating surface erosion. But another fact influencing the nature of land use is the agricultural decline in geographical areas with strong orographic and climatic constraints.

Implementation

Even when regulations or targets exists the lack of control and enforcement of instruments can to lead to implementation difficulties. Sufficient tools and staff for supervision of the implementation are necessary for bringing already existing instruments truly into action.



5. Possible solutions

Well elaborated recommendations for effective solutions have been developed by the Compliance Committee of the Alpine Convention and can be fully read in the corresponding publication (Compliance Committee of the Alpine Convention 2019) and urgently recommends:

- *“To strengthen spatial planning on regional and inter-municipal level by setting binding guidelines for municipalities to effectively contain the soil/land consumption.*
- *To set effective quantitative targets of soil/ land consumption on local and regional/ inter-municipal level, also by prioritising the usage by qualitative aspects, such as soil functions.”*

5.1 An effective solution for economical and prudent use of soil per Alpine State

Qualitative and quantitative criteria can be applied for developing solutions. Thus, **Austria** presents one possible solution for each.

Qualitative - Evaluation of Soil Functions in Austria - a way towards better protection and sustainable management of Austrian soils: Across Austria a variety of legal regulations and procedures for data collection are in place regarding the evaluation of soil functions. To rectify these disparities, a new standard “*ÖNORM L 1076*” was published 2013. The *ÖNORM L 1067* standards and the relevant guidelines provides transparent information how to evaluate several soil functions relevant in spatial planning. The utilization of the guideline is open to everyone. The only condition for the evaluation is the existence and access to suitable data. The intention is to enable a uniform and transparent approach, which can be used for spatial planning. The guideline should inform stakeholders involved in soil protection as they implement projects across all levels. Ideally high-performance soils should be spared from planning and should be considered in the decision-making processes of spatial planning. Thus, it can significantly contribute to a careful management and protection of the resource soil. Additionally, the environmental value of the soil evaluation outcomes can contribute to preservation of the environmentally most valuable soils from destruction by sealing and construction developments. The evaluation of soil functions is especially important in areas where arable land is a rare resource or where high-performance areas collide with economic and structural interests. Examples of results are available to the public (Austrian Standards 2013, Land Oberösterreich 2020, Land Salzburg 2010, Land Salzburg 2014, Land Salzburg 2020).

Quantitative - Infrastructure cost calculator: Based on examples in other regions, an infrastructure cost calculator was developed in Lower Austria. It estimates necessary investments and follow-up costs for settlement expansions and compares the calculated expenditure for the construction or expansion and for the maintenance of infrastructure with the expected income (Amt der Niederösterreichischen Landesregierung Raumordnung und Gesamtverkehrsangelegenheiten 2020).

The aims of the already mentioned land-saving initiative in **Bavaria** are to strengthen interior development, to efficiently mobilize vacant and fallow land, promote inter-municipal cooperation, and reduce land consumption in general as well as in particular the rezoning of greenfield land. In that respect Bavaria considers awareness raising and communication as important. For example, an alliance for land saving with partners from the Government, municipalities, society, and economy was established in 2003. Projects and information material have been developed, e.g. making Bavarian best-practice examples with a focus on land-saving and soil-conserving settlement development available to spur knowledge exchange and to share experience between municipalities. Government-supported role models provide an incentive for additional municipalities to follow the path for land saving. Bavaria provides all municipalities with freely usable tools such as the land management database to facilitate the inventory and management of vacant lots, brownfields, and other interior development potentials. Beyond the inventory, the land management database supports marketing, communication with owners and the determination of demand for residential land. Bavaria also freely offers a "*Follow-up Cost Estimator*" for the municipalities to reveal fiscal unfavourable external developments at an early planning stage. Many cases showed a strong economic incentive to reduce land consumption. Via the funding initiatives "*Inside before Outside*" and "*Unsealing*" the Bavarian Government supports the municipalities financially.

In **France** one of the currently most efficient solution is based on the development of inter-municipal local urban planning that offers the possibility to develop a real integrated territorial management as explained in more detail in the chapter about legally binding quantitative limitations for soil consumption and soil sealing above.

In **Italy**, the solutions implemented by the Region Lombardy is particularly significant. The Region approved a specific law (LR 31/2014) and a specific regulation in the Regional Plan (Integration of the PTR approved in 2019) to reduce land consumption and contextually promote urban regeneration (Region Lombardy 2020). In particular, the Region Lombardy has set the target of 25% reduction of land consumption, referring to the planned settlements of the Municipal Plans in force since 2014 and which must be applied in relation to the demographic trend, the quality of soils and regeneration potential existing in the municipalities. At the same time the Region Lombardy has activated a monitoring system for soil consumption and urban regeneration areas, which is constantly updated as part of a collaboration with all municipalities, provinces and the Metropolitan City of Milan. The main contents of the Lombardy regional project are:

The Regional Law 31/2014 (in force since December 2, 2014) has the aim of "*concretizing the goal envisaged by the European Commission to reach a net occupation of land equal to zero by 2050 on the territory of Lombardy*" and introduces new provisions aimed at limiting land take and to promote urban and territorial regeneration, in all territorial plans. Since the approval of the law, the municipalities can no longer approve new forecasts of land take, but they can approve variations of the plans ensuring an ecological balance of the soil consumption not exceeding zero. The law introduces the definition of land consumption and provides the Regional Territorial Plan (PTR) to determine the criteria to be applied in the local plans.

The PTR integrated in 2019 as required by law, contains the criteria and identifies 33 homogeneous territorial areas (Ato), which represent the most appropriate supra-municipal

reference scale for assessing land consumption. The Plan introduces a plurality of actions aimed at obtaining a reduction of soil consumption, both quantitatively and qualitatively by safeguarding the most critical and highest quality soils. It is also effective in terms of rationality and efficiency of the settlement structure.

