


Article

Integration of Ecosystem Services in Regional Spatial Plans in Western Switzerland

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Abstract: The concept of ecosystem services (ES) is regarded as an increasingly important framework and tool to support spatial planning. A limited understanding of how ES knowledge is used in spatial plans constrains our ability to learn from, replicate, and convey an ES approach. This study examined how ES were integrated into spatial planning at the regional scale in Western Switzerland. A directed content analysis of cantonal structural plans was used to assess how ES were covered in various sections of the plans and to explore the differences in the level of ES integration across cantons. First, the results showed that ES were found in each section of the plans but were not equally distributed. Provisioning ES were always the most mentioned while regulating ES were the least considered. Second, strong discrepancies existed between cantons may demonstrate the lack of cantonal coordination to integrate ES. Finally, the concept of ES was more embedded in nonbinding than in binding parts. Promoting the concept at the national level may facilitate the integration of ES at lower planning scales. Further work could focus on other cantons to ensure that the results are fully representative of the current situation in Switzerland.

Keywords: spatial planning; ecosystem services; structural plan; cantons; Switzerland

1. Introduction

Spatial planning is a key instrument for decision-making to coordinate human activities and minimize their negative impacts on natural and land systems [1,2]. It offers promising opportunities for more integrated management of different land uses in order to reduce conflicts, and achieve ecological, economic, and social objectives [3]. The main challenge in spatial planning is finding ways to organize landscapes, land-use, urbanization, the use of natural resources to meet requirements of society in terms of well-being, environmental quality, and economic prosperity, as well as safeguarding biodiversity [4,5]. In the last two decades, the ecosystem services (ES) concept has been considered a valuable alternative to address this challenge, as it is a broad and inclusive concept that allows for the quantification and qualification of multiple social benefits from ecosystems, and thus the consideration of landscape multifunctionality [6–8]. ES conceptual framework, mapping, and indicators have been developed as part of evidence bases for spatial plans [9,10]. At the conceptual level, Solozzi et al. [11] used a Delphi procedure with decision-makers to assess changes in ecosystem services to explore how ES could be integrated into spatial planning. At the instrumental level, ES knowledge can be used to guide specific decisions [12,13]. At the strategic level, ES knowledge provides support for plans and policies [6,14]. For example, a focus could be on building a tool or decision support systems (DSSs) [15], to support the allocation of urban development zones [16] or on a working method for realizing specific ES integrated with urban development [17]. At this level, ES knowledge is expected to help planners make sustainable land use decisions by providing a more comprehensive understanding of

trade-offs that may arise from them [18–20]. However, there is limited research on how policy-makers use ES knowledge in decision-making [11,21].

The limited understanding of how ES knowledge is used into spatial plans constrains our ability to learn from, replicate, and convey an ES approach [12]. To fill this gap, scientists have used participatory approaches to elicit the opportunities and limitations of using the ES concept into planning practices from key stakeholders [22]. Different methods have been used to include key informants. Fürst et al. [23] applied a score card tool to assess the performance of the ES concept in landscape planning and reveal the potential imbalances regarding the consideration of different ES groups in the Netherlands and Germany. Focus groups and interviews were also used to understand the limitations of ES use in planning in Stockholm at the municipal level [24]. Other work showed that participation approaches can be used to prioritize ES [25,26], but it did not discuss the integration of the ES concept in existing measures. Although elicitation approaches are useful to integrate place-based knowledge in decision-making and to gain a better understanding of how ES can be used for land use adaptation, they do not measure the actual implementation of ES into current planning practices.

Some studies reported the uptake of ES in planning practices by reviewing the content of documents, including strategic plans [27,28], strategic environmental assessments [2,29,30], and urban plans [14,31,32]. However, very limited research has yet focused on the integration of ES in spatial plans at the regional scale. Regional planning can be defined as the “spatial (re)allocation of land use activities, infrastructure, and settlement growth across a larger area of land for which a public regional planning authority is responsible” [33]. It is a multilevel and multisectoral activity that aims to minimize land use conflicts and favor synergies [33]. The main challenge is accommodating various public demands regarding areas which have the potential to provide different ES. Therefore, one may gain further understanding of the potential impact of planning decisions by comparing the level of reference to ES across regions, especially in countries where regional differences in the extent of policy implementation may be expected (e.g., in a federal system) [34].

