ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

REGIONAL REPORT //

Lake Constance

Cross-border Lake Region

Annex to final report // October 2021

This Regional Report is conducted within the framework of the ESPON 2020 Cooperation Programme, partly financed by the European Regional Development Fund.

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This document is a final report.

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The final version of the report will be published as soon as approved.

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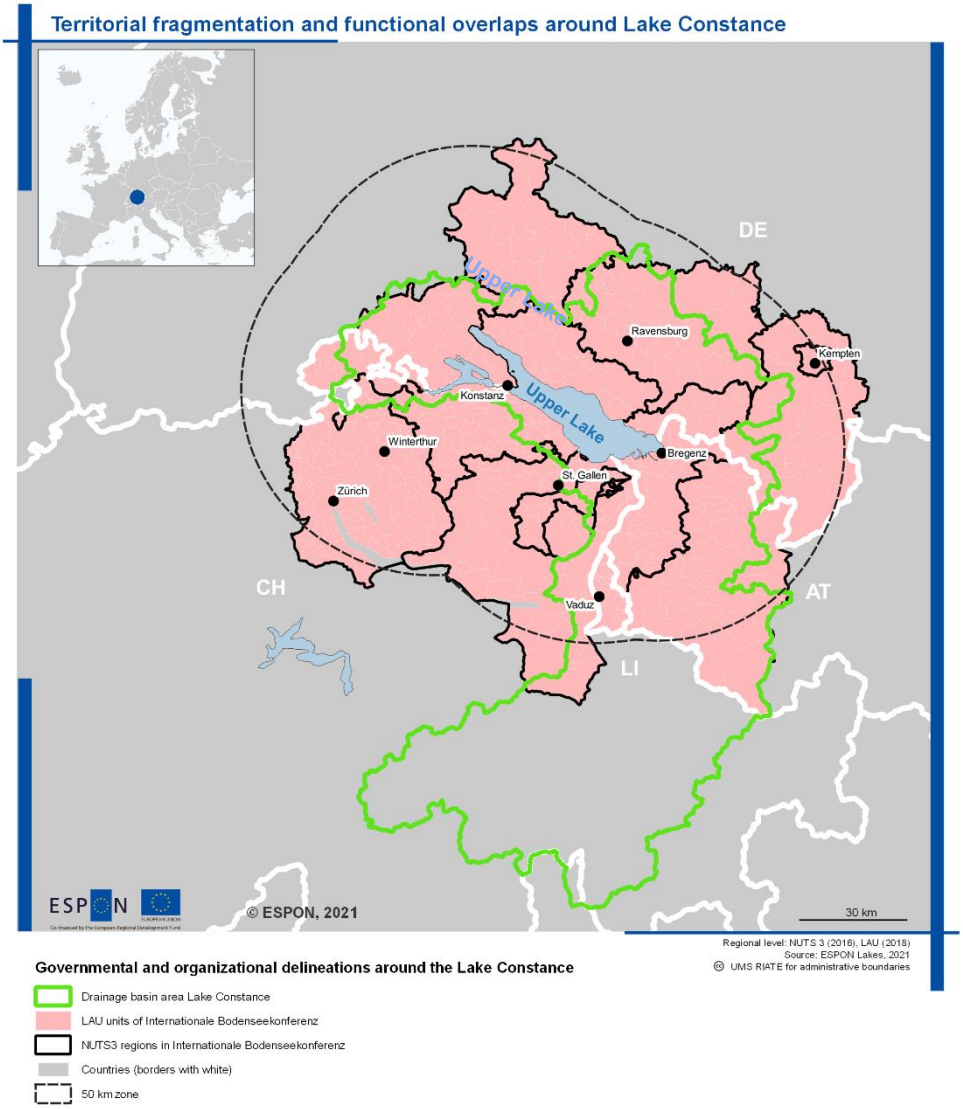
Abbreviations

EU	European Union
GDP	Gross Domestic Product
IBK	Internationale Bodenseekonferenz (ger.) – International Lake Constance Conference
ISB	Internationaler Städtebund Bodensee (ger.) – City network
NUTS	Nomenclature des unites territoriales statistique (fr.) - Nomenclature of territorial units for statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization

1 Introduction

Lake Constance is located at the border triangle between Austria, Switzerland and Germany, resulting in a strong cross-border character of the region. Moreover, the small state Liechtenstein is also part of the watershed. The region is monolingual with German as common language. It is characterised by strong natural elements such as the Rhine river that flows through Lake Constance, the Alpine mountains in the South and the German middle mountain ranges in the North.

Map 1 Lake Constance region



The German name ‘Bodensee’ refers to a small village in the Northwest of the lake, while in other languages the city of Constance is part of the lake´s name. Lake Constance is the third largest lake within Central Europe (surface 536 km², water volume 48 km³). It consists of two parts (see Map 1): The main part is called ‘Upper Lake’ and contains nearly 90% of the lake´s surface. The smaller part of the ‘Lower Lake’ is connected with the large part by the so-called ‘Seerhein’ (Lake Rhine). The Rhine river flows into the lake from the Southwest near Bregenz and flows out in the Western part near Stein am Rhein. The main parts of the shore are located in Germany (more than 60%). Most of these shore areas are part of the German state Baden-

Württemberg (Western part of the German area), small parts belong to the state Bavaria. A quarter of the shore areas belong to Switzerland and around 10% to Austria (IGKB, n.d.).

A particular situation is that most parts of the lake´s borders are not defined through International Treaties (Chilla, 2020). Regulations are in place for the two 'arms' of the lake: The borders of 'Seerhein' and the Lower Lake are defined within an international treaty of the year 1854. The other arm ('Überlinger See') belongs to Germany. For the main part of the lake (Upper Lake), the situation is unclear apart from the shore areas. The water areas with less than 25 m belong to the respective country (IGKB, 1998).

The region around Lake Constance is organised in a polycentric way with numerous medium-sized towns and rural areas. Zurich, southwest of the lake, is the nearest city with a metropolitan character. Furthermore, the region is surrounded by other metropolitan regions like Basel, Stuttgart and Munich. The lake region can be characterised as successful region. It is economically highly innovative, based on a strong industry and a diverse university setting. The lake, the highly attractive landscape and diverse medium sized cities make the region attractive for tourism. Furthermore, well-known agricultural products are produced in the region, in particular related to fruits. The water of the lake provides drinking water to more than four million people living near the lake as well as in more distant parts of Baden-Württemberg up to the region of Stuttgart (see also Scherer et al., 2016).

Cross-border governance has a long-standing tradition in the region. From the 1960s onwards, environmental questions appeared on the political agenda of the region due to increases in shipping and boat traffic on the lake and the increasing pollution with phosphorous. A lack of clear institutional governance gave rise to informal bi- and multilateral cooperation formats, which ultimately became a success story (Chilla, 2020). In 1959, the International Commission for Water Protection (IGKB) was founded and in 1960, an international agreement for the protection of Lake Constance was signed. The International Lake Constance Conference (IBK) as one the key actors in the region was founded in 1972. In 1982, a first 'Leitbild' was developed by the German-Swiss and German-Austrian Spatial Planning Commissions. With the start of the INTERREG programme Alpine Rhine – Lake Constance – High Rhine in 1990, new funding options appeared with a focus on cross-border funding. Since 1994 within the framework of the IBK, constantly 'Leitbild'-processes are undertaken (1994, 2008, 2017) (IBK, 2019).

2 Territorial analysis: the lake and its surroundings

2.1 Water quality

The chemical, physical and biological status of Lake Constance is constantly monitored. In recent years, water quality has been described as perfect. The phosphorus content of the lake is comparable with that of an oligotrophic Alpine lake which means that it is low in nutrients. This situation is a result of the clear rules on water protection and the undertaken actions in the last decades. The phosphorus content in recent years is on the level of the 1950s - in between it increased until the 1970s and decreased after taking measures of water protection since the beginning of the 1980s (IGKB, 2020).

The results of an investigation of 35 trace substances in 2019 within the lake and the inflows show low concentrations and confirm a good water quality. National and EU-standards as well as other standards are met to the highest possible extent (IGKB, 2020).

The European Water Framework Directive 2000/60/EC obliges Member States to achieve “good ecological status” and “good surface water chemical status” in all bodies of surface water, in order to protect aquatic ecosystems and their functioning. The directive introduced a uniform, ecology-based status assessment system and provided a Common Implementation Strategy to support the implementation of the directive. With the help these CIS guidance documents, the ecological status of different water bodies can be compared across the EU. Switzerland as non-EU-member uses the same categories. According to the respective German and Austrian River Basin Management Plans, the ecological status of the Lake Constance did not change between the years 2010 and 2016. Most parts of the lake showed a good status except the shoreline of the Upper Lake, which is characterized by a moderate status. Based on a comprehensive 5-stage structural assessment focusing on the shoreline and shallow water zone of Lake Constance, 45% of the shore length at the Upper Lake is far from the natural conditions, 21% is impaired and only 34% is at least near-natural or natural. This means that the bank and shallow water zone is still in poor condition (see Table 1).

Table 1 The status of the different quality elements in Lake Constance according to the 2nd River Basin Management Plans (2016)

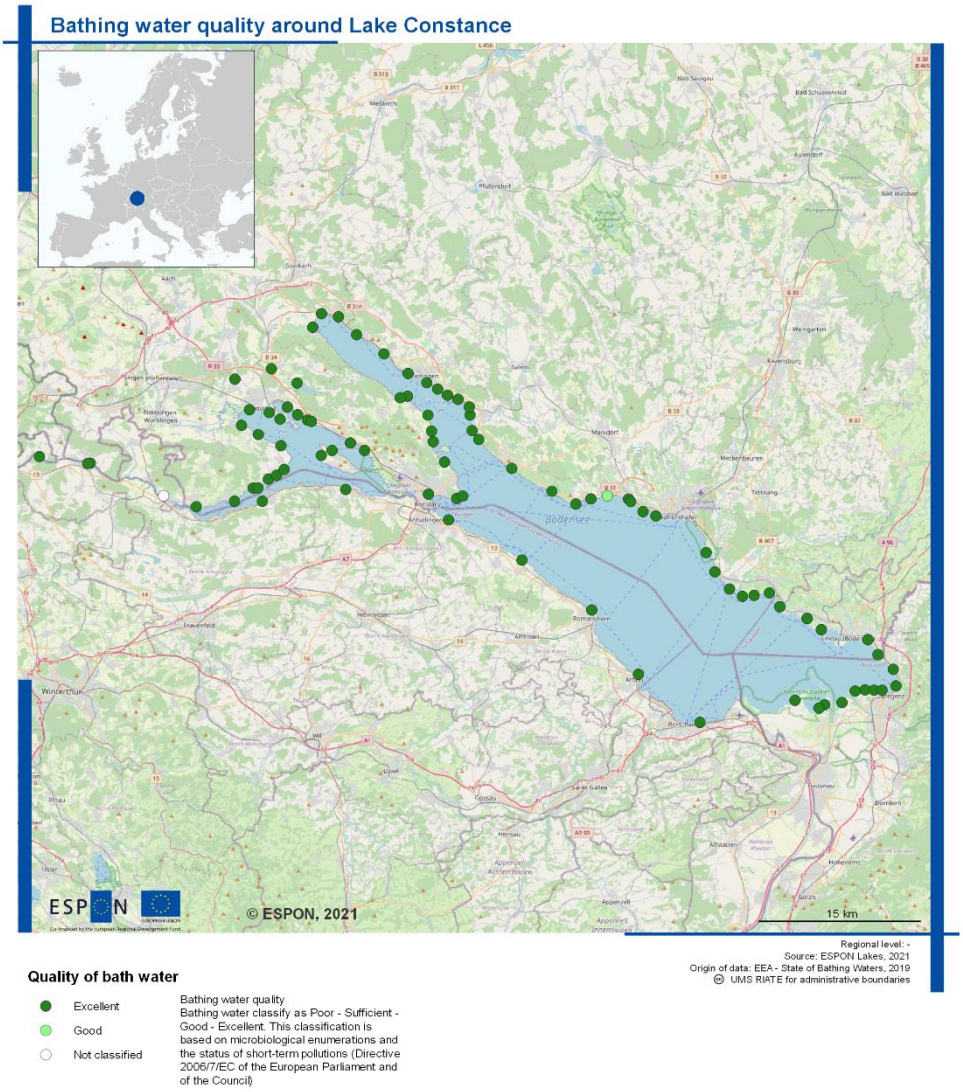
	Lake Constance (AT)	Upper lake (Obersee) – open zone (DE)	Upper lake (Obersee) – shore (DE)	Lower Lake (Untersee) (DE)
Biological elements	Good	Good	NA/NR	Good
Hydromorphology	Good	Good	*Failed*	Good
General physical & chemical conditions	Good	High	NA	Good
Specific pollutants	NA	Good	Good	Good
OVERALL ECOLOGICAL STATUS	**Good**	**Good**	**Moderate**	**Good**

(NA= no data available, NR= not relevant)

Efforts for a good water quality is of high importance as Lake Constance water serves as drinking water basin for approx. 4 million people. Besides the use in settlements situated near the lake, the water is extracted in the North-Western part of the lake and carried through a pipeline network of around 1.700 km. This network provides Lake Constance water not only for the region around Stuttgart but also Northern parts of Baden-Württemberg. The water quality of the extracted drinking water is constantly controlled and meets the quality standards (Zweckverband Bodensee Wasserversorgung, 2020).

The good water quality is also reflected in the monitoring of bathing water. The map (see Map 2) shows the bath water quality of the lake based on the standards of the EU Bathing Water Directive. Nearly all locations (apart from one location near Friedrichshafen) have an excellent bath water quality for the year 2019.

Map 2 Bathing Water Quality



2.2 Ecosystem and biodiversity protection

Lake Constance region is rich of traditional cultural landscapes as well as diverse natural landscapes. The natural landscapes are a counterpoint to intensively used areas, therefore protection regimes are important.

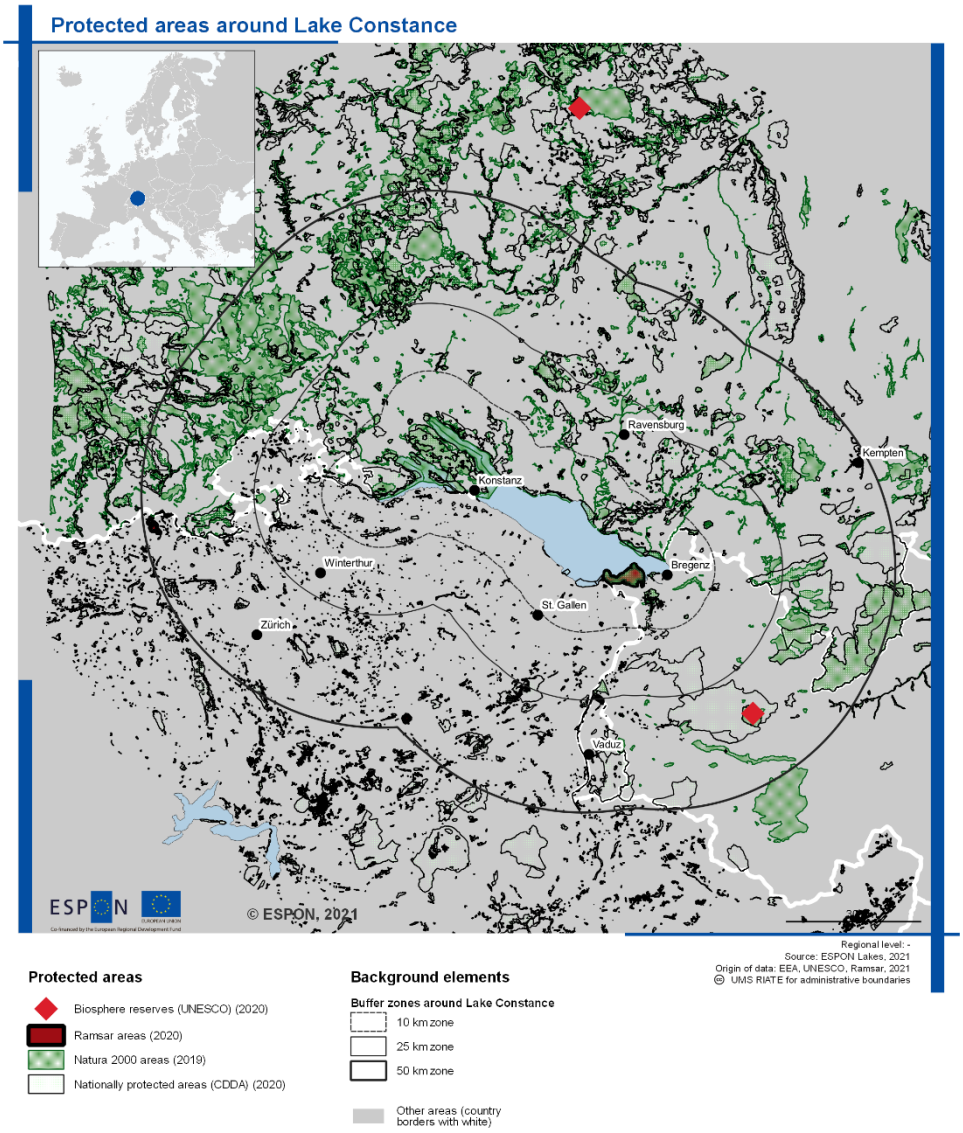
Map 3 gives an overview of protected areas around Lake Constance. It combines nationally designated protected areas and protected areas under the EU Natura 2000 directive. Natura 2000 is based on the 1979 Birds Directive (also called it as Special Protection Areas, SPA) and the 1992 Habitats Directive, that includes two types of areas, Sites of Community Importance (SCI) and Special Areas of Conservation (SAC).