With reference to the UN Agenda 2030, estimates of the need for new settlements must be based on demographic forecasts and compared with the planned land take in the municipal plans in force. Based on these quantities, as well as in consideration of the regeneration potential existing in the territory, the Plan establishes the regional threshold for the reduction of soil consumption of 25% for 2020 and of 45% for 2025. Furthermore, the Plan defines scales of soil value referring to its agricultural, pedological, naturalistic and landscape peculiarities, to guide future planning choices of local administrations. Finally, the Plan identifies densely urbanized territories where regeneration plays a decisive role for the reduction of soil consumption and the reorganization of the settlement structure on a territorial and urban scale.

By two measures of the Regional Law 31/2014 the first tools for the detection and monitoring of soil consumption and urban regeneration areas were activated. During 2018 and 2019 the data was collected and the completion of the municipal data on land take is prepared in a first regional monitoring report in 2020.

With spatial planning instruments, which are anchored in the national building law, the communities in **Liechtenstein** can achieve higher density in certain central areas of crucial development zones. In this densifying perimeter it is allowed to build higher and closer than the law permits otherwise, if open spaces, pathways, children's playgrounds etc. for public good are installed in this perimeter.

The most effective measure, that protects soil from being sealed in **Slovenia**, is the spatial planning system. When preparing their spatial planning documents, municipalities must consider the objectives and basic principles set out in the Spatial Management Act (Law, O.G. 61/17) and Spatial Development Strategy of Slovenia (Ordinance, O.G. 76/04) as well as in the Spatial Order of Slovenia (Decree, O.G. 102/04). In the process of approving municipal spatial plans, the Ministry of Environment and Spatial Planning verifies the fulfilment of the adopted objectives and principles. In the case of non-compliance, the Ministry refuses that the municipality adopts a spatial plan. In most cases the municipalities follow the opinion of the Ministry and change the document until they obtain the positive approval from the Ministry.

The sectoral plan for crop rotation areas (FFF) is a good example from **Switzerland**. Special protection regulations apply in Switzerland for the best agricultural land. The aim of the sectoral plan for crop rotation areas is to maintain at least 438.460 hectare of the best agricultural land. Each canton has to secure a quota, which was established by the Federal Council in 1992. The FFF account for around 40 % of the total agricultural area in Switzerland. The utilised agricultural area covers just over 1.000.000 hectare.

5.2 A glance of soil awareness activities in the Alps

The Interreg Alpine Space project Links4Soils (project partners from **Austria, France, Germany, Italy and Slovenia**) fostered the international cooperation for soil protection in the Alpine area. The Alpine Soil Forum on 14-16 October 2019 in Innsbruck, Austria, marked a highlight and ending point of the project Links4Soils. The transnational event, happening in English, German and Italian showed and discussed the results of Links4Soils and opened the exchange on sustainable soil management in the Alpine area. The event consisted of an indoor conference day including a poster exhibition and a marketplace of ideas followed by an informal exchange round on soil-relevant happenings and an excursion showing the influence of land use management practices on soils. The project came to an end, but the Alpine Soil Partnership was established. It is a network open to everyone interested in soil in the Alps. Short videos were produced to convey information and messages about soil in the Alps (The Alpine Soils Platform).

In the **Bavarian** Alpine area, educational soil trails are installed in two districts. In addition, the house of the mountains, which is a museum including the national park centre and environmental education, was built in Berchtesgaden.

In **Italy** the National Environmental Protection System is carrying out the land cover and consumption monitoring including the production of detailed maps and indicators updated annually since 2012. In 2019 ISPRA proposed to establish regional Observatories with the participation of regional authorities and environmental protection agencies, together with ISPRA. The observatories are already contributing to the report in 2020 to integrate the national point of view with local requirements and needs.

Another important initiative was promoted in 2019 by some Italian regions (e.g. Lombardy, Aosta Valley, Piedmont, Veneto, Liguria, Trentino), which have set up an interregional working group aimed at identifying shared strategies for land use planning, with particular attention to the issues of reducing land consumption and supporting urban regeneration.

Every year the **Liechtenstein** Office of Environment organises the production of the environment calendar (*Umweltkalender*). Within this project, pupils in primary school illustrate a calendar, which addresses environmental issues. The text modules are provided by experts. In the year 2020, the calendar focuses on agriculture. The importance of sufficient areas with fertile soil for food production is highlighted in this context.

Slovenia hosted the 13th Youth Parliament to the Alpine Convention in Maribor from 19-24 March 2018 (Youth Parliament to the Alpine Convention 2018). The umbrella topic "*Preservation of soil*" was discussed between students, politicians and experts. You can read the resolutions, which the pupils adopted on economical use of soil in the next chapter.

On the national level Slovenia prepared guidance for building plots regulation based on the "*In depth review of the Compliance Committee of the Alpine Convention of the subject Economical use of soil*" (Compliance Committee of the Alpine Convention 2019). The guidance provides some general approaches for the organisation of the building plots, lists the general objectives of building plot organisation and explains the division of the building plot into two main categories (sealed and unsealed surface) and their sub-categories.

Furthermore, posters on soil erosion have been prepared by Agricultural Institute of Slovenia for the occasion of the World Soil Day and have been presented to the Slovenian Soil Partnership.

The **Swiss** project "*Sounding Soil*" is another good example, on how to raise awareness on the important role of our soils in an innovative form. Sounding Soil is an inter and trans-disciplinary research project to increase our understanding of soil ecosystems. More than 20 soil areas in Switzerland have been recorded, including intensively and extensively used agriculture land, Alpine meadows and woodland soils. The sound recordings include the animals that live in the soil, such as springtails. From 29 October until 25 November 2018 "*Sounding Soil*" was presented to the public in the Paul Klee Centre in Bern for the first time. The installation was at the Zurich University of the Arts ZHdK from December 2018 to mid-March 2019. Locations across Switzerland will follow in the future.