In Switzerland, regional planning represents the center piece of spatial planning [35]. The federal system creates some regional (hereafter cantonal) discrepancies in the implementation of national land use or other policies (e.g., agricultural) that may affect the provision of ES. The regions (hereafter cantons) also have some leeway in the interpretation of national policies, which may lead to different levels of integration of ES. Research on the current and future state of ES has been conducted at the field scale [36] and regional scale [37,38]. Grêt-Regamey et al. [16] developed a DSS [15], to integrate ES in future urban development zones, which can be used over the entire country but did not include an analysis of cantonal spatial plans (hereafter structural plans). Cantonal structural plans are the centerpiece of spatial planning in Switzerland [39]. Cantonal structural plans are made of three main sections: context, strategy, and operation. It is important to note that only a limited amount of contents is binding and set the actual actions that will be implemented in the canton. They have a broader scope covering aspects such as transportation, urban development, energy supply, or landscape preservation. Hersperger et al. [34] analyzed the integration of landscape goals at the cantonal level but this did not focus on the entire document and fell out the ES framework. Switzerland is a relevant study area to attempt to address the underrepresentation on ES integration in spatial plans at the regional scale in the literature.

The aim of this research is to assess how ecosystem services are integrated into spatial planning at the regional scale in Switzerland. The first objective is to evaluate how ES are covered in various components of the structural plan. The second objective is to explore the differences in the level of ES integration into structural plans across cantons. The final objective is to evaluate the potential differences in the integration of ES in binding and nonbinding parts of the document.

2. Methods

2.1. Study Area

Switzerland is a landlocked country of approximately 4.1 million hectares (ha) with a large topoclimatic gradient (altitude: 196–4634 m a.s.l.) [40]. Switzerland is a federation of twenty-six sovereign states called cantons. Each canton has its own government and parliament. Cantons are further divided into districts and municipalities, which results in decentralized political power, and potential discrepancies with regards to the implementation of land management strategies. We note that the districts are not political entities but only administrative units. In 2009, agriculture covered 35.9% of the land surface area, while wooded areas and urban areas accounted for 31.3% and 7.5%, respectively. Urban areas grew by 23.4% at an annual growth rate of 0.9%, mostly at the expense of agricultural areas between 1985 and 2009, which decreased by 5.4% over the same period [41]; unproductive areas such as glaciers also decreased by 1.1% [41]. We note that wooded areas grew between 8 and 28% in the Alps and Southern Alps, respectively, since 1985, for a total increase of 3.1% [42]. Switzerland has a relatively high population density and demographic growth compared to other European countries, so that urbanization has defined landscapes and land use patterns in recent decades [43].

2.2. Framework for Analysing the Integration of ES into Structural Plans

In Switzerland, spatial planning is guided by the Federal Act on Spatial Planning of 1979. The Act stipulates that all cantons must draft a comprehensive plan as the main tool for territorial management. The main objective of the structural plan is to coordinate all activities with an impact on the spatial organization of a territory [39]. Activities tackled at the cantonal scale are, for instance, water management, resource management, energy provision, transport or tourism. In this research, we analyzed seven structural plans from the seven full or partial French-speaking cantons in Western Switzerland (Figure 1). The cantons were chosen because they are members of the Association of Western Planning and Urbanism Offices (CORAT), and their structural plans were translated and available in French. The plans can be accessed through the Federal Office for Spatial Planning [39].

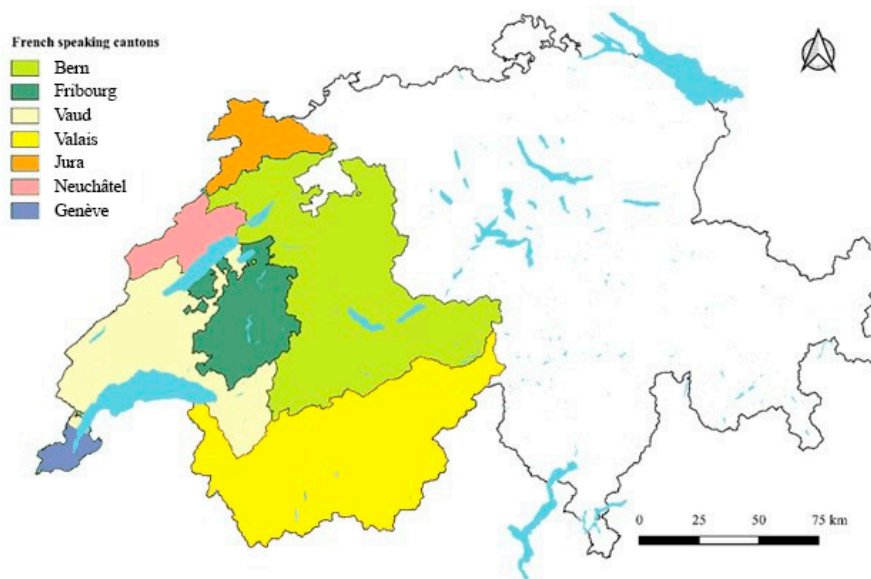


Figure 1. Full or partial French-speaking cantons in Switzerland.