Generally, there are obvious differences between the countries. In Switzerland, most of the protected areas are smaller than in Germany and Austria. In the North-Western part of the map, large parts of the areas are protected. These areas belong to two low mountain ranges in Germany (Black Forest, Swabian Alb). The large protected areas in the South-Eastern part of the map are part of the Alpine mountain range. Directly

situated at the lake, riparian areas are protected as well as the area between the two arms (‘Überlinger See’ and ‘Untersee’) in the North-Western part of the lake. This landscape (‘Bodanrück’) is characterised by a moor and hilly landscape. Moreover, different river entry areas of rivers to the lake are object to protection regimes (e.g. Rheindelta, Eriskircher Ried, Argental). The Rhine Delta is also protected as Ramsar site. Ramsar sites are based on the Convention on Wetlands (signed in 1971). They address wetlands of international importance. Within a 10 km zone around the lake, a total of 14% of the surface areas is protected via national regimes and 18% in terms of the Natura 2000 directive. The EU Green Deal intends to increase the Natura 2000 protected areas up to 30%.

In addition, biosphere reservations are displayed in the map. This protection regime intends to combine the conservation of biodiversity and sustainable use but is not relevant in the region in quantitative terms. Two reservations are part of the map section with some distance to the lake, they refer to the Alpine biosphere reserve (Biosphärenpark Großes Walsertal) in Austria and the German biosphere reserve on the Swabian Alb.

Map 3 Protected areas

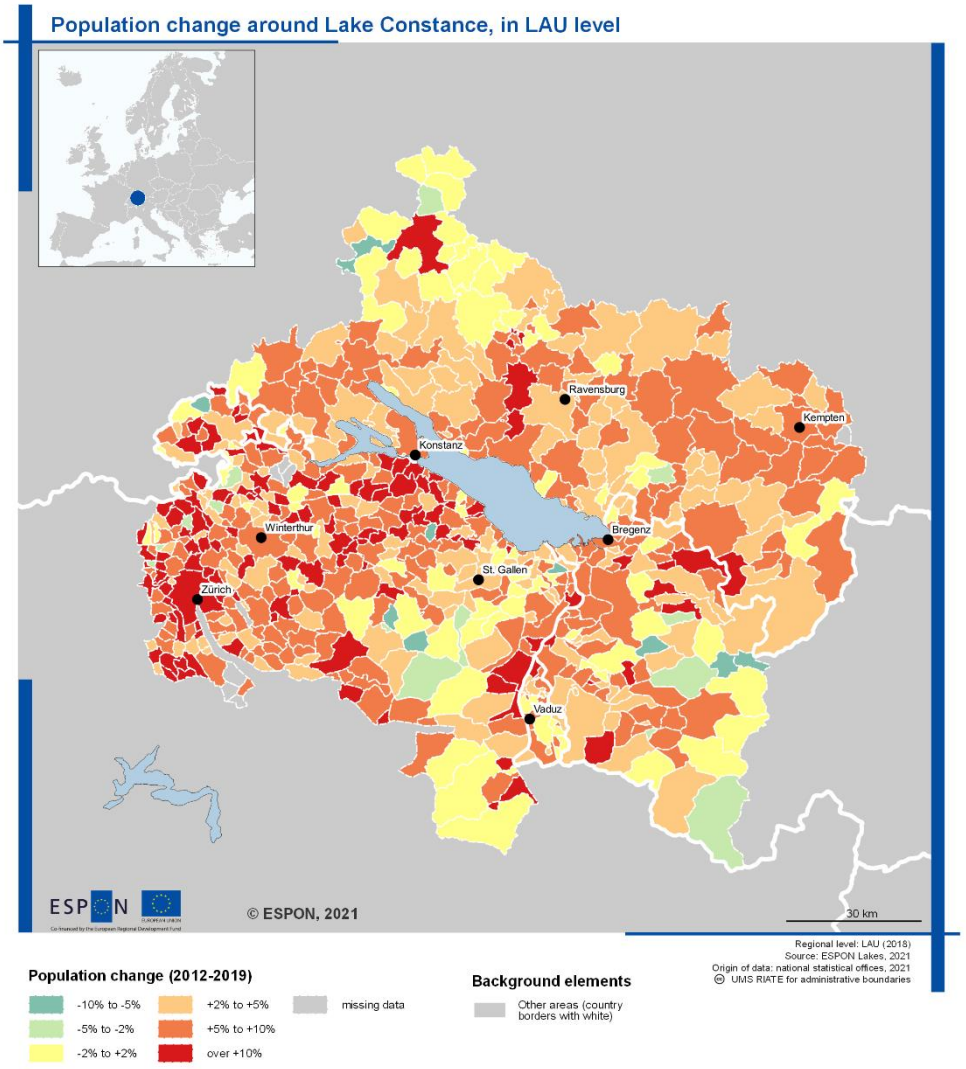


Ecosystem protection of the lake is strongly connected to issues of water quality. Currently, an important issue are non-indigenous species (e.g. quagga-shell). The occurrence of the shell increased rapidly within the last years. It was first discovered in 2016 and is spread widely within the lake now. The effects of such non-indigenous species on the ecosystem is not clear and is object to further observation (IGKB, 2020). Furthermore, a series of efforts aim to improve the situation of the shorelines in order to reconnect habitats.

2.3 Socioeconomic situation in the lake region

The Lake Constance region is a highly attractive place to live and work. The population density of the region is comparable with the average density of Germany. This value is higher than the European and Swiss average (Scherer et al., 2016). Currently, more than 4 million inhabitants live within the perimeter of the International Lake Constance Conference (IBK). The population grew significantly during the last years. Map 4 shows local population changes between 2012 and 2019 within the perimeter of IBK. Population growth is displayed in orange and red colours, while a population decline is shown in green and blue colours. Yellow refers to a more or less stable population size.

Map 4 Population change



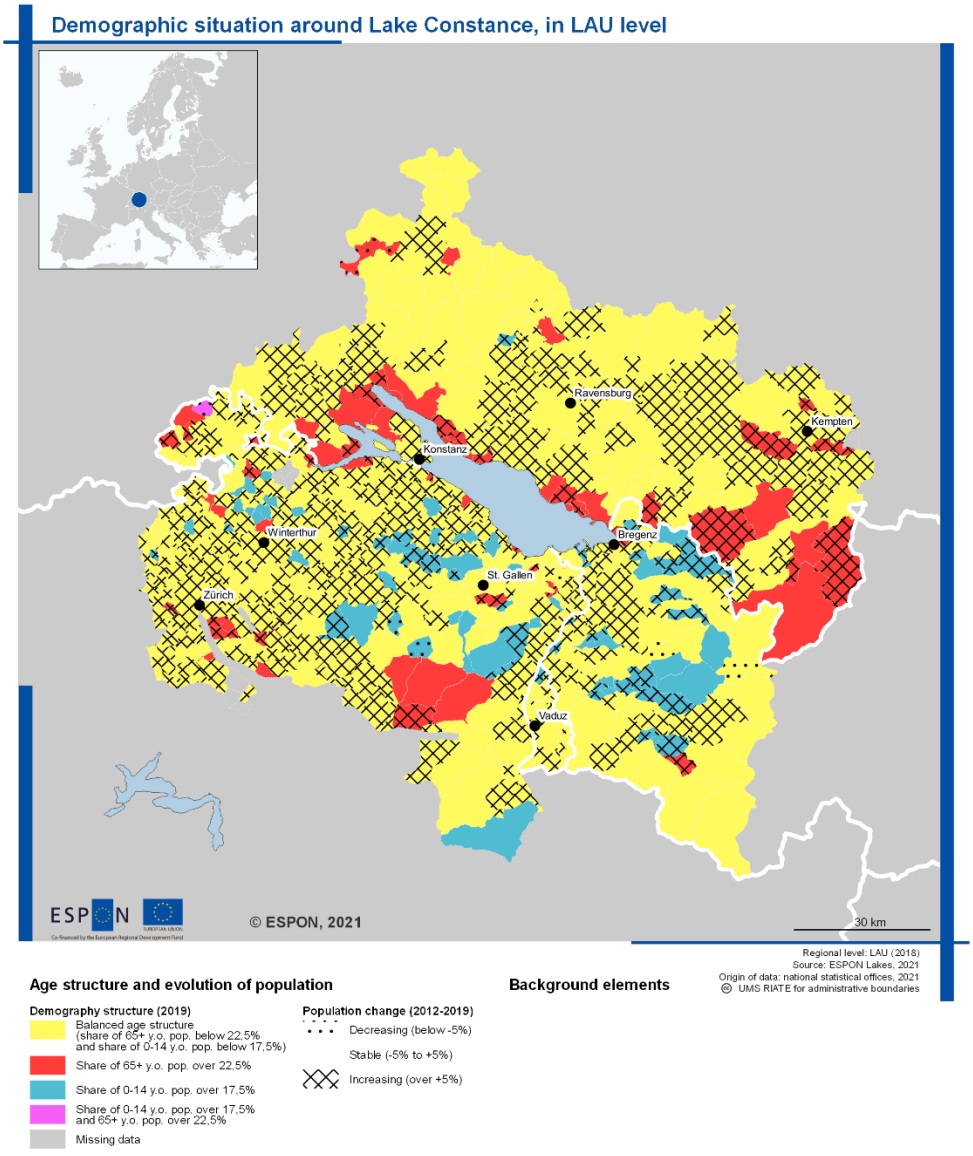
Most of the municipalities of the region grew between 2012 and 2019. The highest growth rates can be found in the South-Western part of the region. In this Swiss area between Lake Constance and Zurich, the population of several municipalities increased by more than 10%. Municipalities with a stable or declining population are located in the Alpine parts of the region in the South-East and as well as parts of the German district Sigmaringen in the Northern part of the map.

Map 5 gives a condensed overview of the age structure in combination with the development of population of the region. The different colours refer to some characteristics of the age structure. The yellow colour refers to a level of people over 65 below 22,5% and under 14 below 17,5%. The other categories highlight regions with a high share of people over 65 (brown), a high share of people under 14 (blue) and a high share of both

of these groups (red). The latter category reflects a high dependency rate as these groups in general do not work but are dependent on parents or social insurances. The dotted and cross-hatched signature adds information about population development. The population in the cross-hached parts increased with a rate of more than 5% between 2012 and 2019, while the population in dotted areas decreased with a rate of more than 5%.

Generally, most of the regions are not above the threshold values with regard to these age groups (yellow coloured). Municipalities with a high share of young people are located in the Swiss and Austrian parts of the region. Some German riparian municpalities and Alpine municipalities have a high share of old peple.

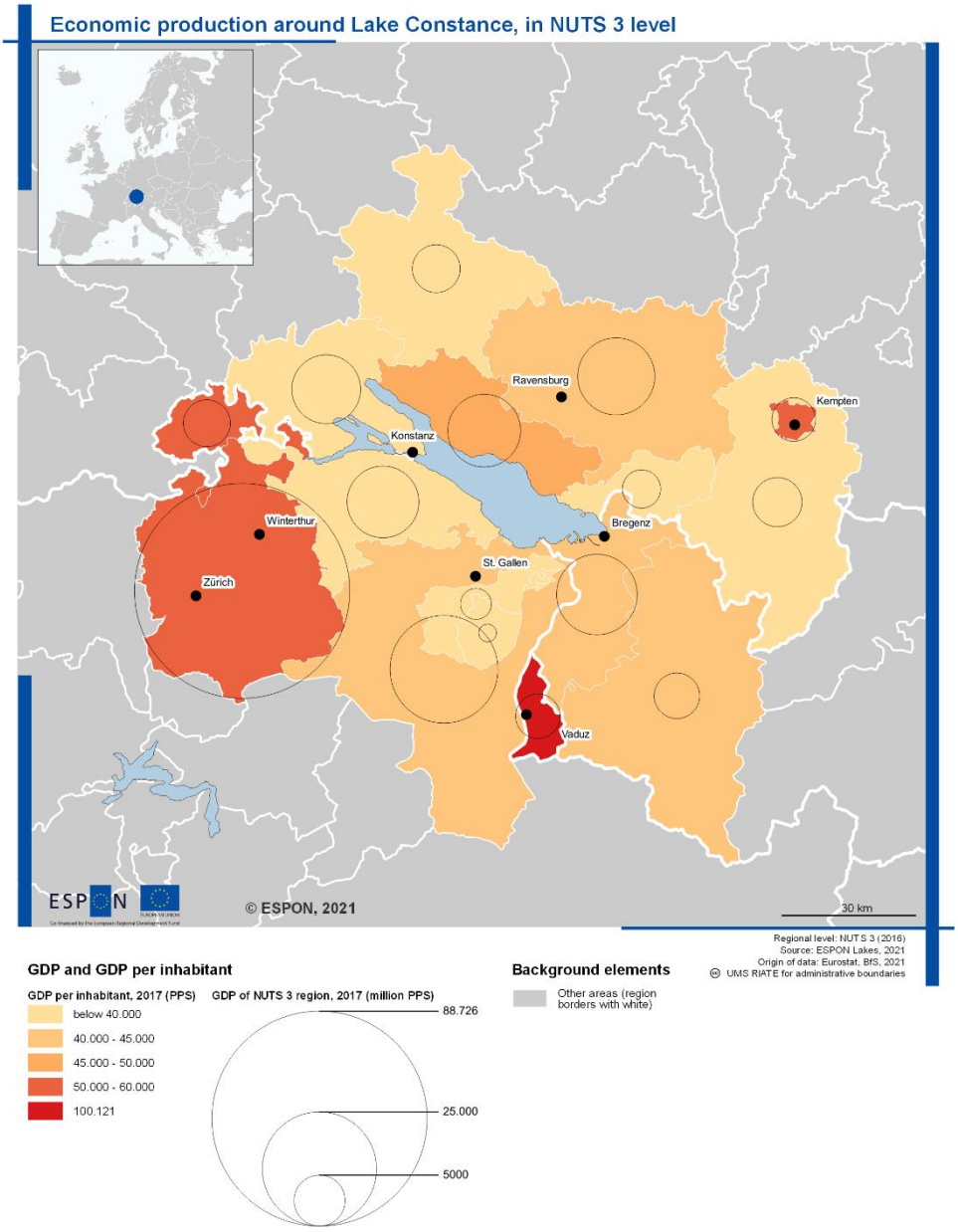
Map 5 Age structure and population patterns



Lake Constance region is an economically successful region. Between the years 2000 and 2018, employment increased with a rate of 20% to a total number of employed persons in 2018 of 2,3 million employees (Fachstelle für Statistik Kanton St. Gallen, n.d.). The main indicator for comparing economic performance is GDP per capita. Map 6 illustrates the indicator in purchasing power standards which is a theoretical currency unit that adjusts price level differences. The GDP per capita of each of the NUTS3-regions is higher than the EU-27 average (2017: 29.300). Economically strong regions are located within the corridor Friedrichshafen-Ravensburg, the Rhine valley and the regions around St. Gallen and Konstanz (see Scherer et al., 2016;

Scherer and Gutjahr, 2012). This is obvious in the map: 'Bodenseekreis' (Friedrichshafen is part of it) and the district Ravensburg, North-West of the lake, have a higher GDP per capita than the surrounding NUTS-3 regions. Liechtenstein, the canton St. Gallen and the Austrian regions that all have a higher GDP per capita are part of the Rhine valley. Especially Liechtenstein is standing out with an enormous value. This can be explained by the special situation of Liechtenstein. The small state with a high wage level attracts a lot of commuters – in 2019, 55 percent of the employees were counted as cross-border commuters (*Grenzgänger in der Bodenseeregion 2019*, 2020). Besides Liechtenstein, the highest levels of GDP are related with the Zurich metropolitan region in the South-West of the region and the city of Kempten. One has to keep in mind, that GDP per capita is strongly influenced by (domestic and cross-border) commuters in particular in small territories like the German NUTS 3 cities (in this case Kempten) and small states like Liechtenstein.