5.3 Voices of the next generation

Like the issue of climate change, soil consumption is a highly relevant topic for future generations, since degraded soil can mostly not be restored in timespans of a human life. The **Youth Parliament to the Alpine Convention**, consisting of pupils from Austria, France, Germany, Italy, Liechtenstein, Slovenia and Switzerland, has intensively dealt with the issue and searched for "*soilutions*" in 2018 and ask actively for their demands to be taken seriously by decision makers. 5 of the 10 demands give possible solutions regarding economical use of soil in the Alpine area:

Resolution 2: Not more, but better – *Environmentally friendly tourism and ways to encourage and increase it in the Alpine region*

Considering the huge amount of new, but unused infrastructure and the building of illegal and nature-harming paths built by dissatisfied vacationers, which is something that damages the soil terribly, we propose to upgrade already existing structures utilizing sustainable materials when possible. With local organisations that determine and draw attention to the demands of special-interest groups, the local government will act upon those demands, selecting what to improve first. Building unnecessary new infrastructure will then be avoided in favour of a more environmentally friendly solution. This will preserve the soil, which will not risk being destroyed, and will improve tourism, making it a better and more sustainable experience.

Resolution 3: Up in the sky - *Companies and the soil that is wasted by their parking lots*

Seen that, for example, around 5 % of Austria is used for roads and parking lots and that 0.3 % of the agricultural space in Europe is used every year to build infrastructure, we think that this is a huge waste of space. We are convinced that a lot of soil could be saved and used in a more efficient way. New parking lots should be built vertically, not horizontally. Newly-built shops or companies should build multi-storey, over ground parking lots to preserve the soil. The national government should define the laws that regulate this process, but the regional government should efficiently apply and control it. This proposal has already been implemented in urban areas in Austria, but in rural areas this is not applied enough yet. To help companies build this kind of infrastructure, they will be subsidized. This way, the environment will be protected and more soil will be saved.

Resolution 4: Fighting soil sealing - *Minimalizing soil sealing and giving alternatives, e.g. to use pervious sealing and to regress and rehabilitate unnecessarily impermeable areas*

The main concern is that every year, more than 1000 km² gets sealed and the soil loses its basic functions, like water purification and flood regulation. Due to urbanization, asphalt and concrete are used to seal the soil to make life more comfortable, yet many areas were sealed where it would not be needed. Therefore, we strongly encourage to regress and rehabilitate those areas by removing the useless asphalt. In public areas, the city council would decide where to remove it, while in private areas, the choice of making an untaxed removal is given to the owner. Furthermore, for new or renewed sealed areas, we promote the use of pervious paving, which allows the soil to interact with the nature above. This would be introduced in pedestrian areas and parking places. Two different examples are the “*Climate Tile*” in Copenhagen, which is used on sidewalks, and the use of pervious paving for parking places in Valpellice, Italy.

Resolution 5: Minimizing Urban Sprawl - *Limiting the extension of urban areas*

The increasing number of city residents, resulting in urbanization, causes the growth of urban sprawl. We cannot stop city growth, but we can try to minimize agglomeration. The committee suggests creating green belts as an option for cities to plan their expansion and to have a clear border between the city and the rural areas as a long-term solution. They also suggest supporting innovation and increasing density and efficiency. Including agricultural land, forest and leisure areas, the green belt would provide food security, decrease air pollution and be a social meeting point. For instance, the city of Portland has designed a virtual line around the city based on predictions and plans of how the city will grow. The line separates rural areas from the city. It is a dynamic process, meaning that they reevaluate the line every time the city reaches that border. We are combining that system with London’s green belt system that surrounds the city. Moreover, we propose the reuse of old and abandoned buildings. Thus, existing resources would be used efficiently and less soil would be sealed.

Resolution 6: Breathing Buildings - *Green spaces in urban areas to act on the problem of degraded soil in cities due to unsustainable spatial planning*

Urban gardening combined with efficient spatial planning facilitates soil protection and a higher quality of life. We propose the diffusion of roof gardening to maximize limited space, especially on flat roofed buildings such as supermarkets. This type of urban gardening leads to many benefits: The presence of plants enables the regulation of pollution. Additionally, the vegetation absorbs water and lowers the heat in the city. This solution manages to make our cities healthier and even more appealing to live in and strengthens the connection between city residents and nature.



6. Spotlight on soil & climate protection

Soil protection is climate protection. Soils store more organic carbon than the biosphere and atmosphere combined. But at the same time soils are highly vulnerable to climate change and land use pressures. Depending on their use, soils do not only release carbon dioxide but are also able to bind it. Therefore, especially carbon rich soils are interesting for climate adaptation and mitigation. Those are particularly soils, which contain a high amount of humus and peatlands. The Alpine Climate Target system 2050 defines thus the need to support preservation and sequestration of carbon in soil and to set-up a common framework for minimising land-take (Alpine Climate 2050).

6.1 Humus – carbon stocks in soil

The humus content refers to the content of organic carbon in soil and is thus a relevant indicator when looking at climate change. Besides soil consumption and soil sealing, also the impact of climate change will have an influence on the humus content of the arable soils.

Comparable humus data covering the Alpine Convention perimeter in the last years do not exist yet. Data about the humus content development is currently not available in **Liechtenstein** and **Slovenia**.

Also in **Switzerland** not enough soil information is available to provide comprehensive reliable statements on the development of the organic matter content in mineral soils. In mineral arable soils organic carbon declined within the last hundred years. However, the contents seem to have stabilized since the 1990s. In agriculturally used former peatland soils the organic matter decreases continuously (Schweizer Bundesamt für Umwelt 2017).