We drew on directed content analysis to explore the integration of ES into cantonal structural plans. We considered that an assessment at the cantonal level was appropriate because it is the main planning scale in Switzerland. In addition, it is particularly adequate for ES integration since regions have administrative boundaries that more closely follow natural features (mountain ranges, watersheds, etc.) than municipal boundaries [23,44].

A directed content analysis was performed by dividing the documents in two different stages, reading all the content and identifying ES related measures using the three ES categories: regulating, provisioning, and cultural, according to the CICES classification v4.3 [45]. It is important to note that directed content analysis focuses on plans themselves and not on the outcomes they produce [46,47].

Planning often has established practices which may limit the explicit mention to “ecosystem services” [2]. In addition, the different wording used in the field of ES makes the use of a keyword-based analysis inappropriate [2,29,48]. Hsieh and Shannon [49] recommended using directed content analysis to support and extend an existing theory as well as identifying key concepts and variables throughout the documents. We chose to perform a deeper content analysis that accounts for the implicit use of the ES concept [14,50].

Following the guideline of the Federal Office for Spatial Development and the report from Messer et al. [51], the cantonal structural plans were divided into two different stages: (1) the strategic section and (2) the operational section (Figure 2). We note that most plans included a short (e.g., few pages long) context section, as an introduction to the role and the history of the plan in the broader planning process. Since the context was not available for all plans (e.g., Geneva and Jura), and the main action lines referred to the operational subsections, we excluded it from the analysis.

The strategic section is a few tens of pages long and focuses on the main strategic themes and corresponding objectives. We note that these may be named differently in the various plans. For example, in the canton of Vaud and Neuchatel, the strategic themes are named strategies and policy priorities, respectively, while the objectives are named action lines in both plans. For consistency, the term strategic objectives will be used. The operational section relates the operationalization of strategies using thematic sheets, divided in measure sheets and project sheets. For the purpose of this study and consistency across plans, only measure sheets were analyzed. The measures are tools to implement the strategies.

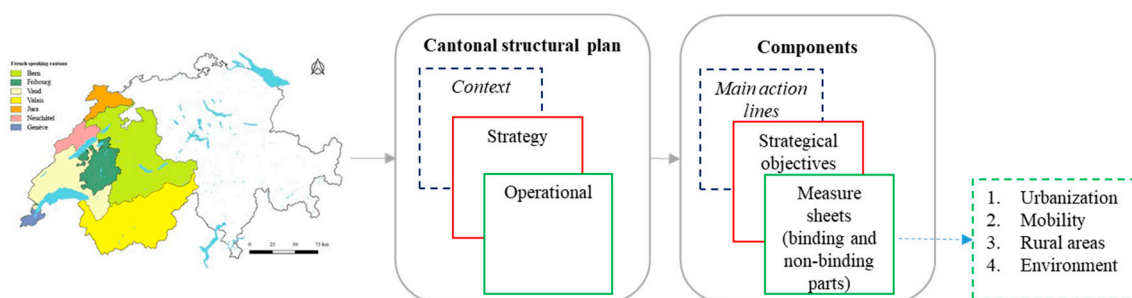


Figure 2. Conceptual framework for the subdivision of cantonal structural plans.

Measure sheets have binding and nonbinding parts. Binding parts typically include the measure statement, the implementation principle and the division of competencies, while nonbinding parts detail the problem statement and an explanatory report. Cantons split the operational section in several subsections where measure sheets are classified. However, there is no consistency in the number and in the denomination of subsections [51]. As a preliminary step, we reviewed each operational section and identified the four most recurring subsections. We reclassified the measure sheets in four subsections: urbanization, mobility, rural areas, and environment to ensure consistency between operational sections (Table 1).

We note that cantons are not obliged to implement a monitoring system for all measures. For example, the canton of Neuchâtel set a monitoring and controlling office as well as a set of indicators to assess change and its effectiveness, while others are still developing it.

Table 1. General themes from the four operational subsections in cantonal structural plans.