Map 6 Economic production



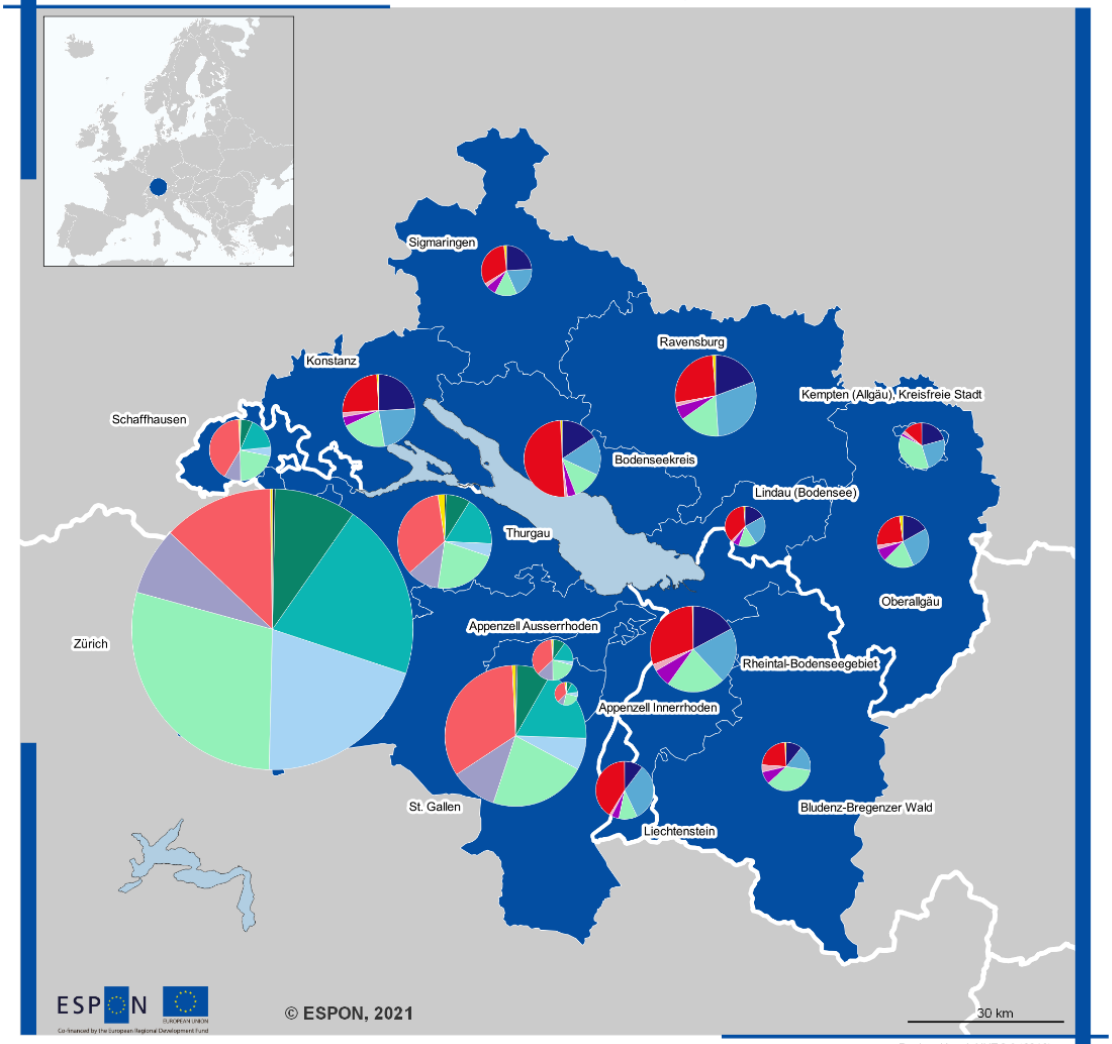
The economy of the region is dynamic and highly innovative. The economic success is based on a series of export-oriented companies in the industrial sector. Following the overall trend, the service sector is getting

more important: In Lake Constance region, services with regard to companies, banks and insurances, research, education and public administration are most prominent. A high innovation capacity serves as basis for the success of the region. This capacity is built on a high research and development effort with regard to research and development in companies and the development of new products and processes (Scherer et al., 2016; Scherer and Gutjahr, 2012). Furthermore, the region has an enormous density of universities (27).

Error! Reference source not found. illustrates regional differences with regard to economic sectors. The pie charts show the contribution of the different sectors to the total Gross value added of the NUTS3-regions. The aggregation of sectors is different between Eurostat data and Swiss data, but some general issues can be identified. The map clearly shows those regions where manufacturing (Sector C) is of high importance: In the NUTS3-region 'Bodenseekreis', approx. the half of the gross value added is produced within the manufacturing sector. Liechtenstein has a high value as well of around 40%. The Swiss data highlights the financing and insurance services (Sector K). This sector is highly relevant in Zurich but also with some relevance in the canton St. Gallen (Scherer et al., 2016).

Map 7 Gross added value by sector

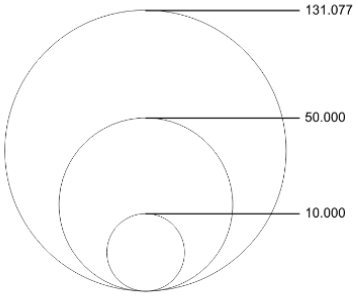
GVA of the economic sectors around Lake Constance, in NUTS 3 level



Regional level: NUTS 3 (2016)
Source: ESPON Lakes, 2021
Origin of data: Eurostat, BfS, 2021
UMS RIATE for administrative boundaries

GVA by economic sectors

Total GVA, 2017 (million euro)



Background elements

Other areas (country borders with white)

Sectors	Clustering of Economic Sector DE, AT, LI	Switzerland
A - Agriculture, Forestry & Fishing	A	A
B - Mining & Quarrying	B, D, E	B, C, F
C - Manufacturing	C	B, C, F
D - Electricity, Gas, Steam & Air Conditioning	B, D, E	D, E, P, Q
E - Water Supply, Sewerage, Waste Management & Remediation Act.	B, D, E	D, E, P, Q
F - Construction	F	B, C, F
G - Wholesale & Retail Trade; Repair of Motor Vehicles & Motorcycles	G - J	G - J
H - Transportation & Storage	G - J	G - J
I - Accommodation & Food Service Act.	G - J	G - J
J - Information & Communication	G - J	G - J
K - Financial & Insurance Act.	K - N	K
L - Real Estate Act.	K - N	L - N, R, S
M - Professional, Scientific & Technical Act.	K - N	L - N, R, S
N - Administrative & Support Service Act.	K - N	L - N, R, S
O - Public Administration & Defence; Compulsory Social Security	O - U	O
P - Education	O - U	D, E, P, Q
Q - Human Health & Social Work Act.	O - U	D, E, P, Q
R - Arts, Entertainment & Recreation	O - U	L - N, R, S
S - Other Service Act.	O - U	L - N, R, S
T - Activities of Households as Employers & for Own Use	O - U	T
U - Activities of Extraterritorial Organisations & Bodies	O - U	n.r.

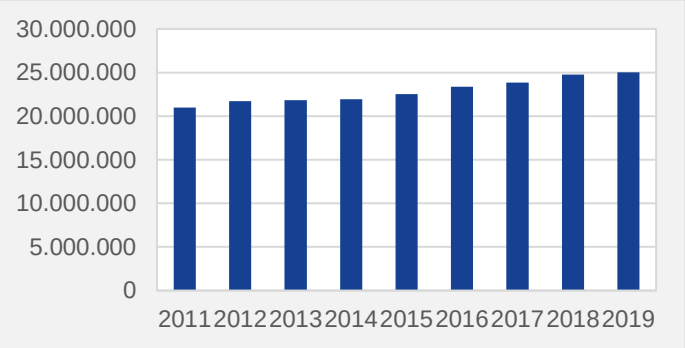
2.4 Tourism and cultural / natural heritage

The Lake Constance region is rich of touristic attractions. Besides the lake, the attractiveness is built on the cities, events, cultural heritage sites and the proximity to the mountains as well as the natural landscapes. The tourism marketing[1] highlights the aspects of being active, culture, nature & adventure, culinary and mobility. Some of the most important highlights are: the Rhine Falls in Schaffhausen, island Mainau, a Zeppelin flight and the Zeppelin museum, the old castle in Meersburg and the Salem monastery and palace, the cableways of Säntis in Switzerland and Pfänder in Austria, the monkey forest 'Affenberg', the boat trips and the different heritage sites. Well-known events are the 'Bregenz Festival', an open-air opera-festival, and the 'Seenachtsfest' in Constance, an open-air night festival.

Moreover, the region has several cultural heritage sites which serve as touristic highlights:

- Since 2000, the monastery *island of Reichenau* has been a UNESCO World Heritage Site. A medieval Benedictine monastery from the year 724 and three Romanesque churches with impressive murals can be found on the island. In addition to three museums that provide detailed information about the World Heritage Site, there is a treasury with many art treasures in the Minster of St. Mary and St. Mark (AG Tourismus im Landkreis Konstanz, n.d.).
- The monastery precinct of *St. Gallen* has been a UNESCO World Heritage Site since 1983. The highlights are the baroque cathedral with significant architecture and a unique collection of works in the Abbey Library of St. Gallen Monastery. The collection includes about 170,000 books and 2,100 manuscripts from the Middle Ages. At the same time, it is the oldest library in Switzerland. It is world famous (AG Tourismus im Landkreis Konstanz, n.d.).
- The *prehistoric pile dwellings around the Alps* have been a UNESCO World Heritage Site since 2011, even though they are not actually visible. These are archaeological sites of pile dwellings from the Neolithic Age and the early Bronze and Iron Age. The sites are located in Austria, Slovenia, Italy, France, Germany and Switzerland. Nine of these archaeological sites are located in the shallow waters of Lake Constance. Due to the exclusion of air in lakes and bogs, the materials and objects have remained preserved until today and thus allow insights into the life of farmers at that time. Three such pile dwellings have been found in the city of Constance. Therefore, the Constance State Archaeological Museum has its own exhibition on the "World of Pile Dwellings". The largest pile-dwelling site on Lake Constance can be found in Unteruhldingen-Stollenwiesen. And there are 23 reconstructed pile dwellings to visit in the Überlingen Pile Dwelling Museum, too. It is one of the largest open-air museums in Europe (AG Tourismus im Landkreis Konstanz, n.d.).
- In addition to the World Heritage Sites, there is also an *immaterial cultural heritage* in the Lake Constance region. Examples are the ‚Konstanzer Fasnacht', the ‚Oberschwabener Funkenfeuer', the ‚Silvesterchlauser Urnäsch' and the ‚Vorarlberer Volksmusik' (Internationale Bodenseehochschule, n.d.; ZHAW (Zürcher Hochschule für angewandte Wissenschaften), n.d.).

Figure 1 Overnight stays in touristic accommodations



[1] https://www.bodensee.eu/de

Datasource: Fachstelle für Statistik Kanton St. Gallen, n.d.

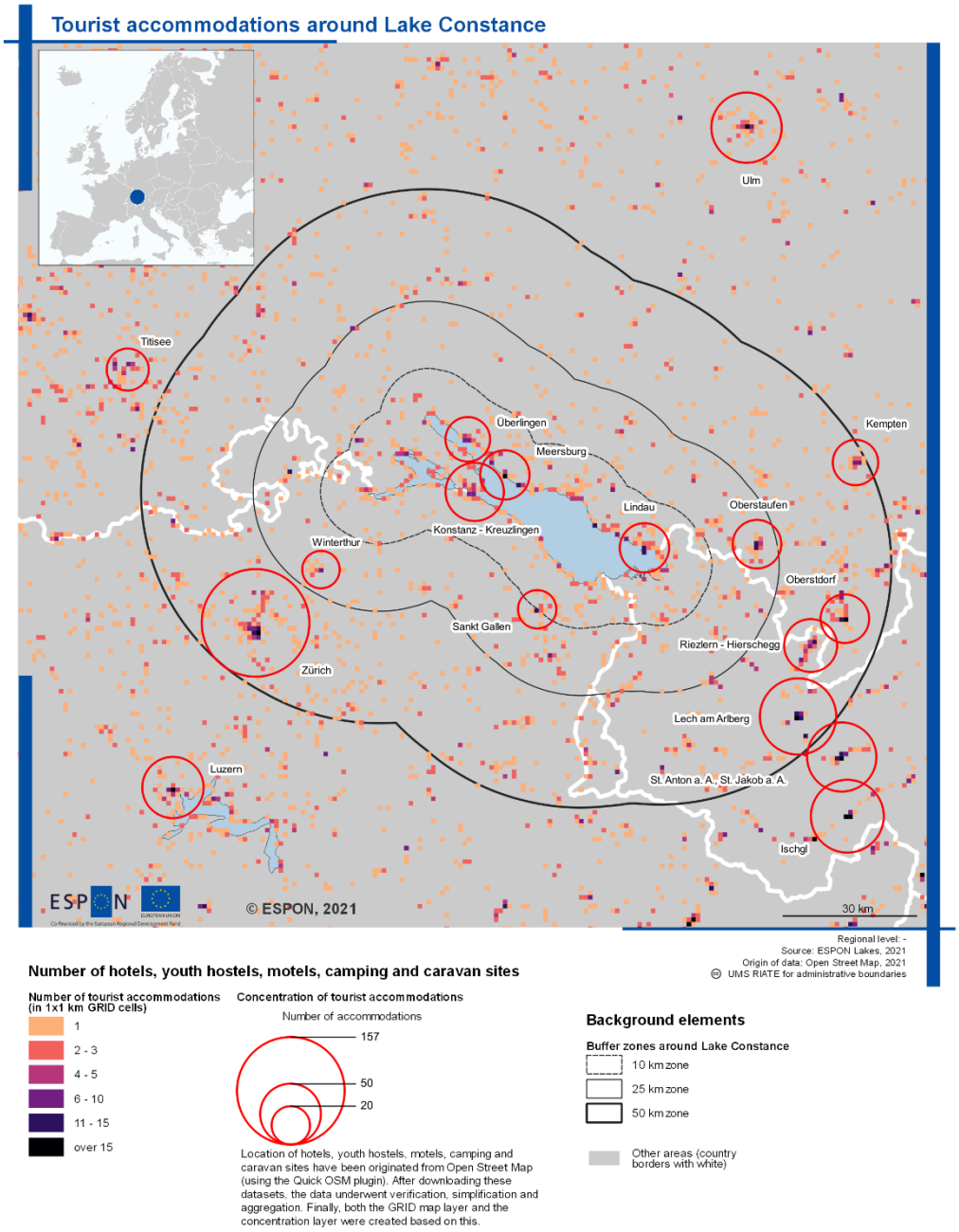
Within the region hiking, biking, water-related activities and winter sport allow active holiday forms and leisure activities. The near mountains as well as the Lake Constance cycle path with 270 km are prominent elements. Water-related activities include swimming, surfing, sailing and boat tours. The lake-based tourism is mostly summer tourism, while within the Alpine areas of the region, winter tourism is quite important.

The region is attractive for overnight tourism and daily trips from the surrounding metropolitan regions but also for the inhabitants of the region. During the last years, overnight tourism increased to a level of 25 million overnight stays in hotels with more than 10 beds in 2019 (see Figure 1). The German part receives the most overnight guests (40% of the overnight stays of the region). The average length of the stays in hotels was 2,3 days (Fachstelle für Statistik Kanton St. Gallen, n.d.). Most of the overnight tourism is based on German tourists, mostly coming from Baden-Württemberg. Furthermore, the region is quite attractive for day trips. The estimated number of day-trippers is still higher than the number of overnight stays: For the year 2010, regional experts estimate a number of 32 million day-trippers (Internationale Bodensee Tourismus GmbH, n.d.). Especially on the German side, during seasonal peak phases the guest intensity in some touristic hotspots is high. This results in overload of car transport infrastructures (e.g. traffic jams, overcrowded parking lots). Generally, the need is seen to develop sustainable tourism offers as the tourism is based on intact landscapes. The “Echt Bodensee Card”[2] is an example as guest card that allows to use public transport in large part of the German Lake Constance area.

Map 8 displays touristic capacities as number of hotels, youth hostels, motels and camping sites within 1km-cells. The data are based on accommodations which are part of the OpenStreetMap-project. The map shows different patterns that at the same time reflect different forms of tourism. Firstly, direct on the lake a higher number of accommodations are situated. Especially on the North-Eastern side of the lake, several grids cells refer to more than 5 accommodations in one cell (e.g. Überlingen, Meersburg, Lindau). Secondly, city tourism is visible within the 50 km buffer. Clusters of higher accommodation intensity refer to the cities of Zurich, St. Gallen on the Swiss side and Kempten on the German side. Thirdly, in the Eastern part of the region the higher touristic intensity is related to the Alpine context of the region (e.g. Oberstdorf, Riezlern-Hirschegg, Lech am Arlberg, Oberstaufen). Fourthly, there is a scattered supply of accommodations within the whole map section which refers to tourism in rural regions (see also *Raumübersichten DACH+*, n.d.). Furthermore, the map shows that touristic capacities directly at the lake are higher on the German side, while the Swiss side is not intensively used as touristic region (Scherer et al., 2016).