The forests and grassland of the mountainous areas in **Austria** hold the highest carbon concentrations. Therefore, the highest potential for improvement are within the arable fields, which mainly lie outside the Alpine Convention perimeter. In this context the evaluation report concerning the impact of several measures for arable land of the Austrian Environmental Programme shows that due to the broad acceptance from the Austrian farmers in participating in the different measures of the programme like greening, organic farming etc. an increase of the humus content in Austrian arable soils was achieved compared to the last period again (Bundesanstalt für Agrarwirtschaft und Bergbauernfragen, Österreich 2019). The humus content of most of the arable soils in Austria lies meanwhile within the optimum range. The evaluations are based on the results of various soil samples, but they cannot be analysed and presented on municipal level. An overview of humus contents in **Austria's** topsoils is displayed in the figure 11.

Within the ongoing research project “CASAS”, which is funded by the Austrian Climate Research Programme, several soil research institutes try to find an approach concerning possible soil organic carbon storage capacities in Austrian agricultural soils. It stays important to undertake efforts to maintain or where possible increase the humus content.

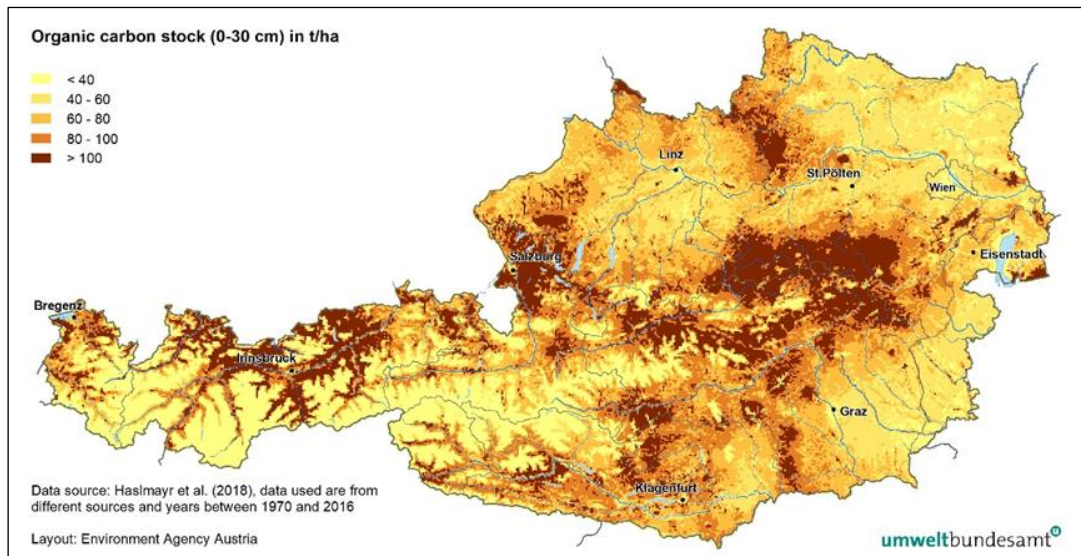


Figure 11: Organic carbon stock in Austrian topsoils (0-30 cm) in tonne per hectare. Source: Haslmayr et al. 2018.

A map of humus contents in **Bavaria** is currently being developed and will be completed soon. Experience has shown that “*Tangelhumus*,” (humus of conifers) is accumulated in the Bavarian Alps.

A reference study covering the entire **Italian** Alpine Convention perimeter is currently not available, however, it is interesting to look at the project SIAS (Sviluppo di indicatori Ambientali sul suolo in Italia/ Development of Soil Indicators in Italy) (Joint Research Centre – European Soil Data Centre 2020, Giandon P. et al. 2010). The project is assessing soil carbon stocks and especially humus. It was a pilot project aiming at developing environmental soil indicators set up by the ISPRA-Institute and has produced an assessment of soil organic carbon stock of the mineral layers of topsoil (0-30cm) for 17 of the 20 Italian regions. Figure 12 displays the assessment for regions in northern Italy.

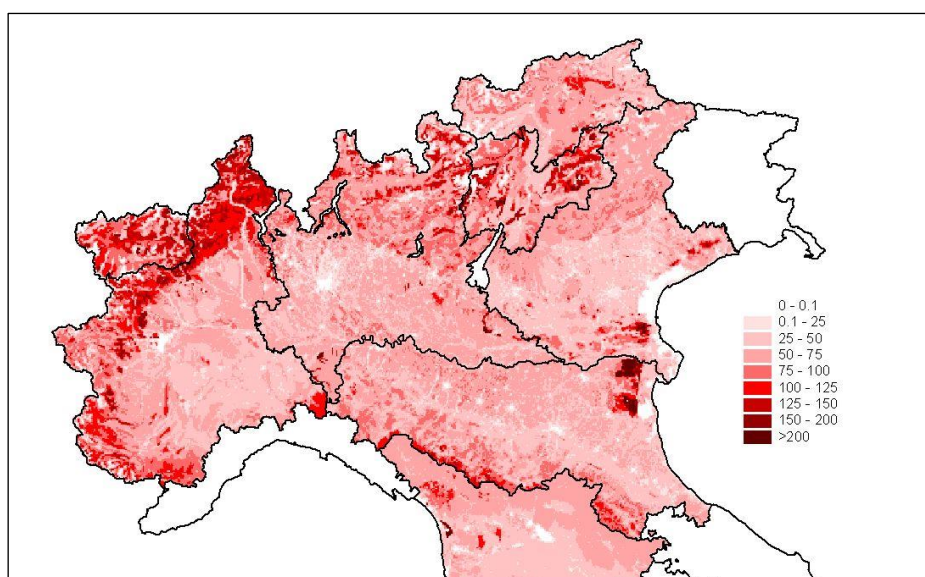


Figure 12: North Italy Soil Organic Carbon stock in t/ha of mineral topsoil layers (0-30cm), humus and litter layers excluded. Source: Joint Research Centre – European Soil Data Centre 2020.