Urbanization	Mobility	Rural Areas	Environment
Urban areas	Public transport	Agricultural areas	Surface water management
Densification	Freight	Building outside building zones	Groundwater management
Building and nonbuilding zones	Mixed mobility	Ecological networks	Water supply
Commercial areas	Civil aviation	Landscapes	Air quality
Tourism	Individual transport	Natural hazards	Energy production
Public infrastructures	Soft mobility	National parks	Remediation sites
Industrial areas		Biotopes	Mineral extraction

2.3. Directed Content Analysis

In general, planning has a long history of recognizing the benefits of natural resources and natural areas, as well as its contribution to well-being without using the specific term “ecosystem services” [28,52]. Directed content analysis can be used to identify key concepts and variables throughout the documents [49,53], and to account for this lack of consistency in the terminology, we captured every time the plan discusses explicitly or implicitly about the benefits ecosystems provide. However, we excluded general statements about environmental protection, landscape preservation, or building green areas, as there is no benefit associated with it, in accordance with previous work [31,50].

2.3.1. Integration of ES in Structural Plan Components

For each stage, we calculated the recurrence of explicit and implicit mentions to each ES category. To cope with different linguistic preferences between cantons, we used a binary coding system of 0 and 1 and limited the number of mentions to one per strategical objective or measure sheets. A strategical objective or measure sheet that mentioned an ES explicitly would receive a score of 1. We summed the binary scores to give a total number of ES mentions in the plan sections (e.g., strategical sections and four operation subsections). This is in accordance with a previous work using content analysis that counted and added textual elements [44,50]. The number of strategical objectives and measure sheets varied across cantons. For example, Vaud had 58 measure sheets while Geneva had 43. Therefore, we relativized the total number of mentions by the number of strategical objectives or measure sheets in each section to measure the relative frequency of ES mentions for each plan section, and multiplied it by 100. The maximum result of 100 meant that an ES category was mentioned in all strategical objectives or measure sheets, while the minimum result of 0 meant that an ES category was not considered in the section. Finally, we averaged the results between cantons to get a general measure of ES integration in plan components.

2.3.2. Difference in ES Integration Across Cantons

The index and references sections of structural plans were not considered in this study, in accordance with a previous work [44]. However, the location of key terms or mentions of ES is crucial to evaluate differences in the integration of ES into structural plans across cantons. Whether ES are acknowledged lower or higher up into the document section, can be interpreted as the degree of importance given to the concept. In addition, Krippendorff [54] mentioned the need to develop a set of criteria for a quantitative measurement of plan quality. The rationale behind this process is to capture how well ES knowledge is embedded within planning, and ease comparison between

plans [46]. For example, acknowledging one ES in the operational section has less impact on planning than recognizing synergies and trade-offs, or the need for spatial-explicit information. Therefore, we developed a five-level coefficient system that accounted both whether the mention to ES was lower or higher in the plan and the level of ES knowledge included. We used the coefficient system to evaluate how ES were addressed across plan components (i.e., strategic section and four subsections of the operational section) (Table 2). The coefficient system was modified after previous work [14,29,55]. The assigned coefficients were cross-checked by the two authors of this research [27,29].

In the strategic section, the concept of ES may not be explicitly mentioned, so acknowledging the relation between ecosystems and well-being was considered more important than acknowledging for ES interaction. In the operation section, a measure stating that “cantons and communes should protect land crop rotation areas in a sustainable manner to prevent constructions and preserve its fertility” would be assigned a coefficient of 2, while a measure acknowledging ES synergies and trade-offs such as “agriculture is multifunctional, ensuring food production [. . .], and preserving landscape beauty at the same time,” would be assigned a 3. Finally, spatially explicit mapping of ES was recognized as critical for their integration in planning [16]. Therefore, it is assigned the highest score in accordance with previous work [14].

Table 2. Coefficient system to evaluate ES integration across plan components.

Coefficient	Strategic Section	Operational Section
0	No evidence of objectives related to ES	No mention of ES
1	Some objectives relate the preservation of ES	Mentions ES in the problem statement only
2	Acknowledges ES interactions	Direct mention of a single ES in the implementation principle and/or of ES interactions in the problem statement
3	Acknowledges the link between ecosystems and well-being	Acknowledges ES interactions such synergies and trade-offs in the implementation principle
4	Acknowledges that ES should be a priority for planning	Measures provide information on ES assessment and/or spatially explicit information

Finally, we conducted a comparative analysis at the cantonal scale. For each canton, we multiplied the relative frequencies of ES mentions with the coefficient obtained for each section and subsection of the structural plans. We note that canton-specific frequencies were used and not the aggregated result aforementioned. The output was aggregated to show the final score by canton and ES categories. This allowed for the identification of variable levels of integration of ES between cantons for each ES category.