[2] https://www.echt-bodensee.de/planen/echt-bodensee-card

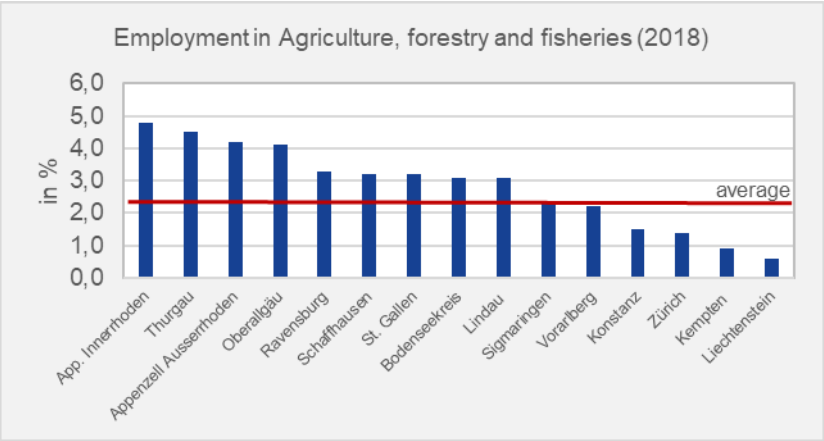
Map 8 Places of touristic accommodations



2.5 Agriculture, fisheries and food production

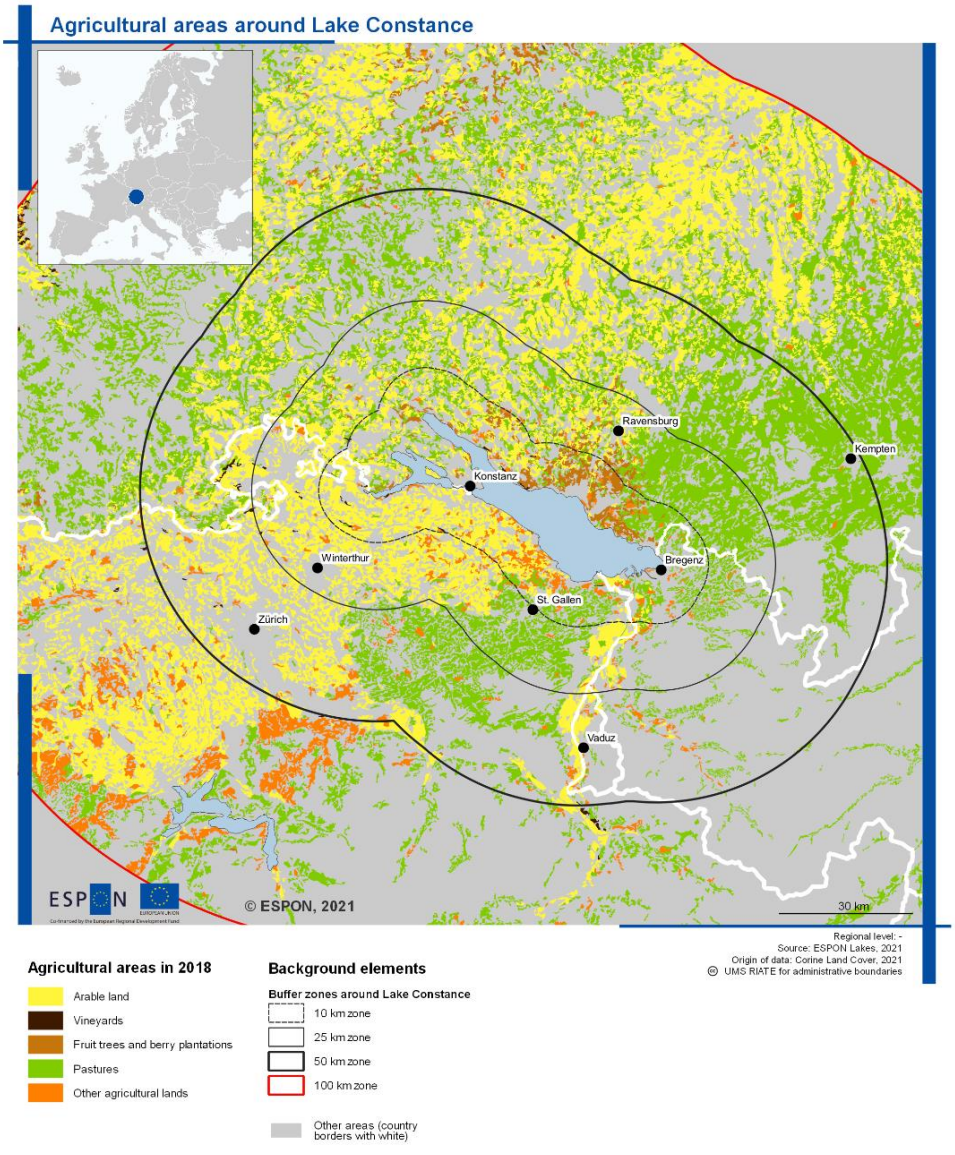
Food production is of importance for the region. Figure 2 shows the share of employed persons within agriculture, forestry, and fisheries. It indicates shares clearly above the average of the region (2,3%) in the Swiss cantons Appenzell Inner- and Ausserrhoden and Thurgau as well as the German district Oberallgäu. Thurgau is known as region where vegetables are grown in an intensive way, while in the 'Allgäu'-region pasture is relevant.

Figure 2 Employment in the primary sector



Datasource: Fachstelle für Statistik Kanton St. Gallen, n.d.

Map 9 Agricultural areas

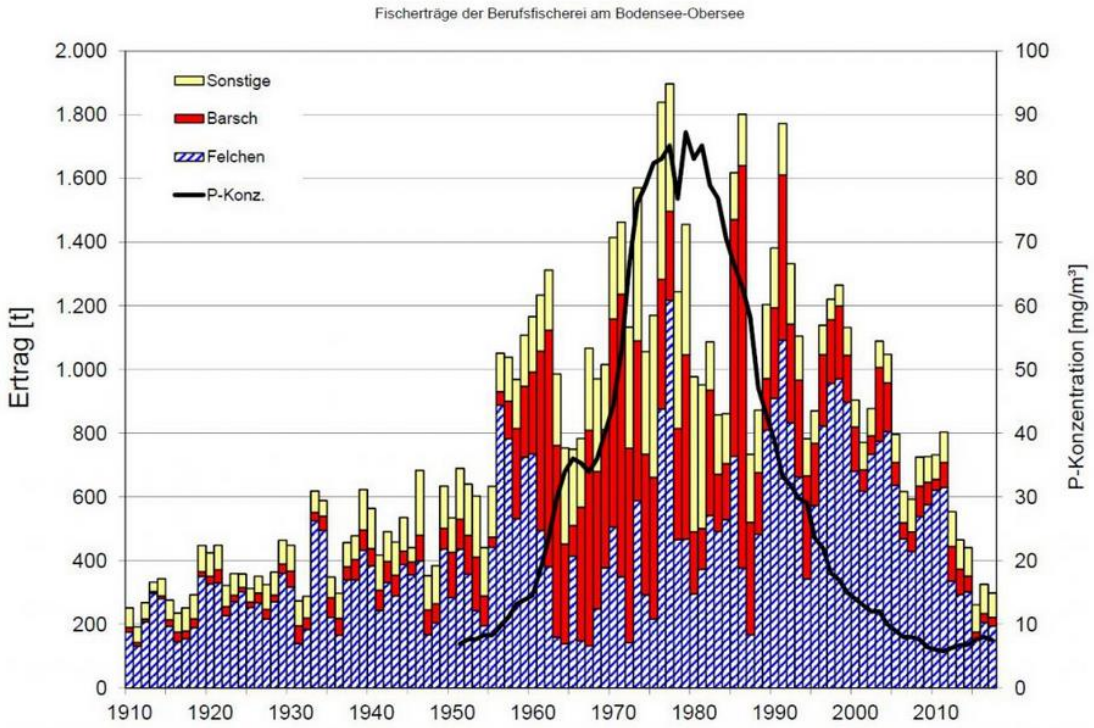


Map 9 shows diverse patterns of agricultural land use in the region. The German areas on the large part of the lake (upper lake) are well-known as fruit growing area (‘Bodenseeobst’). The most famous fruit is the apple: within the German parts, 250.000 tons of apples are harvested each year. Furthermore, hops and vine are cultivated in this area. Vine is grown not only in this part but also in other regions (e.g. Rheintal, Thurgau, Vorarlberg). The growing of vine within the region has a longstanding tradition and is based on the particular climate conditions: The lake as warmth reservoir balances temperature differences as well as it reflects the sun. In the Western Swiss part of the region the dominant category of agricultural use is ‘arable land’ which includes annually harvested plants. As already indicated within this part the cultivation of vegetables is important. In the South-Eastern part of the region, pastures are predominant with the exception of the Rhine valley which is mainly used as ‘arable land’ as well. In the North-Western parts of the region, a mixed used of arable land and pastures is dominant.

The fishery of Lake Constance is connected to measures of water protection but also influenced by other factors, e.g. non-endemic sticklebacks as competitors of other fish species, cormorants that feed off fishes and also climate change, which causes altered fish population levels due to lower oxygen share of the water at great depths. Figure 3 illustrates that the reduction of nutrients (phosphorus content) due to water protection and fishing volumes correlate – showing curves of the phosphorus content and the fishing volumes which increase and decrease nearly simultaneously. In 2019, commercial fisheries produced in total 208 tonnes of fish (Bodensee-Obersee) which is the lowest value since 1910. The low total values in 2019 correlate with the low volumes of whitefish (‘Felchen’) the so-called ‘Brotfisch’ of Lake Constance fishery – this expression refers to the high occurrence of this fish species and the importance for fishery (Baer and Blank, 2020).

As there is not the expectation that fishing yields will increase again the fishing licences where reduced in 2020 to 80 licences. At the same time, the local fish demand cannot be met, e.g. tourists want to get the traditional fishes in the restaurant. For this reason, the traditional fish species are imported (Baer et al., 2017). To solve this problem, some a fishery cooperative wanted to establish aqua cultures to grow whitefish (‘Felchen’). This idea was discussed intensively in the region and criticized by several institutions (e.g. NGOs, International Lake Constance Conference, International Water Protection Commission) and also commercial fishers. As a result of this process the cooperative does no longer pursue the target to establish aquaculture. More generally, the International Lake Constance Fishery Commission (IBKF) deals with the topic how fisheries in the lake can be strengthened in a sustainable way and how commercial fishery for a low number of fishers is still viable (Internationale Bevollmächtigtenkonferenz für die Bodenseefischerei, 2020).

Figure 3 Fishing volumes ('Ertrag') and phosphorus content ('P-Konzentration') for Lake Constance (Upper Lake)

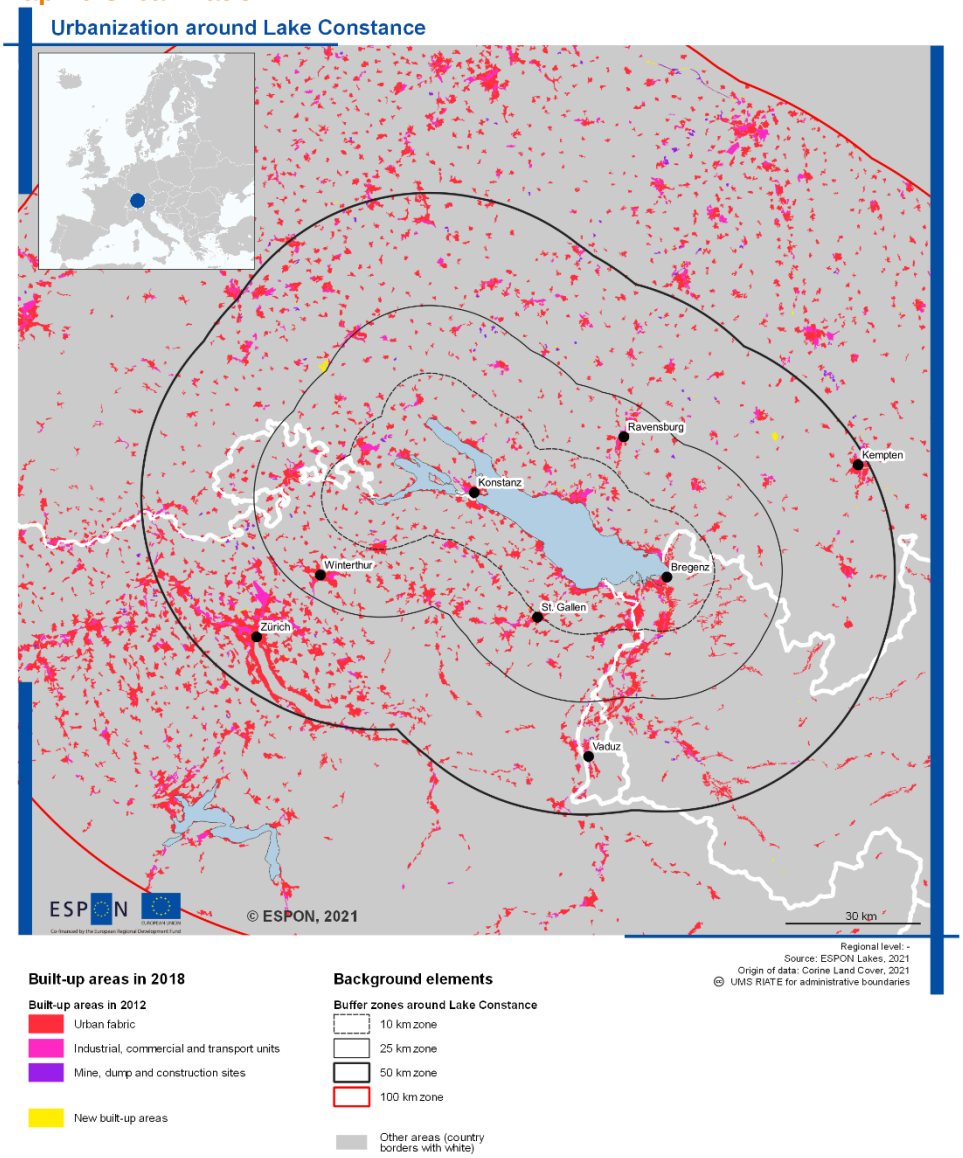


Source: http://www.ibkf.org/fangstatistiken/

2.6 Spatial structures and transport

The region around Lake Constance is organised in a polycentric way with numerous medium-sized towns. Zurich in the South of the region is the only bigger city but only located at the fringe of the region. Without a metropolitan centre, the medium-sized towns have certain centrality functions for the surrounding areas (Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS), 2011). Map 10 displays areas of the region that are related to settlements. The red category ('urban fabric') relates to dwellings and buildings, while the two purple categories show areas used for economic activities. The map highlights the areas of Zurich and the Rhine valley (between Vaduz and Bregenz) as most urbanised areas. The Swiss part within a buffer zone of 25 km is more urbanised than other parts of the buffer zone. In the South-Eastern part of the map, the settlements follow the valley structures of the Alpine mountain range. Furthermore, the map shows that large parts of the shore of Lake Constance are used for settlements. Changes within built-up areas are nearly not visible within the map. The DACH+-project reports that new built-up areas are manly related to expansion of settlement areas. The report highlights that the reduction of land usage should be a priority of spatial planning (*Raumübersichten DACH+*, 2014).

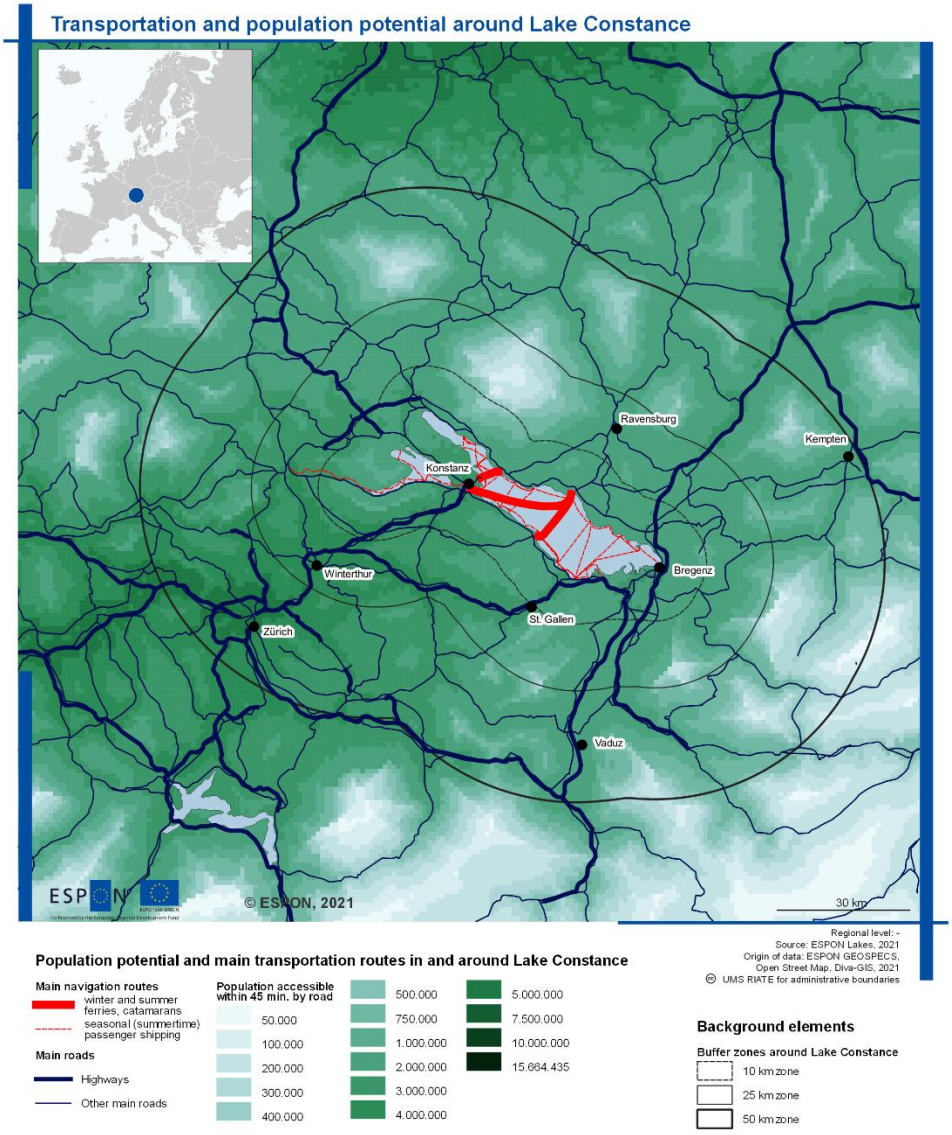
Map 10 Urbanization



Map 11 shows different aspects of transportation in the lake region. Firstly, shipping lines on the lake are displayed. Most of the lines refer to seasonal lines that are used in summer and mainly serve touristic purposes (“Weiße Flotte”). Additionally, two car ferry lines are in place. The ferry in the middle of the lake connects Friedrichshafen on the German side and Romanshorn on the Swiss side within 44 minutes. The second ferry connects the two German towns Constance and Meersburg within 15 minutes. Between Friedrichshafen and Constance, the catamaran is operating. It connects the two cities within 52 minutes. The ferry line between Friedrichshafen and Romanshorn allows connection to the public transport by train and is part of the second Bodanrail-project[3]. The INTERREG-project aims at the improvement of the cross-border public transport by train in the Lake Constance region. With regard to the ferry line, the intention is that the ferry operates each half-hour instead of each hour but there are still issue to be solved, e.g. financing issues.