6.2 Wetland, peatland, and moor areas

“Wet peatlands offer attractive nature-based solutions for various environmental challenges, including climate change mitigation, water regulation and biodiversity conservation. Yet, they are largely threatened or degraded in many European countries. More than 80% of peatlands in the Alpine region are located on the axis Lyons – Salzburg. In addition, smaller peatland clusters and corridors occur in Slovenia and Carinthia, parts of the Central Alps and the Italian High Alps. Many of them are small mountain peatlands that differ fundamentally from larger lowland fen areas in their geomorphology and ecology as well as their land use. With regard to small mountain peatlands, due to their limited potential for carbon sequestration, they are at risk of being overlooked. However, they deserve recognition as important habitats for rare plant and animal species as well as for their crucial role for water management in rivers’ upstream catchment areas.” (German Federal Agency for Nature Conservation et al. 2020).

The guiding principle for conservation of soils in wetlands and moors in the perimeter of the Alpine Convention is laid down in Article 9 of the Protocol Soil Conservation of the Alpine Convention.

Conservation of Soils in Wetlands and Moors

- (1) The Contracting Parties undertake to preserve high moors and lowland moors. To achieve this objective, the use of peat shall be discontinued completely in the medium term.
- (2) Drainage schemes in wetlands and moors shall be limited to the upkeep of existing networks unless there are sound reasons for exceptions. Remedial measures shall be promoted to minimise the environmental impact of existing drainage systems.
- (3) On principle, moor soils shall not be utilised or, when used for agricultural purposes, shall be managed so that their characteristic features remain intact.

Different definitions and differing approaches of mapping also exist regarding peatlands. In scope of the project Impuls4Action, which is running for the timespan August 2019 to January 2021 and is co-financed by the European Regional Development Fund, a master thesis was written with the aim of collecting and combining datasets on peatlands in the Alpine area. The resulting overview of peatlands in the Alps (figure 13) consists of a combination of 76 peatland related datasets. The brown signature shows the identified peatlands. The chosen perimeter represents the maximum extend of the Riss glaciation (Reichart, A. F. 2020), since this glaciation had the largest extend around the Alpine area and thus a significant natural influence on the development of hydrological system. It can however not be regarded as a map of all peatlands in the Alps, since there should be data on additional peatlands and not all peatlands in the Alps have been mapped yet.

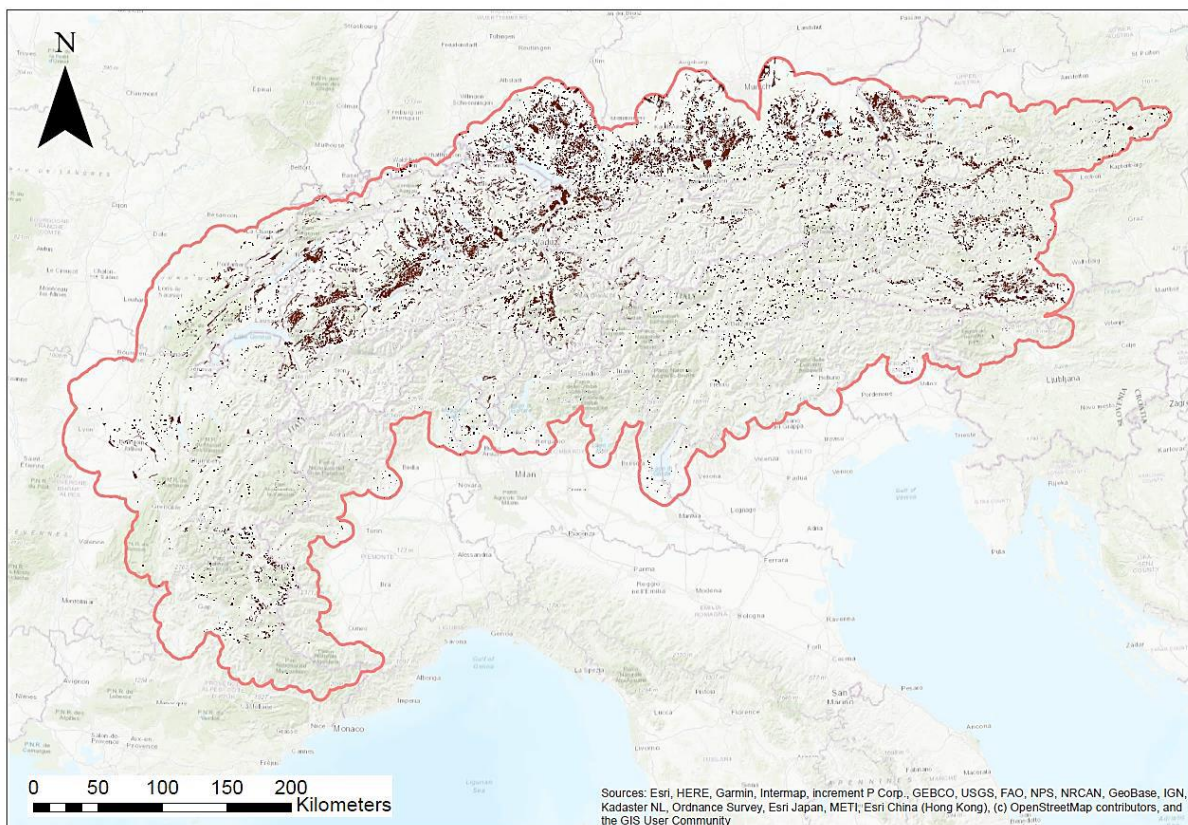


Figure 13: Map of peatlands, based on 76 datasets, in the Alps in the perimeter of the maximum extend of the Riss glaciation. Source: Reichart, A. F. (2020).