2.3.3. Binding and Nonbinding Operational Parts

The measure sheets in the operational section are split into nonbinding and binding parts, which set the actual actions that will be implemented in the canton. Therefore, this may also be interpreted as a degree of importance given to ES. It is important to understand how ES mentions are distributed between binding and nonbinding parts of measure sheets. First, we calculated the recurrence of mentions to ES in binding and nonbinding parts, separately. Again, we limited the number of mentions to one per measure sheet and relativized the number of mentions by the number of measure sheets for each canton to get the relative frequency of ES mentions. Then, we developed a five-level coefficient system and used it to assess how well the ES concept was embedded in the two parts of measure sheets (Table 3). The coefficient system was different than the previous one (Table 2) because the coefficients had to be independent of the location in the measure sheets (e.g., problem statement, implementation principle, etc.) The objective was to capture the differences between binding and nonbinding parts.

Again, spatially explicit mapping of ES was recognized as critical for their integration in planning [16]. Therefore, it is assigned the highest score in accordance with previous work [14].

Table 3. Coefficient system for the analysis of binding and nonbinding operational parts.

Coefficient	0	1	2	3	4
	No mention of ES	One ES mentioned	Multiple ES mentioned	Acknowledges trade-offs and synergies	Acknowledges need for spatially explicit data

Then, the relative frequency of ES mentions was multiplied by the coefficient for each binding and nonbinding part of the measure sheets. The results were aggregated by ES category to give a total score of ES integration in binding and nonbinding parts independently in each canton. To show whether ES were more embedded in one part or the other, we calculated the difference between the total scores of the binding parts and the nonbinding parts. A positive result was interpreted as ES being better integrated in the binding part while a negative result meant that ES were considered mostly in the nonbinding part.

3. Results

3.1. Frequency of ES Mention in Structural Plan Components

There is a great variability in the representation of ES across plan components. Most ES were present in less than 50% of all structural plan components (Figure 3). The environment subsection was the second most representative component for all ES after rural areas, while mobility failed to address ES in more than 80% of all measures. While regulating ES (RES) were present in less than 20% of the strategies and measure sheets, more variability was observed for the provisioning and cultural categories. Provisioning ES (the acronym PES is not used to avoid confusion with payment for ecosystem services) were represented in 33% of strategic objectives. In the operational section, the representation of provisioning ES varied from 16% to 83%, in the mobility and rural areas subsections, respectively. A similar trend can be observed for cultural ES (CES), where the lowest representation was observed in the mobility subsection and the greatest in the rural areas subsection. In proportion, the representation of provisioning ES and CES followed a similar trend across components. For example, when provisioning ES representation was at the highest in the rural areas subsection, CES embedding also reached its highest level. On the contrary, both reached their lowest level in the mobility subsection. This was less clear for RES which were almost equally represented in the rural areas and environment subsections.

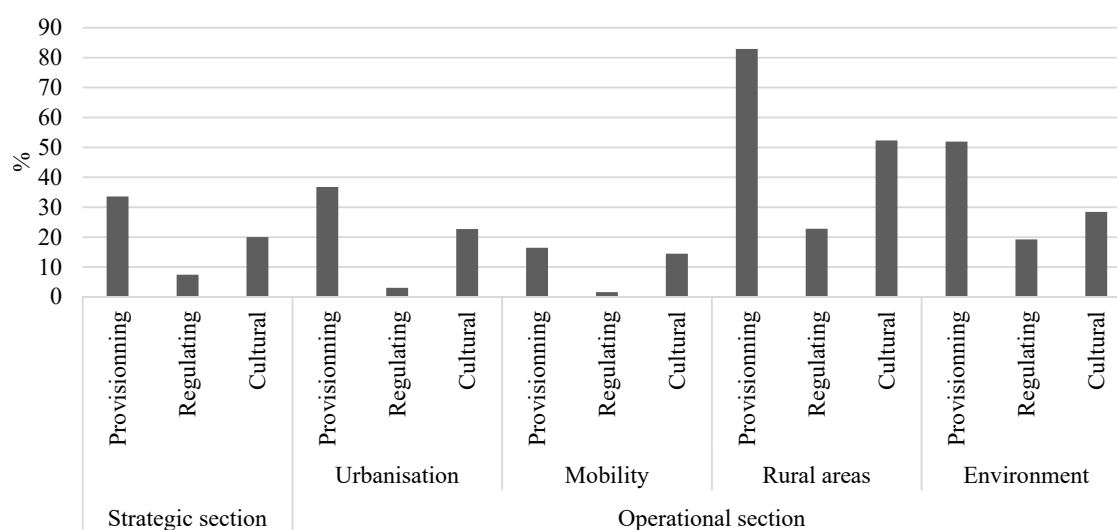


Figure 3. Frequency of ES mention in the different plan components.

We note that provisioning ES were always the most represented followed by CES and RES, which were always represented to a very low level (e.g., 3% in urbanization and 1.5% in mobility measure sheets).