[3] https://www.bodenseekonferenz.org/bodanrail-2040

Map 11 Ferry lines and population accessible within 45 min.



Secondly, the map illustrates how many inhabitants can be reached within 45 minutes' car driving. The patterns are based on road infrastructure quality and population density. Dark green coloured areas refer to high population values that can be reached within 45 minutes. The highest values within the 50 km buffer are related to the Zurich metropolitan area. Around Lake Constance, medium values are shown. The Alpine parts and other rural areas show low levels.

Transport development in the region is high on the political agenda. Cross-border connections but also the connections to the metropolitan regions of Stuttgart, Munich and Zurich could be improved as well as the connection of lake-based transport and train connections (IBK, 2018). With regard to train connections different systems meet in the region. In Switzerland the train network is of high density and intensity while the German network is of lower density. In Vorarlberg, bus transport play an a particularly important role (*Raumübersichten DACH+*, 2014). The already mentioned Bodanrail-projects serve as strategic concept towards a better coordinated public transport via train and also includes links to ferry connections.

3 Governance in the lake region

The Lake Constance region is a particular region, given the following unique characteristics:

- The lake is strongly characterised by the national borders of three countries (and the near Principality of Liechtenstein), which is a particular precondition for all kinds of policy making, management and planning.
- The political borders of the upper lake are not defined. This even enlarges the challenges of political organisation.
- At the same time, the region is one of the (worldwide) forerunners of cross-border cooperation in particular with regard to environmental issues.

3.1 Actors involved in lake-based governance

The Lake Constance region is characterised by an enormous institutional thickness: pan-lake initiatives are accompanied by domestic and cross-border initiatives on different scales and in different perimeters. The impressive number of approx. 500 cross-border cooperating organisations and 5.000 regional politicians illustrate this situation (Zumbusch and Scherer, 2015).

From a historical perspective, the lake was the starting point for cross-border cooperation in the region as it was necessary to protect it against pollution and coordinate the utilization of the water. In 1857, a first agreement was signed which dealt with the outflow of water (Zumbusch and Scherer, 2015). The first agreement on fishery was signed in 1893. Zumbusch and Scherer split the cooperation history into different phases:

1. The ‘phase of formation’ had a focus on the lake as common good based on the negative consequences of industrialization.
2. The ‘post-war phase’ is characterised by a focus on political exchange across borders.
3. Starting in the 1960s, the ‘phase of environment’ addressed conflicts between economic growth and protection of environment.
4. In the 1980s and 1990s, a ‘phase of regionalization’ was characterised by efforts of local and regional actors that became part of the cooperation landscape.
5. The last two phases are related to European processes, especially the INTERREG programmes.

Zumbusch and Scherer see in the earlier phases mainly cooperation of administrative institutions, while in the last phases the importance of other actors (e.g. economy, civil society) raised. The financial resources of the EU supported the formalization of institutions (own staff and budget).

On the *pan-lake level*, **International Lake Constance Conference (IBK)**[4] is the key actor of the region. It was established in 1972 and is based on a cooperation on the level of the ‘heads of government’ which represents the level of regional governments (federal states in AT and DE and cantons in CH) and in Liechtenstein the national level. Concretely, besides of Liechtenstein (NUTS 0), two German states (NUTS 1), one Austrian state (NUTS 2) and six Swiss cantons (NUTS 3) are part of the cooperation. In Germany, the states of Baden-Württemberg and Bavaria act on behalf of the seven NUTS 3-regions that are situated near the lake Constance (see **Error! Reference source not found.**, Introduction chapter).

The IBK is structured as follows (Geschäftsstelle der Internationalen Bodenseekonferenz, n.d.):

- Conference of ‘Heads of Government’: The representatives of the regional governments meet once a year. The Conference decides on general priorities of the IBK. This conference also prepares recommendations for national governments and towards European institutions.

[4] https://www.bodenseekonferenz.org/de/home

- Permanent Committee: The Permanent Committee consists of high officials of the respective administrations. It prepares the Conference of Heads of government and carries out the decisions taken in the Conference. The Committee meets three times a year. Some of these meetings include the chairmen of IBK-Commissions and guests from other organisations.
- IBK-Commissions: The commissions deal with different policy areas (education, science and research, culture, environment, transport, economy, health and social issues, public relations; the spatial planning commission is an associated partner). Additionally, working groups can be installed to work on current topics.
- The presidency and the office of the IBK are responsible for the daily operations. The presidency shifts each year between the members.

On the *pan-lake level*, also other organisations bring together political actors and deal with a broad range of topics:

- **Parliamentary Conference (IPBK)**[5]: The network of parliamentarians was founded in 1994. While IBK connects the executive level, in this network the legislative part of the regional government level is connected (same level as IBK). The delegation of each parliament consist of up to three parliamentarians. The assembly meets twice a year. The objectives of the network are manifold, e.g. to represent the population of the Lake Constance region and to have an exchange and cooperation between parliaments, and also between parliaments and the executive side (governments and IBK) (Internationale Parlamentarische Bodensee-Konferenz, 2018).
- **City network (ISB)**[6]: The network was founded in 2009 and has 26 members on the local level. Mayors of the members form the presidency and steering group. The general assembly meets once a year. The tasks that are defined in the 'Charta' are identification of common interests towards states, cantons, national governments and the EU (ISB, 2009).

Moreover, the following organisations have to be mentioned:

- **INTERREG Alpine Rhine – Lake Constance – High Rhine**[7]: The INTERREG A programme facilitates project funding of cross-border projects. Liechtenstein and Switzerland as non-EU member states take part in this EU programme.
- **Lake Constance Council („Internationaler Bodenseerat')**[8]: The organisation was founded in 1991 and includes actors from different fields. Besides political actors, also actors from economy, education and culture take part. The Council intends to represent the population of the region and bring up relevant topics. The members meet twice to three times a year.
- **'DenkRaum Bodensee'**[9]: The ThinkTank is based on the cooperation of different universities and research institutes to provide inspiration for the development of the lake Constance region.

On the *pan-lake level*, **the Spatial Planning Commission** (ROK-B) focuses on territorially integrated development. The Spatial Planning Commission includes the authorities of spatial planning on a regional level. In Switzerland the cantons (NUTS3) and in Austria the state level (NUTS2) is involved. On the German side a regional planning level lower than the state level exists, the so-called 'Planungsregionen'. These regions combine some NUTS3-regions and form a specific administrative level between the NUTS3- and NUTS2-level. Not only the level of the members differs in comparison with IBK but also the spatial perimeter: In Switzerland and in Germany the perimeter is a little larger than the IBK-perimeter. The members of the Commission meet regularly.

Lake management of Lake Constance needs to be organised in a cross-border way. This is due to the fact that water quality etc. is never organised in political perimeters, and in Lakes Constance the situation is even

[5] https://bodenseeparlamente.org/
[6] http://www.staedtebund-bodensee.org/
[7] https://www.interreg.org/
[8] https://www.bodenseerat.org/
[9] https://denkraumbodensee.org/

more complicated as the political borders are not defined within the lake. Lake management is organised with different international agreements that regulate water protection measures, fisheries and shipping:

- **International Water Protection Commission Lake Constance (IGKB)**[10]: The Commission for water protection was founded in 1959. It is based on a cooperation between the two German states Bavaria and Baden-Württemberg (NUTS1), Austria (NUTS0) and Switzerland (NUTS0). Liechtenstein and Germany are observers. Meetings of the Commission take place once a year in May. Moreover, an expert committee with 20 members of all countries exists within the Commission. This committee meets four times a year and provides information to the Commission. It is supported by different subject areas (lakes, catchment area, damage absorption). In each of the areas relevant institutions are involved, e.g. within the lakes subject area different research institutes are involved (Institut für Seenforschung for Baden-Württemberg, EAWAG for Switzerland etc.). For the lake´s water catchment area also other agreements exist (Internationale Rheinregulierung IRR, Internationale Regierungskommission Alpenrhein IKRA).
- **International Lake Constance Fishery Commission (IBKF)**[11]: The Commission is built on an agreement which was signed in 1893 ('Bregenzer Übereinkunft'). Similar to IGKB the members are to be found on the regional government level. The Commission meets once a year.
- **International Shipping Commission Lake Constance (ISKB)**: The agreement on shipping was signed in 1973 by Austria, Germany and Switzerland.

Several cooperations deal with further sectoral issues. The following two are most notable:

- **'Internationale Bodensee Tourismus GmbH**[12]': The organisation is based on shareholders that represent tourism organisations mostly on regional and local level (e.g. Landkreis Bodenseekreis, Liechtenstein Marketing, Verband der Tourismuswirtschaft Bodensee e.V.). These shareholders communicate with other tourism related units like destination managements.
- **Lake Constance Foundation**[13]: The NGO serves as umbrella organisation for nature conservation associations and implements different projects within the Lake Constance region but also on European level. Within the Environmental Council ('Umweltrat'), 20 nature conservation associations are represented. They aim to have a cross-border exchange on environmentally relevant issues, aiming to protect and develop the region around lake Constance in a sustainable way.

Financial resources for cross-border cooperation in Lake Constance region are based on national, regional or local resources as well as project financing provided by the respective EU cooperation programmes. The latter include the INTERREG cross-border programme Alpine Rhine – Lake Constance – High Rhine as well as the transnational programme Alpine Space. Liechtenstein and Switzerland, though not full EU member states, actively participate in these EU programmes even if the financial mechanisms differ. For environment-related issues also the EU LIFE-programme provides financial resources (e.g. currently ongoing project of Lake Constance Foundation 'Blue Lakes' dealing with micro-plastic in lakes). For research projects, also traditional, domestic research funding is used (e.g. DFG – Deutsche Forschungsgemeinschaft).

3.2 Cross-sectoral and multi-level interplay

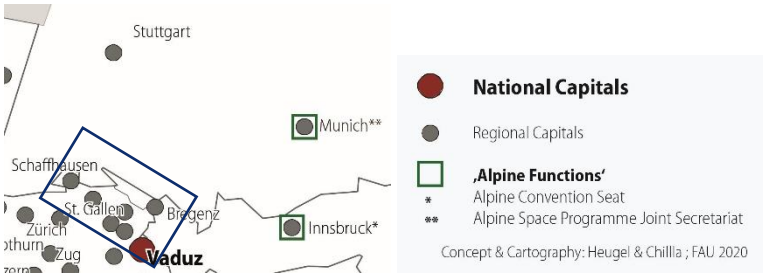
The actors that are presented in chapter 3.1 refer to organisations with a focus on the whole lake or the whole region. For the case of Lake Constance, cooperation on this level automatically means cross-border cooperation. The formal political mandates for all topics are based on the domestic level. On the pan-lake level, different forms of cooperation apply. Some of them are based on 'softer' tools where exchange and

[10] https://www.igkb.org/start/
[11] http://www.ibkf.org/
[12] https://www.bodensee.eu/de
[13] https://www.bodensee-stiftung.org/

strategic orientation is in the foreground. Other topics are regulated with international agreements. They are based on the principle of unanimity. The regulations need to be implemented into national law. All topics with a focus on the lake and its region are part of negotiation processes between the different domestic actors, and intergovernmental politics are important on all levels.

Cross-sectoral and multi-level governance is based on involvement of various actors. The cross-border character of the region makes these governance settings even more challenging. This is true, firstly, because the involved countries are administratively organised in different ways. The level of regional governments within the different countries illustrates this (see Figure 4): On the German side, the regional governments are responsible for the federal states (16 states), within the European NUTS-nomenclature this level refers to NUTS1-level. In the Lake Constance case the governments and ministries of Baden-Württemberg are located in Stuttgart and of Bavaria are located in Munich – both with some distance to the Lake Constance. In Austria, regional governments are also responsible for federal states (9 states), referring to the European NUTS2-level. The state of Vorarlberg is completely included within the Lake Constance region. In Switzerland, regional governments refer to 26 cantons (NUTS3-level). They are much smaller than e.g. the German states, and six of them are members of the IBK and other Lake Constance cooperation formats (Appenzell Ausserrhoden, Appenzell Innerrhoden, St. Gallen, Schaffhausen, Thurgau and Zürich). Liechtenstein as a small state is always represented via the national government level (NUTS0) and does not have a political, regional level. Obviously, the competences of regional governments differ between the countries.

Figure 4 Regional capitals (Part of map created for Alpine region, Lake Constance region highlighted in blue)



Source: (Chilla and Heugel, 2021)

Furthermore, the level of mandates differs between policy areas, e.g. in Germany. This can be illustrated for the case of spatial development. Within the Spatial Planning Commission (ROK-B) the Swiss cantons (NUTS3) and the Austrian state level (NUTS2) are involved, while in Germany the competence for regional planning is on the level of planning regions (see above, between NUTS 2 and 3). This setting of actors within the policy area differs e.g. from the IBK-setting where on the German side the NUTS1-level is included.

Secondly, policy approaches differ between the countries. This can also be exemplified with spatial planning. In Switzerland spatial planning plays a stronger role than e.g. in Germany. To develop a joint vision within such a field makes it necessary to deal with these different approaches and find compromises e.g. how exactly to formulate objectives.

Given the institutional complexity of the Lake Constance region, forms of stakeholder coordination are manifold. In principle, the following forms apply:

- Formal participation procedures on the domestic level (e.g. usual procedure in land use plans on the local and regional level)
- Formal or associated membership, hearings, guest participations etc. in cross-border committees (e.g. IBK, ISB, Lake Constance Council)
- Rather informal networking and participation in the 'epistemic community' of the Lake Constance region

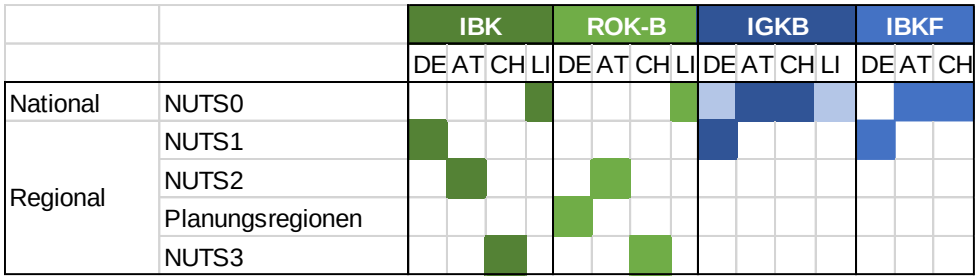
The International Lake Constance Conference functions as 'umbrella organisation' (Zumbusch and Scherer, 2015) within the region. It has formalized partnerships with other cooperation formats:

- The Water Protection Commission (IGKB) as well as the Spatial Planning Commission (ROK-B) are associated members.
- In 2019, a common declaration between IBK and the City Network (ISB) was signed. This declaration includes objectives on a content side as well as mutual information and communication between the organisations (ISB, 2009).
- The statute of the Lake Constance Council has a paragraph expressing the willingness to cooperate with the IBK. It includes the understanding of the Council as partner of the IBK as well it states that a representative of IBK is always invited to meetings of the Council. Furthermore, the exchange on the level of working groups is foreseen (Internationaler Bodenseerat, 1993).
- The Conference of Parliamentarians (IPBK) formulates in its statute the objective to set relevant topics onto IBK agenda. As well an exchange between the organisations is foreseen (Internationale Parlamentarische Bodensee-Konferenz, 2018).
- A list of further partners can be found on the IBK homepage[14].