Rewetting in **Austria** mainly occurs as compensation measures according to procedures of environmental impact assessments. Concrete numbers or data on the extent is not available for Austria yet. But the Austrian Environmental Agency provides a compilation of wetlands focusing on Ramsar areas and on wetlands in general (Umweltbundesamt Österreich 2020). Table 7 shows an overview regarding peatland protection and rewetted areas in the last years in the perimeter of the Alpine Convention in Austria without the claim of exhaustiveness. To develop a national peatland strategy, a working group has been established in scope of the national Ramsar committee. The working group comprises designated members from the federal states. The goal is to present the national peatland strategy, including action plans for the regions, on World Wetlands Day in February 2022.

Region	Amount of rewetted areas	Area in ha	Strategy in place
Tyrol	8	20,7	yes
Vorarlberg	4	48,5	yes
Styria	8	21,7	yes
Carinthia	4	21,0	yes
Salzburg	6	62,5	yes
Upper Austria	12	47,5	yes
Lower Austria	1	9,0	yes
Burgenland	0	0,0	no

Table 7: Peatland protection - Rewetted areas in the perimeter of the Alpine Convention.

In the **Bavarian** area of 740 km² of superficially developed fens and peat bogs existed in the Alpine Convention perimeter in 2016. Some rewetting activities in the Bavarian Alps are summarized in *Bund Naturschutz* (n.d.). Furthermore, a Bavarian-wide map on a scale of 1: 25.000 showing the distribution of hydromorphic organic soils has been created (Bayerisches Landesamt für Umwelt 2020). Figure 14 shows their identified occurrence in the Bavarian perimeter of the Alpine Convention.

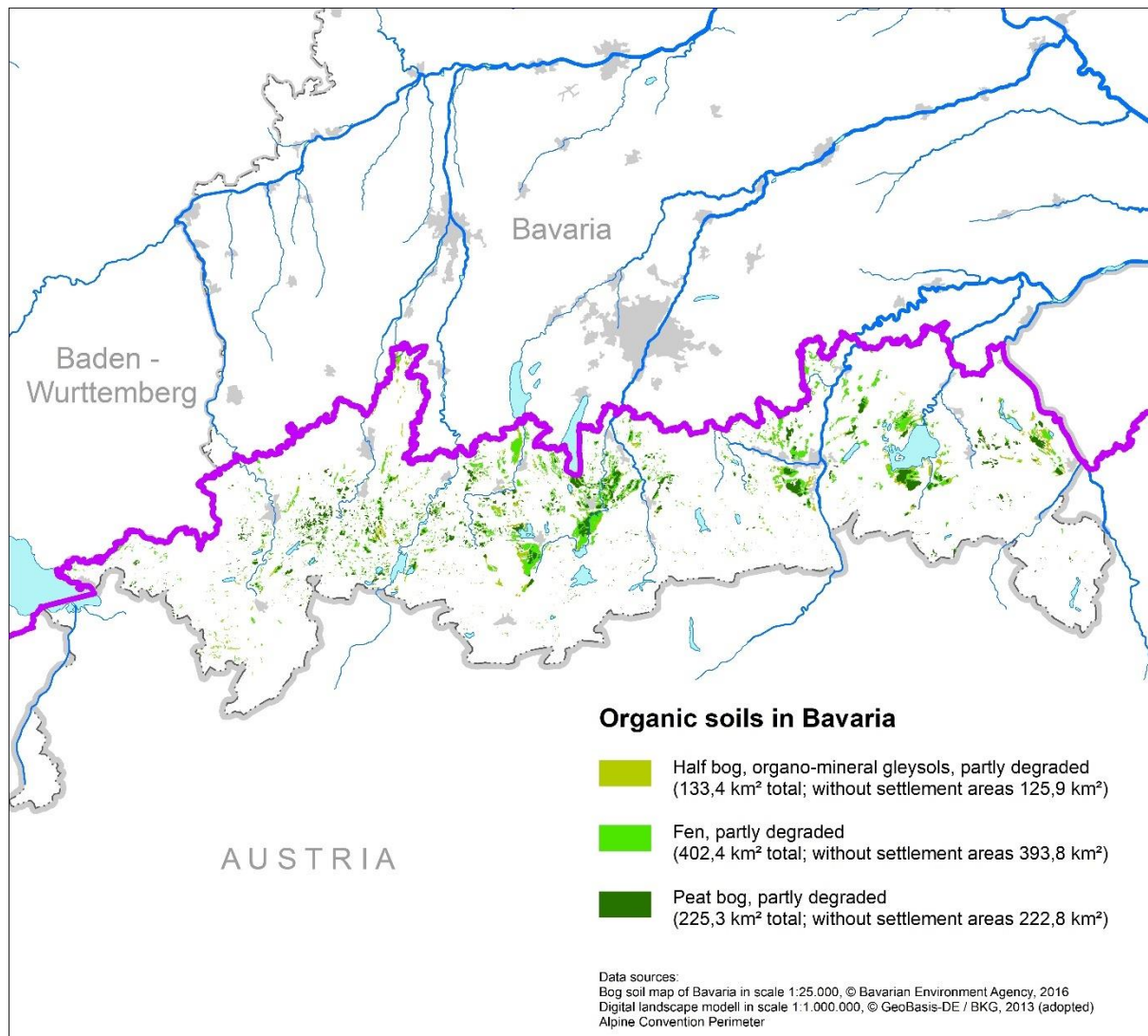


Figure 14: Organic soils in Bavaria.

Wetlands in **Italy** covered approximately 913.254 hectares in 2011. The data is collected in the Italian wetland inventory (ISPRA 2020b, ISPRA 2020c, D'Antoni et al. 2011), which was elaborated in 2011 by ISPRA, the Ministry of the Environment, Land and Sea, and ARPA Toscana and it is based on "*Pan Mediterranean Wetland Inventory*" (PMWI) MedWet. Unfortunately, the collection criteria were not always homogeneous between the regions. Moreover, it is not possible to reliably separate the information regarding the type of wetlands, such as peat, bogs or lakes.