3.2. ES integration Across Cantons

The final scores displayed in Figure 4 show the relative frequency of ES integration in structural plan components, multiplied by the coefficients obtained for the strategic section and each of the operational subsections (Table 2). RES showed the lowest representation across all cantons, while CES showed medium representation and provisioning ES scored the highest in all cantons. The final scores were 3.5 to 5 lower for RES than for provisioning ES. However, the results showed there were some differences within each ES category between cantons. The cantons of Valais, Vaud, and Geneva tend to stand out for all ES categories, with Valais scoring the highest for all categories. Vaud showed a higher score for the integration of RES than Geneva, while the opposite was true for provisioning ES and CES. The cantons of Neuchâtel and Jura almost displayed the same level of ES integration on aggregate with the former scoring better for CES and the latter for provisioning ES and RES. Finally, Bern was the canton with lowest scores across ES categories: 2 to 8 times lower than other cantons. For example, Valais had a score of 8.45 for CES while Bern had a score of 1.1.

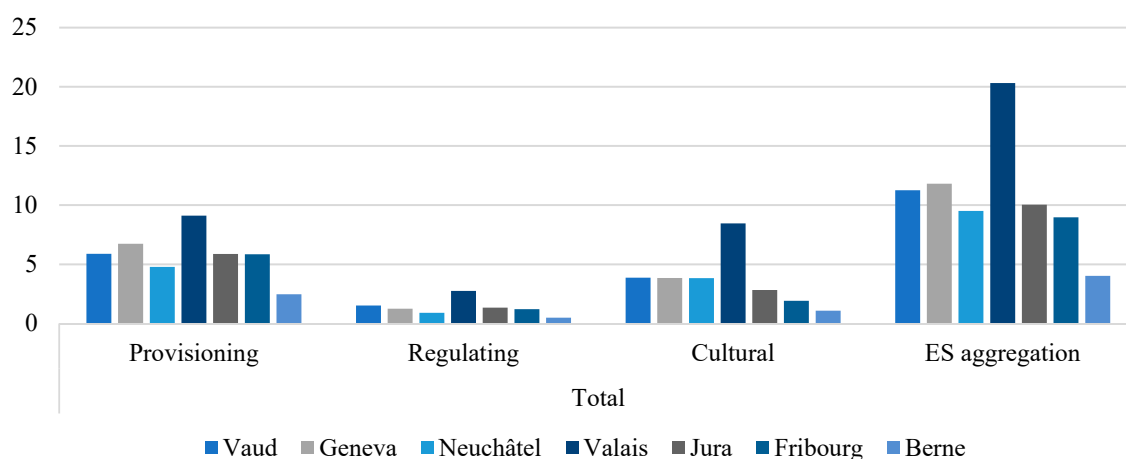


Figure 4. Ecosystem services integration across cantons “ES aggregation” is the sum of all final scores obtained for each ES category.

3.3. Binding vs. Nonbinding Operational Parts

Measure sheets in the operational section are divided into binding and nonbinding parts. Binding parts include the measure statement, the implementation principle and the division of competencies, and are binding for the authorities. The nonbinding parts are included into the measure sheets and are found under the terms problem statement and explanatory report. Figure 5 shows the cantonal differences in ES representation between binding and nonbinding parts for each ES categories. We note that the entire measure sheet was binding in the canton of Bern so the analysis could not be performed. First, some cantons performed better at integrating ES in the binding parts. Valais was the best performing one followed by Vaud and Neuchâtel. Although, provisioning ES and CES tend to be more present in binding parts in all three cantons, RES scored poorly. RES scores were even zero and negative for Neuchâtel and Vaud, respectively. The last three cantons—Geneva, Fribourg, and Jura—show a lower integration of ES in binding parts. While scores were always negative for provisioning ES and RES in the three cantons, it was positive for CES in Fribourg and Jura.

It is important to note that RES were the least represented ES category in binding parts, across cantons except in Valais where the score was slightly positive. On the contrary, CES tend to be better integrated in binding parts except in Geneva where the score was strongly negative. The results

were more mixed for provisioning ES, where positives scores were observed in Vaud and Valais, and negative scores were observed for the four others.