The IBK is based on the cooperation of public actors. Some voices in the region are in favour of a stronger involvement of NGOs within the framework of the IBK. Such an involvement is realized in other cooperation formats like the Alpine Convention.

Competences within the federal systems of the countries are based on different levels and differ between sectors: Figure 5 summarizes the territorial level (in the NUTS classification) of the partners involved in major soft cooperation instances around Lake Constance. It shows the complexity of cooperation patterns to tackle various issues: government cooperation (IBK), spatial planning (ROK-B), water protection (IGBK) and fisheries (IBKF). These examples reflect the diversity of territoriality involved in lake related cooperation (Chilla et al., 2012).

Figure 5 Territorial level of involved partners in major soft cooperation instances around Lake Constance



[14] https://www.bodenseekonferenz.org/kooperation

3.3 Governance of major lake-related issues

During the LAKES project, a standardised list of lake-related issues has been produced which covers topics of territorial and lake development (see Table 2). In contrast to other lake regions in Europe, nearly all the issues of this list are relevant for the Lake Constance region to a certain extent and they are reflected in governance structures. Firstly, this chapter provides an overview of institutions that tackle the subjects. Secondly, some policy areas are reflected in more detail.

Table 2 List of standardised lake-related issues

Policy areas	No	Standardised lake-related issues
Water management	1.1	Regulation of the water level of the lake
	1.2	Regulation of the quality of water discharge from urban wastewater
	1.3	Regulation of the level of pollution from agricultural sources
Ecosystem management	2.1	Protection of lake-specific ecosystems (marchland, forests)
	2.2	Protection of lake-specific biodiversity
Food production	3.1	Lake-related branding for food products
	3.2	Regulation of fish catches / support to lake-based fisheries
Demography, labour market and attractiveness	4.1	Strategic measures for demographic attractiveness: -e.g. in tourism lake, to keep a sufficient level of resident population -e.g. in peripheral lake, to avoid brain drain and keep young people -e.g. in urbanised lake, to attract highly educated population
	4.2	Business development policies targeting entrepreneurs in the lake region
	4.3	Access to Services of General Interest in the lake region
Tourism	5.1	Development and networking of the tourism industry
	5.2	Branding of the lake as a tourism destination
Cultural and natural heritage	6.1	Protection and valorisation of cultural and natural heritage around the lake
Transport	7.1	Regulation of maritime traffic on the lake
	7.2	Organisation of public transport across the lake (ferry)
	7.3	Management of daily mobility
	7.4	Management of transit traffic
Spatial planning	8.1	Limiting urban-sprawl and soil-sealing
	8.2	Promotion of urban polycentric development (functional complementarity between urban nodes)

The policy area **water management** is highly relevant for the lake region. In 1959, the International Commission for Water Protection (IGKB) was founded. In 1967 guidelines were formulated which are constantly updated. They refer to both subtopics that were defined within the LAKES project (discharge from urban waste water and pollution from agricultural sources). The water level cannot be regulated within Lake Constance as no construction for regulation exists at the outlet of the lake. After a flood event in 1999, the respective authorities decided to initiate a common forecast model. In 2004, the website 'www.bodensee-hochwasser.info'[15] was launched providing information on water level. Since 2006 data are available on a daily basis (see Sieber et al., 2008).

The regulation of **fish catches** and **maritime traffic** on the lake are also based on international agreements. Both are interrelated with water protection measures. The reduction of nutrients due to water protection measures reduced dramatically the fishing volumes. Furthermore current trends of climate change accelerate the reduction of fish population levels.

[15] http://www.bodensee-hochwasser.info/

With regard to **lake-specific ecosystems**, the preservation and renaturation of shorelines ('Uferrandstreifen') is high on the agenda but is not yet implemented. This objective is also formulated in the guidelines of the Water Protection Commission (IGKB, 2018) and is a topic of a dialogue between the IGKB, Lake Constance Conference, and the Spatial Planning Commission.

Most of the other topics are based on rather soft cooperation formats. Within the policy area '**Demography, labour market, attractiveness**', several cooperation formats and projects exist. Within an INTERREG project which focused the common economic space of the region ('Internationaler Wirtschaftsraum Bodensee'), the common brand 'Vier Länder Region'[16] was developed and launched in 2011. Regional marketing is implemented via 'Bodensee Standort Marketing GmbH (BSM)'. Within the university and research sector, a cooperation of universities is in place (Internationale Bodenseehochschule IBH) as well as a ThinkTank (DenkRaum Bodensee). Moreover, different formats cooperate for issues of labour market (Netzwerk Arbeitsmarkt, Arbeitsgemeinschaft Bodensee-IHKs, AK Handwerk und Gewerbe). The IBK Economic Commission is involved in some of the formats. On a political side, the commission also arranges delegation trips to Brussels.

In Lake Constance region, joint **tourism** marketing is coordinated by the International Lake Constance Tourism GmbH (IBT GmbH). The communication with regional and local tourism organisations is organised via the shareholders of the GmbH (e.g. Landkreis Bodenseekreis, Liechtenstein Marketing, Verband der Tourismuswirtschaft Bodensee e.V.). Based on an INTERREG project which developed a positioning of the tourism region, this organisation aims at implementing and developing the tourism strategy and a brand for the region. The tourism marketing makes use of the region´s brand 'Vier Länder Region'. The protection of **Cultural Heritage** is based on national regimes but it is used for tourism marketing purposes[17].

Public **transport** on the lake is operated by four shipping companies that cooperate within 'Vereinigte Schiffahrtsunternehmen für den Bodensee und Rhein' (VSU). This cooperation provides a cross-border ticket system and timetable on the lake. Public train and bus transport in contrast, is organised in different tariff associations. For touristic purposes, a one or three-day-ticket allows to use all modes of public transport (train, bus, ferry) in the German, Austrian and Swiss parts of the region (Bodenseeticket[18]).

The cross-border coordination of **spatial planning** is a topic of the Spatial Planning Commission (ROK-B).

3.3.1 Water management and lake-specific ecosystem management

The regulation of water quality was defined as important topic decades ago in order to reduce the pollution of the lake. One important aim is to maintain the drinking water quality. In 1959, the International Commission for Water Protection (IGKB) was founded. In 1960, an international agreement was signed which formulated the obligation for international cooperation with regard to water protection. This is concretized as protection from pollution and improvement of water quality as well as coordination of the utilization of the lake. In 1967, guidelines for the lake ('Bodensee-Richtlinien') were formulated which are constantly updated. They refer to waste water, water-endangering substances, agriculture and forestry, fisheries, thermal use of the water, shipping, shore areas and hydro-engineering installations (IGKB, 2018).

The chemical, physical and biological status of the lake is constantly monitored taking into account the lake itself and the water catchment areas within the framework of the International Water Protection Commission (IGKB). The monitoring system has a longstanding tradition. The results are constantly reported in the so-called 'green reports'[19] of IGKB. Current relevant topics are e.g. the effects of climate change, the effects of non-indigenous species and thermal use of water. The issue of water protection is highly connected with ecosystem management of the lake. With regard to lake-specific ecosystems, the preservation and renaturation of shorelines ('Uferrandstreifen') is high on the agenda. Large parts of the shorelines are artificially modified. This leads to the disconnection of habitats on the shorelines and a reduction of the lake´s capacity to filter water as well as to reduce contamination. Furthermore, the shorelines are important habitats for birds, insects, amphibians and fish (Rey et al., 2009).The objective is to preserve shore areas that are still

[16] https://www.vierlaenderregion-bodensee.info/de/
[17] https://www.bodensee.eu/de/was-erleben/kultur/unesco-weltkulturerbe
[18] https://www.bodensee-ticket.com/
[19] https://www.igkb.org/oeffentlichkeitsarbeit/limnologischer-zustand-des-sees-gruene-berichte/

in a natural state and connected, and to renaturate modified parts. This aim is also formulated in the guidelines of the Water Protection Commission (IGKB, 2018) and is a topic which is part of a dialogue between the IGBK, Lake Constance Conference and the Spatial Planning Commission. The renaturation of shore areas is a challenge (e.g. elimination of concrete walls, high costs for restoration). An INTERREG-project ('Renaturierung von Auenwäldern am Bodensee') with the complex objective to plan floodplain forest showed that high land prices make it nearly impossible to extend the natural parts of the shore areas.

The IGKB is the key actor within the area of water protection. The formal structure of the Commission includes the different countries as well as experts (IGKB, 1996, n.d.):

- Commission: It is based on a cooperation between the two German states (NUTS1), Austria (NUTS0) and Switzerland (NUTS0). Austria acts on behalf of the state Vorarlberg and Switzerland of the cantons Thurgau, St. Gallen and Graubünden. The two cantons Appenzell Ausser- and Innerrhoden are located within the catchment area as well and go along with the measures of the Commission. Liechtenstein and Germany are observers. Meetings of the Commission take place once a year in May.
- Expert committee: 20 members of all countries are part of an expert committee. This committee meets four times a year and provides information to the Commission.
- Three working groups are permanently installed. Furthermore, it is foreseen to have temporal working groups if necessary.
    - Working group 'Lake': 15 experts of Baden-Württemberg, Bavaria, Switzerland and Austria take part within this working group. Within it research institutes (e.g. Institut für Seenforschung[20], EAWAG[21], Umweltinstitut des Landes Vorarlberg[22]) and the respective authorities (e.g. Bayerisches Landesamt für Umwelt) take part. The working group tackles mainly the following topics: state of the lake, future development of the lake and renaturation of shore areas.
    - Working group 'Catchment area': Within this working group experts of the catchment area take part. The experts are also part of research institutes and environmental- and water-related authorities.
    - Working group 'Damage absorption': In this working group also experts of the catchment area are included. They are part of ministries, environmental- and water-related authorities and fire brigades. The following topics are mainly tackled: development of emergency plans and operational plans to enable an international approach in emergency cases, performance of training courses and internationally organised practical trainings

The so-called 'Bodensee-Wasser-Informationssystem' (BOWIS) is a central system for the collection of water related data. Since 1974, regular measurements referring to the state of the lake are published as 'green reports'. Moreover, since 1963 research results are published within the 'blue reports'.

The regulations of the Commission are implemented on domestic level by the respective authorities.

The measures with regard to water quality take into account the lake and its catchment area. Within the catchment area, territorial impacts on the lake water result from waste water of settlements and agriculture. In the lake area also the intensity of shipping and built-up areas e.g. on the shorelines have an impact on water quality. Shorelines are the connection to spatial planning concepts in the region.

3.3.2 Spatial planning

On the pan-lake level, the Spatial Planning Commission (ROK-B) focuses on territorially integrated development. The Spatial Planning Commission started working in the year 2000 following the idea of the German-Swiss Spatial Planning Commission. In 2004 ROK-B became an officially associated member of the IBK. IBK has the status as observer within the ROK-B.

[20] https://www.lubw.baden-wuerttemberg.de/wasser/institut-fuer-seenforschung
[21] https://www.eawag.ch/
[22] https://vorarlberg.at/-/umweltinstitut_aufgaben

As already explained, the Spatial Planning Commission includes the authorities of spatial planning on the regional level. In Switzerland the cantons (NUTS3), in Austria the state level (NUTS2) and on the German side 'Planungsregionen' are involved. Both in Switzerland and Germany ROK-B refers to a larger area than the IBK-perimeter (see **Error! Reference source not found.**). The members of the Commission meet on a regularly basis.

The ROK-B's primary goal is to develop a common and limitless understanding of space. The leading topics are the internal and external development of the Lake Constance region, the improved exchange and harmonization of data bases, the cooperation between the urban centres and landscapes or quiet zones. In addition, the aim is to overcome borders and to use them as opportunities wherever possible. A common spatial concept is a long standing objective (ROK Bodensee, 2009, 2011).

Several projects were implemented within the framework such as different German spatial development projects (MORO), participation on different Swiss spatial development, the DACH+ project which developed a spatial monitoring system within an INTERREG A project. The DACH+ project serves as basis for current reflections on the spatial structure of the region. It developed four categories of priority areas: settlement area, tourism, cultural landscape and natural landscape. Moreover, non-building zones for wind power were discussed and a current project develops climate change adaptation tools for spatial planning[23].

A currently process aims at developing a concept for spatial development of the whole region. The so-called 'Zielbild Raum und Verkehr' (Vision for territorial development and transport) is part of the strategic priorities of the current 'Leitbild' of the IBK. The process is coordinated between ROK-B and the IBK-Commission Transport. The underlying idea is to agree on common objectives of spatial development that are based on national and regional objectives of spatial planning. The concept develops different area categories for the whole region which are based on the development of settlements, mobility, landscapes and tourism.

The concept is meant to complement concepts of the domestic level with regard to the cross-border context. Several spatial development concepts, plans and regulations are in place around Lake Constance.

Spatial planning in the lake region refers to the territory, some concepts include the shore areas. The lake as such remains a hardly addressed topic of territorial development. Even if the relevance of territorial dynamics for the water body is broadly accepted, the spatial planning perspective does not focus on coordinating the territorial and water related aspects in an explicit way.

3.4 Main trends in adaptive capacity, resilience, learning

Climate change is one of the future major challenges. Some strategic documents have been scanned with regard to this topic (see chapter 0). The 'Leitbild'[24] of the International Lake Constance Conference refers to climate change as one of the strategic priorities. One of the aspects of this priority is the implementation of an e-mobility strategy[25] for Lake Constance region. Energy efficiency of buildings is another key aspect. Within an INTERREG project low tech buildings were evaluated[26]. The idea of low-tech buildings is to reduce the energy consumption without causing too much technical and financial efforts. The improvement of energy efficiency and use of renewable energy sources as well as the reduction of air pollution was part of the INTERREG V period of the Alpine Rhine – Lake Constance – High Rhine programme.

Not all regional planning documents refer to climate change (analysed document see Annex). The 'Raumbild Vorarlberg 2030'[27] is one of the documents that include the challenges of climate change for the region and the need of adaptation measures. It highlights the effects of climate changes on mountain regions. Natural hazards will increase and regional resources will change. Therefore, the concept underlines that measures for the protection of settlements and economy from natural hazards are necessary as well as that the tourism sector needs to be prepared for the changes. With regard to planning issues, green areas and open spaces

[23] http://klima.dachplus.org/
[24] https://www.bodenseekonferenz.org/strategie
[25] https://www.bodenseekonferenz.org/de/home/elektromobilitaet
[26] https://www.interreg.org/projekte/P2/SZ4/ABH020
[27] https://vorarlberg.at/documents/21336/66439/Raumbild+Vorarlberg+2030+-+Zukunft+Raum+geben/fa34a934-eb59-40e5-859c-74fc0b8413b6

have a high relevance. The negotiation of different land use demands is described as gaining still more importance within the context of climate change.

Climate change is also a big challenge for the lake itself. The temperature of the lake water is constantly rising (IGKB, 2020). The rising water temperature will have effects on the layering and mixture of the lake water. As a consequence, the water quality and use of the lake as drinking reservoir as well as shipping can be affected. Low water levels might result in constraints with regard to the access to harbours and berths. A high awareness of the changes and consequences exist in this region: The topic was e.g. addressed in the INTERREG IV project KLIMBO[28]. Generally, it is seen as necessary to have a constant monitoring of the situation in order to identify changes and to be aware of consequences. This allows to develop adaptation strategies for the lake. The so far implemented measures to maintain a good water quality are seen as important step. The existing observation and research structures are promising also for future development (e.g. Institut für Seenforschung as part of Landesamt für Umwelt Baden-Württemberg).

In the Lake Constance region, several monitoring systems are established within different fields:

- Sectoral monitoring: The lake water quality[29] and water level[30] are constantly observed. With regard to fishing, a monitoring exists for the fish species that are important for fishing.
- Spatial development: Within the INTERREG-project DACH+, a spatial monitoring system[31] was developed. The project developed key indicators on municipal level. Due to data availability restrictions, six indicators were implemented on municipal level: Housing areas with a good accessibility of public transport, new-built up areas, urban sprawl, protected areas, gross value added, employment rate and unemployment rate.

The concept of resilience refers to different aspects. The resilience of the lake was part of the research project 'Seewandel'[32]. The project explores the impact of stressors on ecosystem and biodiversity of the lake as well as the human utilisation of the lake. Investigated stressors are e.g. the reduction of nutrients, climate change or non-indigenous species.

Governance resilience is an important topic within the cross-border region. Institutional thickness, mutual trust and longstanding experience are strong points. In particular with regard to water related issues, the cooperation is good functioning. At the same time, the soft character of cross-border cooperation challenges resilience: Due to its cross-border character, the region was highly affected by the border closures during the Covid-pandemic. In the media pictures of the temporarily built-up border fences were spread not only within the region. As a reaction to the challenges, the heads of government confirmed in June 2020 to strengthen cross-border cooperation and formulated the task to develop a concept for cross-border coordinated approach in the case of a pandemic. The Health Commission of IBK developed the concept by the end of the year 2020[33]. The cooperation was also strengthened in form of a regularly exchange between health authorities and a web platform for the exchange of data. These efforts made it possible to avoid general border closures after the first period with high infection numbers. IBK also provides up-to-date information about the occurrence of infections and the respective measurements within the countries. Furthermore, the capability to react to crises shall be part of the interim evaluation of IBK strategy.