Wetlands make up ca. 3,02% of the total land area in Italy, while 0,32% of the total land area of Italy are wetlands located in the perimeter of the Alpine Convention. Table 8 shows the number

of wetland sites within the perimeter of the Alpine Convention and their areal extend. The numbers are displayed for the Italian Regions, which lay completely or partly in the perimeter of the Alpine Convention. Almost 24% of the wetland areas in those regions lay inside of the Alpine Convention perimeter.

Region	Wetlands within the Alpine Convention perimeter		Wetlands in the region	Share of wetlands inside the Alpine Convention perimeter
	Number of sites	Area (ha)	Area (ha)	%
Friuli Venezia Giulia	1	2.466	32.760	7,5%
Liguria	2	45	5.895	0,8%
Lombardy	3	11.461	29.058	39,4%
Piedmont	3305	21.123	145.534	14,5%
Autonomous Province of Bolzano/Bozen	17	919	919	100,0%
Autonomous Province of Trento	38	34.175	34.175	100,0%
Aosta Valley	7	50	50	100,0%
Veneto	6	25.125	153.776	16,3%
Total	3385	95.804	402.167	23,8%

Table 8: Wetlands in the Italian Alpine Regions.

About 1.250 hectares of wetland exist in **Liechtenstein**. 980 hectares of agricultural land is drained and 170 hectares are inventoried and protected. No areas were rewetted in the last 20 years.

In **Slovenia** some areas of wetland, moor and peatland are protected as national designated areas according to the Nature Conservation Act. Those are for example regional parks – i.e. Cerknjiško jezero Lake; landscape parks – i.e. Ljubljana Barje Moor. Habitat types from Annex II of the Habitat Directive are included in the Natura 2000 network and three areas are designated as Ramsar sites: the Škocjanske jame Caves (underground Ramsar location), lake Ceknica and Sečovlje salina. They are also part of the NATURA 2000 network.

In 2000 a wetland inventory based on the Ramsar classification system was prepared and published, summing up ca. 35.650 hectares of wetland areas including over 8.200 hectares of Ramsar areas in the whole territory of Slovenia (Beltram, G. 2003, Ramsar Convention Secretariat 2020).

In **Switzerland** 1.924 hectares of high moors and transitional mires, as well as 19.223 hectares of lowland moors and 87.404 hectares of peatland areas were inventoried in 2017.



7. Monitoring soil consumption

Various actors monitor soil sealing and soil consumption in **Austria**, like the Austrian Environmental Agency or the ÖROK Atlas. Based on these data, further in-depth evaluations for the individual federal states or their municipalities in the perimeter of the Alpine Convention are possible (ÖROK Atlas 2020).

In **Bavaria** land consumption is annually monitored by the Bavarian State Office for Statistics and measured by the Bavarian Land Surveying Agency. The cadastral delineation of sealed surfaces is supported by aerial photos to delineate actual land use and land cover classes (Bayerisches Landesamt für Statistik 2020). However, unsealed land within settlement and traffic areas such as green spaces or gardens is included in the land consumption rate. Soil sealing has been monitored for settlement and transportation areas for the years 2000 and 2015 with semi-automatic remote sensing methods that combine aerial photos, satellite images, and cadastral data.

Land consumption monitoring in **Italy** is in progress. The National System for Environmental Protection (SNPA) oversees this task, as required by law (L. 132/2016). SNPA is composed of the National Institute for Environmental Protection and Research (ISPRA) and the Regional/Provincial Environmental Protection Agencies (ARPA-APPA). Since 2015 the monitoring system gives yearly updated data on land consumption, soil sealing and urban development, through thematic maps and specific indicators. Earth observation is used to classify land cover, land use and land consumption. The land consumption map is the result of the monitoring system, which is based on semi-automatic classification of Sentinel-1 and Sentinel-2 images followed by photointerpretation of high-resolution images. The map has a 10 m resolution and is classified in three hierarchical levels to get information about: consumed/non consumed land; sealed or permanent/non permanent consumed land; type of artificial land cover, such as buildings or road network.

Soil consumption in **Liechtenstein** is monitored by the nationwide land-use statistics, which is conducted every 6 years following the procedure of Switzerland. Soil sealing can be monitored by evaluating the available land cover mapping data of Liechtenstein.

Data on the annual growth rate of built-up land ("*land consumption rate*" as relative figures) and data on land consumption (absolute figures) in **Slovenia** are currently not available yet. But the calculation of the increase in built-up areas will be possible after the establishment of the built-up areas register, which is in the process of establishment. Currently Slovenia is in a phase of data acquisition. Data on build-up areas will be available for the whole Slovenian territory after 30 June 2021. Data on infrastructure will be added afterwards. Data for the areas of Slovenia where the survey has already been carried out are already available (Republika Slovenija, Ministrstvo za okolje in prostor 2020).

The area statistics "*Arealstatistik*" gives a comprehensive overview of soil consumption in **Switzerland** on national scale. The survey of the area statistics is based on digital aerial photographs and image strips taken by the Swiss Federal Office of Topography in the timeframes 1979-1985, 1992-1997, 2004-2009 and 2013-2018. A sampling grid of 100 metres

mesh size is applied to the areal images. Its intersections form the sample points at which land use and land cover are interpreted based on the category catalogue of the area statistics. The interpretation of the aerial photographs takes place on a screen or other system that enables three-dimensional, stereoscopic image viewing. In this way, slope inclinations, depressions and terrain breaks can also be detected and the height of trees and buildings can be estimated. Limitations of this process arise by the time it requires. However, the land use/cover statistics produced by the Federal Office for Statistics for the whole territory of Switzerland is foreseen to be continued from 2019 on as a rolling survey with a periodicity shortened to 6 year (Bundesamt für Statistik Schweiz 2019). Partially or entirely automated methods are envisioned to support and reduce the high workload of the interpretation task.