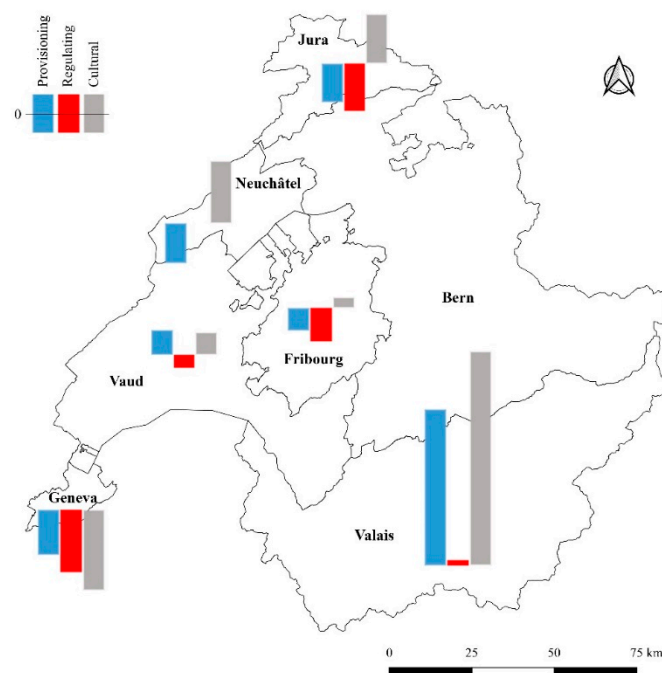


Figure 5. Difference in integration between binding and nonbinding operational components. The bar height tells how the extent of the difference in ES embedding.

4. Discussion

4.1. Discussion of Results

The integration of the ES concept as base for evidence in spatial planning has been increasingly promoted in the literature [16,31], as well as in policy guidelines [56]. Regional planning is particularly relevant for the integration of the ES concept because it aims to reconcile different land uses and weight the various public demand areas which have the potential to provide different ES [33]. Despite some advances in the analysis of its implementation in decision-making, particularly in strategic environmental assessments [2,29,44], little evidence is available in terms of ES integration within spatial planning across regions and within different sections of spatial plans. The results are discussed in four subsections: three addressed the research objectives and the last one addressed the requirements for coordination across cantons. We also provide a discussion of the methods.

4.1.1. Harmonizing ES Representation in Plan Components

In this study, a directed content analysis was conducted to explore the various levels of ES integration across full or partial French-speaking cantons in Switzerland. Cross-cantonal comparison is considered fundamental in the operationalization of ES-related research [14]. First, we showed that all categories of ES were found in each section of the structural plans (i.e., strategical section and four operational subsections). However, their presence was not equally distributed across sections and cantons, in accordance with other studies [32,57]. Provisioning ES were always the most mentioned services across all plan components, with the highest frequency found in the rural areas operational subsection. It shows the importance given to provisioning services in Switzerland, particularly food production, which has been part of planning in the country for decades [58]. This is translated through the federal requirement to preserve the best arable land in the country, also called land crop rotation areas (LCRA). The focus on LCRA preservation has progressively shifted from managing agricultural production to supporting spatial planning and the allocation of building zones [59]. We postulate that

the strong focus on provisioning ES failed to recognize the importance of other services, particularly RES. It also tends to confirm the previous hypothesis that the focus of LCRA could have a negative impact on other ecosystems, and potentially on their benefits [60].

Studies conducted at the urban scale also found that ES integration was generally greater in the operational section than in the strategic section. However, they also showed that CES, such as recreation, were the most recognized ES followed by RES [14,28]. Food supply was one of the least represented ES, which could be expected in the urban context. It shows that the scale of analysis has a strong impact on the results and care should be taken in the interpretation of results concerning ES priorities in spatial planning [61].

Interestingly, the integration of CES tend to follow the one of provisioning ES, proportionally. A possible explanation is the relationship between agricultural landscapes and CES such as leisure, landscape aesthetics, or heritage. In other words, cantons stipulated multiple times that there was a strong relationship between the forms of food production and CES. This is in accordance with reports from the Federal Office for Environment [62] and research in other contexts [63,64], but it is in contradiction with other work which showed that the synergy between agriculture and CES was weaker than previously thought in Switzerland [65].

4.1.2. Discrepancies in ES integration Across Cantons

A lower integration of RES was detected consistently across cantons. We note that references to flood regulation services were the most common in all plans. Others such as carbon sequestration were rarely mentioned. A possible explanation is the high importance given to water correction in the country to mitigate flood regulation and ensure water supply. Provisioning ES were most represented followed by CES, as shown by other research [13]. However, there were strong discrepancies in the level of representation of ES across cantons, where Valais tend to integrate ES better than other cantons and Berne was the least performing. It demonstrates the lack of coordination between cantons to integrate ES. In addition, missing directives on the integration of ES at the national level may lead to different interpretation of how ES should be included in land management policies, if at all. We also note that cantons may score poorly due to recurrent general statements about environmental protection, landscape preservation, or building green areas. However, these “keywords” do not stipulate any benefit that human may get from ecosystems. We postulate that lack of details in the cantonal structural plans may lead decision makers to miss the focus of ES preservation and address other topics which received more detailed explanation such as transport.