[28] https://www.igkb.org/aktuelles/klimbo-klimawandel-am-bodensee/

[29] https://www.igkb.org/oeffentlichkeitsarbeit/limnologischer-zustand-des-sees-gruene-berichte/

[30] http://www.bodensee-hochwasser.info/

[31] https://www.dachplus.org/raumbeobachtung/indikatoren

[32] https://seewandel.org/

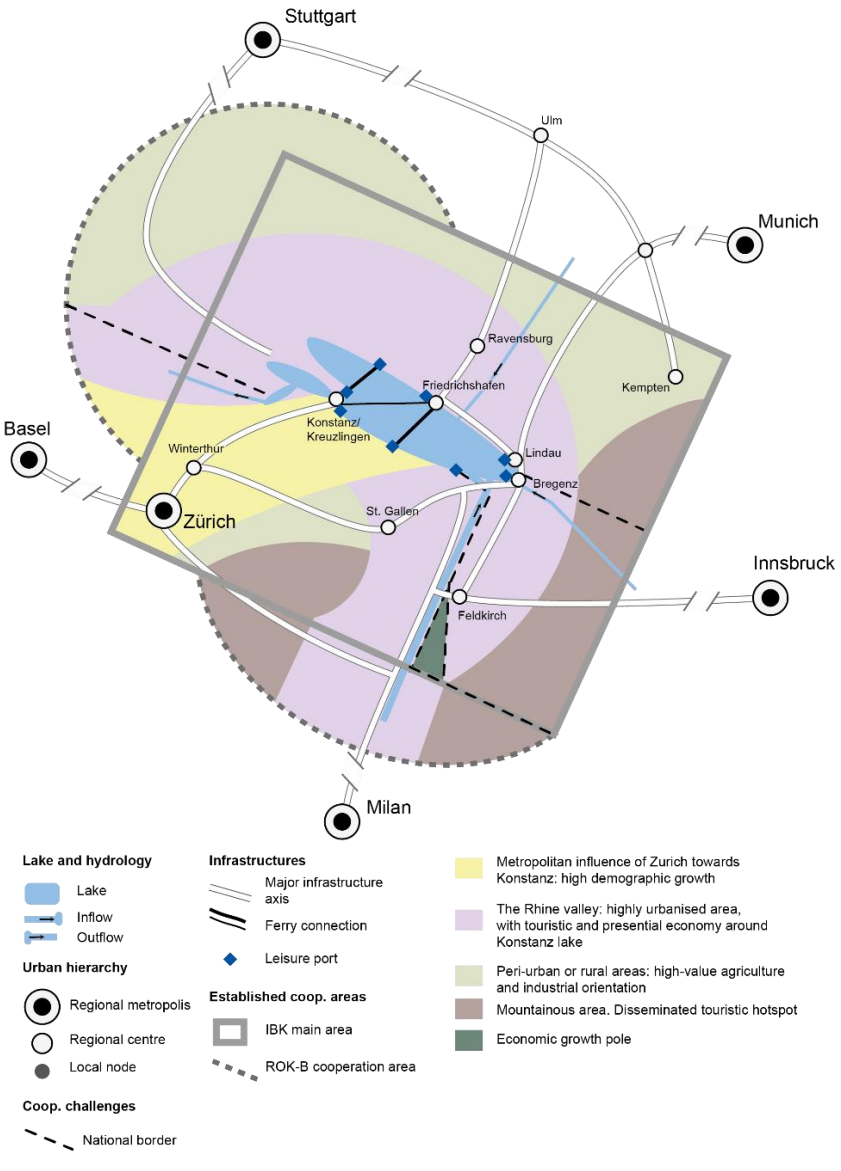
[33] https://www.bodenseekonferenz.org/bausteine.net/f/11363/Brosch%c3%bcre_Konzept-Pandemieplanung-IBK-2021_interaktiv_NEU.pdf?fd=3

4 Status quo in a nutshell

Following the territorial analyses of the LAKES project a **mapshot** was developed which allows a condensed view on territorial structures in the Lake Constance region (see Figure 6). It highlights different aspects characterising the region. Firstly, a challenge in this region is its cross-border character including four countries. Secondly, the mapshot illustrates the polycentric organisation of the region with several regional centres and surrounded by various regional metropolises. Thirdly, it differentiates five categories of territorial structures (based on ESPON ACTAREA project):

1. An urbanised area of closely connected settlements around Lake Constance and the following Rhine valley;
2. A growth area around Winterthur connecting the Lake Constance area with the Zurich metropolitan area;
3. In the southern and eastern parts mountainous areas with a high touristic relevance;
4. Liechtenstein as a growth pole of its own;
5. In particular, in the north but also parts of eastern Switzerland, (semi-)rural areas with a certain share of industrial and agricultural activities.

Figure 6 Mapshot of Lake Constance



Fourthly, the map shows some lake-related aspects. The Rhine in the southern part is the most important inflow to the lake. The illustrated inflows typify that the catchment area of the lake which is based on these inflows is highly interrelated with the lake itself especially with regard to water quality. Moreover, important infrastructure elements are included. They show on the one hand links of the region with the surrounding metropolitan regions and on the other hand lake-crossing connections. Between Friedrichshafen (DE) and Romanshorn (CH) as well as Meersburg (DE) and Konstanz (DE) car ferries are in place, while between Konstanz and Friedrichshafen a Katamaran is operated (passenger transportation). Important ports are also included as one element connecting land and lake.

The Lake Constance region is a diverse region with various assets and at the same time different demands that need to be balanced. The region is organised in a polycentric way and surrounded by metropolitan regions (Basel, Stuttgart, Munich, Zurich). The polycentric character is based on a settlement system with different medium-sized towns (e.g. Friedrichshafen, Ravensburg, Konstanz, St. Gallen, Bregenz) and rural regions. Moreover, economic functions are dispersed within the region (e.g. corridor Friedrichshafen-Ravensburg, Rhine valley, St. Gallen). The economy of the region can be described as dynamic and innovative. Especially around Friedrichshafen and in Liechtenstein industry plays a key role. The innovative character is also connected with an enormous number of universities. The attractiveness of the region as place for living and working is also reflected in a growing population with the highest rates in the Swiss parts. At the same time, the region as economically successful place is not very prominent. To gain more visibility between the metropolitan regions and to better connect it to them, e.g. with public transport is a shared concern within the region.

Furthermore, the region attracts a high number of tourists. The region serves as destination for daily tourists, as nearby recreation area as well as destination for overnight tourism. The lake attracts many German tourists, mostly from Baden-Württemberg. That also applies for daily trips, e.g. for people living in the metropolitan region of Stuttgart. At the same time Swiss people make use of the differences of price levels between Switzerland and the EU states, making daily shopping trips to the German side.

The cross-border character of the region is a particular situation in comparison with other lake regions. Different wage levels make it highly attractive to work in the Swiss parts of the region as well as in Liechtenstein. These cross-border commuting patterns are overlapping with domestic commuting patterns. The governance of the region builds on cross-border cooperation in different formats.

The lake is used in multiple ways, e.g. for leisure activities, fishery, transport. At the same time the protection of the ecosystem and the water quality are important issues. Water quality was improved in the last decades with major efforts, e.g. improvements of the waste water management. At the same time, this had enormous impacts on fisheries in the lake. The volumes of fisheries decreased significantly, and they are currently on a historically low level. The lake on the one hand connects places around the lake and on the other hand it connects the region with more distant areas. The lake management (management of water quality, fisheries and transport) is regulated with intergovernmental agreements and cooperation. These topics were starting points for early cooperation within the region.

The **SWOT-analysis** (see Figure 7) summarizes the strengths and weaknesses as well as opportunities and threats of territorial and governance structures of the region in a condensed way.

Figure 7 SWOT of Lake Constance, summarising the findings from previous sections

STRENGTHS	WEAKNESSES
Territorial aspects - Highly attractive place for living and working, growing population, economically dynamic region - High innovation capacities - Diversified touristic attractions, different types of tourism - Good water quality **Governance aspects** - Long tradition of cross-border cooperation - Established governance structures for a wide range of policy areas - Established structures for lake-related topics (water management, fisheries, shipping), continuous monitoring and research - Water protection measures are successful	**Territorial aspects** - As region with polycentric metropolitan functions not as 'visible' as other metropolitan regions - Transport connections, especially public transport connections within the region and to surrounding metropolitan regions could be improved **Governance aspects** - Cross-border character hampers the use of binding concepts and instruments on the lake-region level - Intensive coordination processes due to complex governance structures (e.g. multi-level mismatch)
OPPORTUNITIES	**THREATS**
Territorial aspects - Good fit of regional assets with focus on innovative economy - Amenity orientation of highly skilled labour force - High diversity of landscapes **Governance aspects** - Experience that coordination and development processes can work - Institutional thickness - Mutual trust based on long-standing cooperation experience	**Territorial aspects** - Effects of climate change - Disparities due to metropolisation processes - Demographic change, shortage of skilled labour force - Land take (endangering also protected areas close to the lake under high pressure), urban sprawl **Governance aspects** - Conflicts due to high demands of land and water use - Changes related to border-regime, e.g. border closures due to Covid pandemic

5 Participatory process: Towards integrated development

5.1 Starting points for participatory process

The focus of the ESPON Lakes Project is on spatial progress and integrated development opportunities of large lake regions. The underlying question is which elements help to foster integrated spatial development in lake regions.

Spatial planning is a key instrument of territorial development. In the Lake Constance region, spatial planning is a task of domestic politics. Within the multi-level system of the countries, a variety of plans and concepts are in place. For the whole region, questions of spatial development are tackled within the Spatial Planning Commission (ROK-B). A currently ongoing process aims at developing a concept for spatial development of the whole region. The so-called 'Zielbild Raum und Verkehr' (Vision for territorial development and transport) is part of the strategic priorities of the current 'Leitbild' of the International Lake Constance Conference (IBK). The process is coordinated by ROK-B and the IBK-Commission Transport and they concretise the more general strategic objectives. The underlying idea is to agree on common objectives for spatial development that are based on national and regional objectives of spatial planning. The concept develops different spatial categories. These categories are based on the development of settlements, mobility, landscapes and tourism. The concept is meant to complement concepts on the domestic level with regard to the cross-border context and give a framework orientation for other projects on the lake region level, e.g. Bodenrail in the transport sector.

Spatial planning in the lake region predominantly refers to the land use issues, sometimes including the shore areas and rarely referring to the water body. The lake as such remains a hardly addressed topic of spatial development. Even if the relevance of territorial dynamics for the water body is broadly accepted, the spatial planning perspective does not focus on coordinating the territorial and water related aspects in an explicit way.

The management of Lake Constance is part of intergovernmental agreements and commissions. Within these agreements, regulations for water protection, shipping and fishing are defined. The measures with regard to water quality take the lake and its catchment area into account. Within the catchment area, territorial impacts on the lake water result from waste water of settlements and agriculture. The lake is very much influenced by the intensity of shipping and built-up areas e.g. on the shorelines. Shorelines are the connecting element between spatial planning concepts and water related regulations.

Summarizing the situation, development policies of the lake region have different dimensions: The lake management is organised in a rather sectoral way. The international agreements and commissions tackling lake management issues are established and good-functioning. Spatial planning is a key instrument of territorial development even if its role has been very limited due to the cross-border context. The current process on the 'Zielbild Raum und Verkehr' makes a step towards spatial integrated policies.

Furthermore, cross-sectoral planning and integrated spatial planning play a key role for the Lake Constance region.

Cross-sectoral planning:

Numerous sectoral perspectives are interlinked on cross-border level, e.g.:

- guidelines of the water protection commission (Bodenseerichtlinien) on cross-border level that formulate requirements to various other sectors (waste water, agriculture and forestry, fisheries, constructions on the riparian and swallow water areas and in the lake) and in a more general sense to spatial planning
- Cooperation of International Commissions for water protection on lake Constance with water protection commission on the Rhine, commissions referring to fisheries and shipping are included in international agreements
- Cooperation between IBK-Commission transport and ROK-B for the development of the new framework concept

The cross-sectoral perspective also has a multi-level dimension, e.g.:

- The spatial plan (Richtplan) of the Kanton Thurgau refers to the guidelines of the water protection commission to with regard to number of boats and moorings

Integrated spatial planning:

Domestic level:

- On regional level several spatial planning documents are established:
    - In Germany: regional plans on the level of planning regions (Regionalplan / Planungsregionen); in Baden-Württemberg, the Lake Constance region is incorpated in the federal state planning, including separate riparian planning, even if it is rather old (Landesentwicklungsplan from 2002)
    - In Austria: planning on the level of the state Vorarlberg and existing spatial vision (Raumbild Vorarlberg 2030)
    - In Switzerland: regional plans (Richtplanung) on the level of the Kantons, this also includes planning of riparian areas, moreover strategic documents within a special programme for agglomerations (also cross-border including Vorarlberg and Liechtenstein, the programmes enable financial support from the federal government with a focus in transport and settlement development), efforts to establish the region as metropolitan region (also together with Vorarlberg) (→ Initiative Metropolitanraum Bodensee)

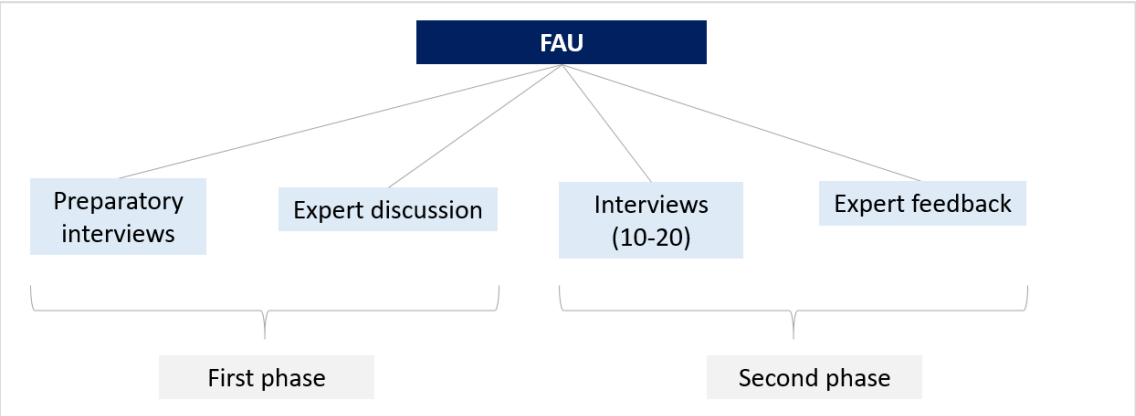
Cross-border level:

A framework concept is currently under development. The concept is developed by the Spatial Planning Commission (ROK-B) and the IBK-Commission which is responsible for transport development. The focus of the framework concept is on settlement and transport development. It is politically embedded in the Leitbild of the IBK and will as final step be approved by the Conference of Heads of Government. Moreover, the International City Network (ISB) and the International Parliamentary Conference (IPBK) will participate in form of a hearing. But it serves 'only' as strategic document and makes no binding regulations as the competences for spatial planning are on the domestic level.

5.2 Methodological framework

The participatory process in the Lake Constance region included two rounds that allowed for feedback loops (see Figure 8). The first round served to develop perspectives, the second round to validate them. In parallel, semi-structured interviews were conducted to accompany the process.

Figure 8 ESPON Lakes Participatory Process Lake Constance



5.2.1 First Round

The first phase included preparatory interviews to concretise the thematic focus for the process. Key questions of cross-border spatial development and land-lake interactions are in the centre of the participatory process.

In an expert meeting (18.5.2021), we discussed the relevance of the land-lake topic for the Lake Constance region and further elaborated the topic. Participants of the expert discussion:

- Marion Hammerl, Lake Constance Foundation, Stakeholder of Lakes project
- Klaus-Dieter Schnell, IBK, managing director
- Ueli Strauss-Gallmann, former ROK-B president and contractor for the development of the framework concept

5.2.2 Second Round

After the expert discussion, interviews were conducted with experts in the fields of sectoral policies and spatial planning (see Table 3). Furthermore, as a synopsis of the ideas including results of document research, the expert discussion and the interviews an internal synthesis was formulated. It reflects on the idea and relevance of land-lake-interactions for integrated spatial development in lake regions. As last step, the non-paper was sent to the participants of the expert discussion to get feedback or comments on it.