8. Soils for food: How to safeguard agricultural production areas?

Two areas of action are required: The agricultural land must be protected from further land take and the sustainable management by farmers must be guaranteed. **Austria** gives two examples how the two tasks are implemented.

Agricultural precaution areas: On basis of the Tyrolean spatial planning law 2016, agricultural precaution areas are issued by order of regional spatial planning programmes. Such designation bans the dedication of fields for settlement activities. A link to other open space categories like ecologically important areas can be drawn (Land Tirol 2020).

Mountain farmers in Austria: The mountain farms are assigned to four levels of difficulty depending on their altitude, terrain and transport connections. The respective subsidies build up a basic income for the majoritarian small and family farms, compensates the high ratio of manual work and guaranties local food production. Livestock farming in the Alpine mountain regions by 52.891 farms or more than 92% of all mountain farmers is of outstanding importance for the preservation and management of grassland and the associated cultural landscape.

In **Bavaria**, the State Development Program is the basis for spatial development. Amongst others it defines for the Alpine area that forests and their protective function as well as the care for the cultural landscape by farming and forestry must be secured. Alpine pastures worth preserving shall be redeveloped and made accessible as far as it is ecologically reasonable. The spatial development of the Bavarian Alps is regulated by the “*Alpenplan*” (=Alpine plan), in which the Bavarian Alpine area is categorized in the three different zones (A, B and C). Different regulations for spatial development and protection apply in the respective zones. Whereas most development projects are possible in zone A, conducting transportation projects is only permitted in zone C, as far as necessary for maintaining the cultural landscape, thus for traditional agriculture and forestry.

Furthermore, Bavaria supports the upkeeping of the cultivation of Alpine pastures by many support measures. Additionally, mountain farmers are supported by investment support programs and by special training opportunities. Hence the extent of mountain pastures (39.000 hectares) and the number of mountain pasture farms (1.400) is stabile in Bavaria.

In **Italy**, agricultural areas are specifically designated and bound for this use. There are also other ways which can safeguard agricultural production. For example, the regulation on the origin of products, which is based on a control and certification system, which guarantees the enhancement of the products and safeguards the production chain. Furthermore, the Ministry of Agricultural, Food and Forestry Policies fixes strategic priorities based on Common Agricultural Policy (CAP) and developed the PSR (Rural Development Programme) and the PSN (National Strategic Plan). The main goals for the PSR consider the sustainable management of natural resources, climate action and the development of rural areas. Protected areas, where land use for innovative agriculture, soil protection and green economy can be developed, are able to play a significant role, as well on the Alpine level. To improve the protection of agricultural areas it is also appropriate to define policies and actions to reduce land consumption, which also introduce qualitative criteria for assessing soils with reference to the agricultural productivity, pedological, natural and landscape value in addition to quantitative criteria, like e.g. the Region Lombardy - 2019 Plan.

In **Liechtenstein**, areas preserved for agricultural production are designated and protected by law. However, the sustainability of agricultural production on certain drained organic soil is questionable. Therefore, data is needed to predict the development of these drained soils under the current and an adapted agricultural production. Technical solutions to maintain the fertility of specific sites should also take place. If there is no reasonable solution to preserve certain drained sites for agricultural use on a long-term basis, rewetting is worth considering. For these questions, no time schedule is defined. Currently, as a first step a targeted-oriented improvement of the existing soil data is considered.

In **Slovenia** agricultural land will be protected as areas of permanently protected farmland. The determination of the farmland to be permanently protected is currently in the process coordinated by the Ministry of Agriculture, Forestry and Food. It will take several years, as it will have to be determined in 212 municipalities. The process of preparation and adoption of the spatial plan depends on the respective municipalities. It is estimated that around 350.000 hectares of permanently protected farmland will be designated in Slovenia. Once designated in a spatial plan, those areas cannot be changed for a timespan of at least 10 years from the entry into force of the municipal spatial plan.

In addition to the before mentioned sectoral plan for crop rotation areas in **Switzerland**, the new Soil Strategy of Switzerland includes strategic recommendations referring also to agricultural production areas such as: to avoid permanent compaction of agricultural soils, impairment of soil functions through erosion on agricultural land, impairment of water bodies and near-natural habitats and infrastructure by washed away soil material from agricultural land and permanent loss of soil biodiversity and activity due to agricultural use. Also, the loss of soil organic matter as a result of agricultural use of mineral soils has to be compensated and the loss of soil organic matter due to agricultural use has to be minimized. As well a substantial reduction of the risk to humans, animals, plants and water bodies as a result of pollutant and foreign substance inputs like pesticides, fertilisers and other means of production should be reached. The content of the strategy works as an orientation framework for future decisions of the cantons and the federation. Timeframes depend on the respective canton and region.

9. Outlook

Municipalities are at the core of implementing economical and prudent use of soil. Those who show how a sustainable areal development is possible and positive on the long term, need to be regarded as good examples. As the report has shown, the topic of an urgently needed economical and prudent use of soil in the Alps is on the agenda in the **Alpine Countries**. In scope of the **Alpine Convention** the **Working Group Soil Protection** will continue its work for the protection and sustainable development regarding soil in the Alps. The **Alpine Climate Board** has established implementation pathways towards a climate neutral and climate resilient Alpine area by 2050; one of them focusing on minimising land take and soil sealing. Protection and sustainable management of soil in the Alps will also be supported by the **Alpine Soil Partnership**, which comprises soil experts, practitioners and people who are interested in soil protection in the Alps. Furthermore, the EU Strategy for the Alpine Area (**EUSALP**) has adopted the declaration "*Sustainable Land Use and Soil Protection – Joining Forces for Nature, People and the Economy*". Finally, efforts towards a more sustainable use of soil are undertaken on the **European-** and **global level**, like in the framework of the European Green Deal and the Sustainable Development Goals.



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Protocols and declarations of the Alpine Convention:

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