Table 3 Interview participants in the second round of the participatory process

Martin Wessels	Institute for Lake Research Langenargen, institute with a central role in the IGKB
Markus Böhm	Internationale Bodensee Tourismus GmbH
Jan Baer	Fischereiforschungsstelle Baden-Württemberg, expert for Baden-Württemberg in the IBKF
Ute Stegmann	German Lake Constance Tourism GmbH
Patrick Ruggli	Chairman IBK Commission Transport, Head of Public Transport Office Canton St. Gallen
Susanne Gatti	Chairwoman ROK-B until the end of May 2021, Cantonal Planner Canton Schaffhausen
Eduard Stützle	Lindau District Office, responsible for local public transport, IBK Commission Transport
Jonas Metzger	Ministry of Transport Stuttgart, Commission member BW IBK Commission Transport
Bänz Lundsgaard-Hansen	Federal Office for the Environment Switzerland, management IGBK until end of June
Stefan Obkircher	Regional Planning Vorarlberg, Member ROK-B
Wilfried Franke	Director of the Regional Association Bodensee-Oberschwaben
Frank Weber	Managing Director Bodensee-Schiffsbetriebe GmbH
Frank Hämmerle	President Lake Constance Council
Sebastian Wilske and Jean Michel Damm	Association Director Regional Association Hochrhein-Bodensee and new Chairman of ROK-B and staff member

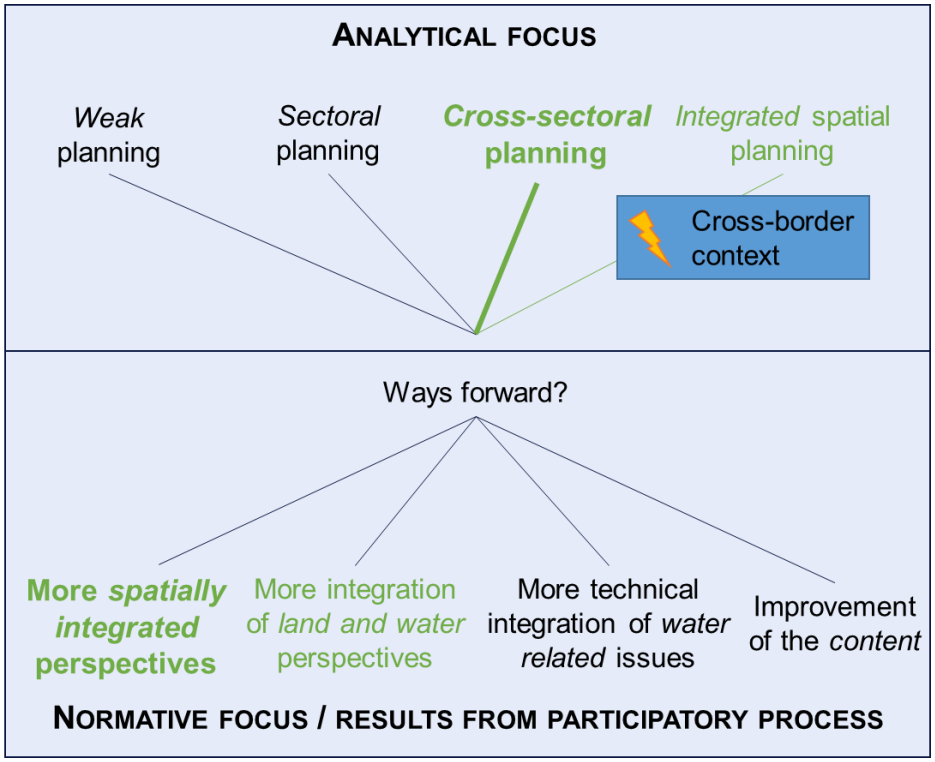
5.3 Results of the participatory process

5.3.1 Towards integrated spatial development

The results from the case study can be presented in a condensed manner (see Figure 9). In the Lake Constance region, **cross-sectoral and integrated spatial planning** play key roles at the moment and the cross-border context is of major importance. Under the umbrella institution of the IBK, the relevant policies have a systematic framework also in the cross-border functioning. However, spatial planning is only now starting to become a more prominent policy. Numerous sectoral perspectives refer to each other. Despite a high number of integrated number of concepts on domestic level, a planning competence does not exist on the lake region level. The framework concept including spatial and transport development are currently under development (Zielbild Raum und Verkehr).

Generally speaking, territorial development does not often address the lake in an explicit way. Therefore, we also focussed on land-lake-interactions at the cross-border level (=lake region level) in the participatory process. In a nutshell, the participatory process indicated that **more spatially integrated perspectives** and **integration of land and water perspectives** remain to be the focus of the way forward. In particular, the land-lake interactions bear a potential for further development.

Figure 9 Results of the Lake Constance case study in a nutshell



Besides this exploratory topic of deepening of land-lake-interactions on cross-border level (**more integration of land and water perspectives)**, **more integrated spatial perspectives** are still an issue in the region. Cross-border mismatches are an ongoing challenge towards more integrated spatial perspectives. The interviews of the second phase showed that some arguments relativize the potentials of addressing land-lake-interactions in a more prominent way, in particular with regard to the cross-border context. A series of challenges has to be solved on the concrete and local level and not necessarily on a higher level. Moreover, the political will for further cross-border concertation has to be seen in a realistic way. The region faces relevant challenges that are not directly related to land-lake interactions but are, nevertheless, highly relevant (e.g. high land demand, invasive species in the lake, climate change effects and adaptation strategies in general). Against this background, it seems crucial that moving forward means to develop a successive, careful strategy.

Considering instruments that affect the Lake Constance region, the following findings emerged during the participatory process:

Legal instruments: As there are no spatial planning competences on the cross-border level, it is important to refer to the lake on the domestic level. The participatory process indicates, that the interactions between land and lake should be taken into account in national planning documents, e.g. in the context of the update of the state development plan of Baden-Württemberg.

Incentives and support tools: The INTERREG A programme is an important cross-border funding option for the region. Therefore, continuation of close cooperation with INTERREG A Programme Alpine Rhine - Lake Constance - High Rhine (EU) is of high relevance. Furthermore, the Lake Constance region is also part of the INTERREG B Programme Alpine Space and some projects already build on Alpine Space funding. Additionally, to the INTERREG A programme the B programme is a good cross-border funding option.

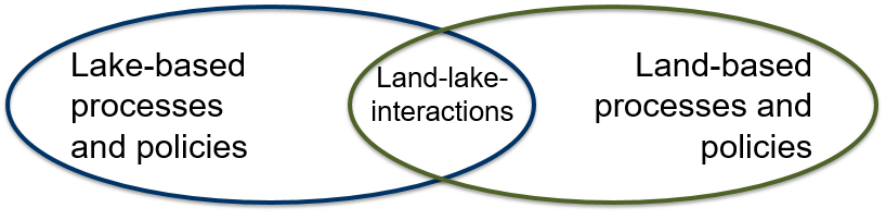
Soft instruments: Exchange formats on temporary not institutionalized basis to address land-lake interactions on regional and local level are important. These problem-oriented exchange formats allow to address concrete issues of land-lake-interactions. Moreover, the relevance of addressing land-lake-interactions in strategic sectoral processes and documents was emphasized. Sectoral documents can address land-lake-interactions in a strategic way together with sectoral questions on land or the lake. It seems obvious that the currently ongoing strategic processes on cross-border spatial development should be continued. Further elaboration of cross-border planning perspectives based on a framework concept for spatial development and transport are highly relevant. Besides, a more intensively exchange of ROK-B with other actors to include land-lake-interactions in cross-border spatial development perspective was mentioned in the process. An involvement of other actors especially environmental and lake actors into cross-border spatial development processes could broaden the focus.

5.3.2 Land-Lake-Interactions in the Lake Constance Region

The presence of a lake is an important characteristic of any ‘lake region’: It has an important impact on the spatial structure and, thus, on a series of policies, including transport infrastructure, environmental policy and tourism.

The relations between the territorial parts of the region (‘land’) and the lake itself (see Figure 10) are often not explicitly tackled in lake regions. On the one hand, many water related policies (e.g. shipping, fishery, and water quality) address the management and development of the lake. On the other hand, a series of land related policies are in place, coordinated to a varying extent by spatial planning instruments. Some of the latter handle the lake as a black box, for example in cartographic representations where the lake appears as one homogenous and somehow ‘empty’ space (cp. the Vänern case study of the ESPON Lakes project).

Figure 10 Land-lake-interactions (Own draft, see ESPON Policy Brief MSP and LSI[34])



[34] ESPON (2020): Maritime spatial planning and land-sea interactions. Policy brief. https://www.espon.eu/sites/default/files/attachments/Policy%20Brief%20MSP-LSI.pdf#viewer.action=download.

Firstly, land-lake interactions comprise *direct*, physical connections between the lake and the surrounding land areas. Drinking water pipelines are an obvious example. The shore area as physical contact zone is in the core of this question as the diverse functions meet in an often competing way (leisure demand, ecological sensitivity). Harbours and landing stations for ferries are the physical meeting points for transport purposes.

Secondly, land-lake-interactions comprise *indirect*, functional connections between land and lake. This addresses the question if the lake has a certain barrier function between two territorial poles on either side of the lake, e.g with regard to transport and large-scale touristic flows triggered by the lake as attracting pole. Obviously, the direct infrastructure relations and the indirect functional interlinkages are closely interlinked.

In short, we understand land-lake-interaction as physical and functional interlinkages that concern developments on both 'sides'.

This argumentation shows parallels with the debate on maritime spatial planning and integrated coastal zone management: In recent years, the linkage between maritime seas and the land was put on the agenda of spatial development debates. In the shadow of maritime policies, there might be good reasons to start a similar reflection on land-lake-relations.

Lake Constance region is a particular example as it is characterised by a complex cross-border context. The lake is the interface of three national systems (AT, CH, DE) in close distance to a fourth state (LI). The situation of the lake as a condominium increases the necessity of continuous cross-border cooperation.

This context multiplies the challenges for addressing land-lake-interactions as the frictions linked to national borders frequently come into play. Figure 11 captures the current state in a simplified way. It illustrates that water related policies and territorial development are intensively addressed on the domestic level. Land-lake relations do play a role, but in a modest way. On the cross-border level, the situation is different: Whereas water related policies are in place and function rather smoothly, spatial planning and development only starts to be an instrumental policy. Land-lake relations play a rather implicit role.

Figure 11 Challenges for addressing land-lake-interactions

	'Lake' (water related policies)	**Land-Lake-relations**	**'Land'** (spatial planning and development)
Cross-border lake region	++	(-)	(+)
Domestic	++	+	++

+/- maturity of regulations

To be more concrete: On the domestic level, the regions that are riparian to the lake refer in their plans to a series of land-lake interactions, including the following examples:

- protection of drinking water (e.g. Landesentwicklungsplan Baden-Württemberg, Agglomerationsprogramm Kreuzlingen-Konstanz)
- protection of riparian areas (e.g. Uferpläne Baden-Württemberg, Regionalplan Allgäu, Richtpläne Thurgau and St. Gallen)
- excursion boats and ferries (e.g. Regionalpläne Bodensee-Oberschwaben, Hochrhein-Bodensee and Allgäu, Richtpläne Thurgau and St. Gallen, Agglomerationsprogramm St. Gallen-Bodensee).

Whereas some documents include several land-lake-interactions, not all do so, e.g. not all spatial plans include statements on the protection of the lake as drinking water reservoir.

On the cross-border level, a series of international agreements exist that define regulations for water protection, fishery or shipping. Concerning water protection issues, the key guidelines (Bodenseerichtlinien) relate also to land based issues like agriculture or constructions in the riparian and shallow water zone. They

formulate the demand for spatial planning to take care of territorial developments not to influence the lake negatively.

The formal competences for spatial planning are located on the domestic level. On the cross-border level, the spatial planning commission is currently elaborating a 'target concept for spatial development and transport' which is based on the longstanding cooperation in the field of spatial planning. This document is of strategic, non-binding character. The draft documents address challenges related to the tourism dynamics and transport axes including ferry connections, but they remain rather implicit with regard to other land-lake-interactions.

The current situation in Lake Constance Region results from decades of cross-border cooperation and continuous efforts for coordinated development in sectoral policies and spatial planning. The question now is if addressing land-lake-interactions in a more explicit way is a promising path to follow and how this could be organised.

Several strong arguments plead for a more explicit addressing of land-lake-relations: In particular, the functional perspective focuses on the reduction of barrier effects. In the transport sector, the Bodanrail project is an instructive example. It aims at a coordination of train connections *around* Lake Constance and is also linked to transport *across* the lake (e.g. a more frequent operation of the ferry between Friedrichshafen and Romanshorn or the establishment of a full ring of train connections around the lake). Furthermore, an interlinked perspective helps to balance competing demands, e.g. in the sensitive shore areas.

Concrete topics that might be of interest for better addressing land-lake interactions in the cross-border context could include the following:

- Cross-border development of riparian areas, e.g. paths along the lake, ports and moorings
- Joint responses on to lake-related tourism impact on the environment, touristic use of riparian areas, overloaded hotspots
- Climate change adaptation strategies
- Shore area management
- Cross-border strategic development of transport issues reducing the barrier effect of the lake
- Management of still relevant water pollution sources (use of pesticides in agriculture, temporary sources of pollution like construction sites)
- Coordination of thermal use of the lake water (technical information are provided by the IGKB, see MAS Raumplanung 2015/17 concept EnergieNährBodenSee[35])
- …

At the same time, some arguments relativize the potentials of addressing land-lake-interactions in a much more prominent way, in particular with regard to the cross-border context. A series of challenges has to be solved on the concrete and local level and not necessarily on a higher level. Moreover, the political will for further cross-border concertation has to be seen in a realistic way. The region faces relevant challenges that are not directly related to land-lake interactions but are, nevertheless, highly relevant (e.g. high land demand, invasive species in the lake, climate change effects and adaptation strategies in general). Against this background, it seems crucial that moving forward means to develop a successive, careful strategy. In particular, the following perspectives are relevant for developing on land-lake interactions:

A) Ad hoc actions and technical cooperation

An important format to address land-lake-interactions is the exchange on an ad-hoc and not institutionalized basis. Two concrete examples illustrate this:

- Temporarily limited exchanges within the framework of the IBK are appreciated by the stakeholders and seem to be a good tool with regard to conflicts of interest, e.g. Symposium 'Pesticides in Agriculture'. The example is relevant for the link between water protection and agriculture.

35 https://masraumplanung.ethz.ch/studienprojekte/abgeschlossene-studienprojekte/Bern1.html

- Concrete construction projects on harbours and tributaries may have effects on the water quality of the lake. In such cases, the dialogue between the project stakeholders and IGBK is useful.

Maintaining these rather technical and reactive formats of addressing land-lake relations seems to be necessary.

B) Strategic sectoral project base

Furthermore, land-lake-interactions can be addressed in a more strategic way in sectoral policies: The already mentioned Bodanrail project is a good example as it develops a concept that aims at improving cross-border public (train) transport in the Lake Constance region, across the lake and in relation with the surrounding regions. It develops proposals to improve the cross-border train connections and to increase the operating time of the ferry between Friedrichshafen and Romanshorn. This sectoral strategic process of the IBK-commission transport aims at improving cross-border public transportation and also at reducing the barrier function of the lake. As the competences in this sector are on the domestic level, the concept develops ideas but leaves the concrete implementation to the domestic institutions.

This kind of rather large-scale projects can serve as a trigger of cooperation intensification and a stronger reflection of land-lake-relations. Their potential is to link concrete problem solving approaches with strategic processes.

C) Integrated spatial development and planning

Spatial development and planning has the potential to integrate different sectoral policies and foster strategic perspectives. Currently, the framework concept on spatial development and transport ('Zielbild Raum und Verkehr') is developed. This process is based on the cooperation of the Spatial Planning Commission (ROK-B) and the IBK transport commission. After more than twenty years of rather general reflections on spatial development, this is an important step of concretization. It is obvious, that this first step of explicit cross-border planning perspectives should be carried forward.

In parallel to the formulation of strategic documents, the procedural aspect is important. An exchange of ROK-B with other actors (e.g. IGKB, the IBK-environmental commission) could address the need for a spatial development perspective that stronger includes land-lake interactions. Such an exchange could pave the way towards a continuous communication between these actors or be a basis to include land-lake-interactions more intensively in cross-border spatial development. In the long-term this could be taken up in an update of the framework concept.

Both the concept development and the institutional dimension can be regarded as important for a stronger integrated perspective.

The interviews conducted in the framework of the ESPON lakes project have shown that all three approaches have their potential. At the same time, they have to be seen against the background of the ongoing challenges of cross-border cooperation in general. Integrated spatial development means both – addressing development across political borders and across the boundary between land and lake.

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Annex

Table 4 List of spatial planning documents included in the analysis

Leitbild und Strategie der Internationalen Bodensee-Konferenz (IBK) für die Bodenseeregion
(Interreg V-A) DE-AT-CH-LI - Germany-Austria-Switzerland-Liechtenstein (Alpenrhein-Bodensee-Hochrhein)
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Regionalplan Bodensee-Oberschwaben (DE)
Regionalplan der Region Allgäu - Ziele und Grundsätze
Raumbild Vorarlberg 2030
Zukunftsbild Agglomeration Rheintal AP4 Agglomerationsprogramm AP4 Grundsätze & Prinzipien zum Zukunftsbild
Agglomerationsprogramm Kreuzlingen-Konstanz 3. Generation Teilbereich Siedlung und Verkehr Zukunftsbild AP3

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