4.1.3. Binding and Nonbinding Integration of ES Across Cantons

The results from the analysis on binding and nonbinding operational parts confirmed that less attention was given to RES compared to provisioning ES and CES. Most cantons mentioned RES mainly in the nonbinding parts while the opposite was observed for CES, except for Valais, which discussed all ES predominantly in the binding parts. We previously mentioned that provisioning ES were the most represented category across structural plan components, followed by CES. However, the opposite was true when it came to making ES binding, except in Vaud. This shows that cantons tend to mention more evenly provisioning ES in both binding and nonbinding parts, but also give more importance to CES as an element of spatial planning.

Finally, we note that Geneva showed the lowest level of ES embedding in binding parts. It is also the most urbanized canton, with urban areas making up a third of the total surface area, where it makes up only 2.5% in Valais, which is also the least urbanized canton [41]. One may postulate that the integration of ES in structural plans is related to the level of urbanization, as cantons with the largest shares of agricultural, wooded, or unproductive surfaces integrated ES better as a binding element. It is acknowledged that the ability of urban ecosystems to provide services is often jeopardized by fast land use change [66,67], and that including them in spatial plans is crucial [50]. However, this can be limited by the current instruments and tools for mapping and assessing urban ES [68].

4.1.4. Requirements for Coordination Across Cantons

Albert et al. [69] pointed out that integrating ES in planning is highly dependent of the flexibility of governmental planning instruments, as integrating new elements may require active support from higher authorities. In Switzerland, spatial planning is guided by the Federal Act on Spatial Planning of 1979. The Act stipulates that all cantons must establish a list of priorities within their structural plan. They are also entitled to scale the areas that will be affected by urbanization, coordinate urbanization, and transport, as well as favor inner development (e.g., densification). In the Act, very little reference is made to environmental protection and no implicit or explicit mention is made to the concept of ES. There is no evidence that the concept of ES has been considered for supporting spatial planning decisions at the national level. In the same way, no cantonal structural plan included explicitly the term “ecosystem services” despite some reference to the Swiss Biodiversity Strategy which take up the ES concept. While Tzoulas et al. [70] showed that interdisciplinarity was crucial for addressing the complexity of the spatial planning process, Salet and Faludi [71] argued to move from interdisciplinary to multidisciplinary because planning requires knowledge within and across disciplines. A multidisciplinary team with deep theoretical understanding and empirical expertise from diverse fields, as well as some transdisciplinary practitioners, is needed to integrate ES [72]. However, the results showed little evidence of multidisciplinary between spatial planning and environmental planning. The two themes are divided between two different offices and little overlap seems to exist.

Integrating ES into spatial planning may be a promising approach towards sustainable development because it makes the benefits of ecosystems to humans explicit, as well as corresponding trade-offs with socioeconomic aspects such as urbanization [16]. However, it requires a shift of focus from urban development, also known as the urbanistic paradigm [2] of spatial planning, to a more holistic approach [2]. We argue that the cantonal structural plan is a strong tool to consider ES in territorial development. The different level of ES integration across cantons shows that beyond some requirements from the Federal Act on Spatial Planning, cantons have sufficient room to take up the concept of ES into the binding parts of their structural plans. However, promoting the concept at the national level may be key to facilitate the integration of ES at lower scales.

4.2. Discussion of Methods

In this study, a directed content analysis was conducted to assess how ES were integrated into spatial planning at the regional scale in Switzerland. Regional planning usually concerns spatial areas that are sufficiently large to study and address ecosystem processes [69]. In addition, cantonal structural plans are the centerpiece of spatial planning in Switzerland. Therefore, the scope of the analysis was particularly relevant for this study. We analyzed seven cantonal structural plans of full or partial French-speaking cantons. The number of reports was reduced given the scope of our study which was to focus only on members of the Association of Western Planning and Urbanism Offices (CORAT). We acknowledge that considering about 25% of total structural plans (7 out of 26 cantons) may not be fully representative of the current situation in Switzerland. However, the results were significant and could illustrate an overall picture of the current state of the relationship between ES and spatial planning in the country. Other studies only focused on a limited sample but drew significant conclusions on the integration of ES into planning [25,31,73].

Directed content analysis is more time-consuming than keyword-based analysis but allows for the inclusion of implicit mentions to ES. We acknowledge that directed content analysis is more prone to subjective interpretation than a keyword-based approach that would use a predetermined list of codes. However, the lack of consistency in ES terminology and linguistic preferences in cantonal structural plans made directed content appropriate in the research context. According to Hsieh and Shannon [49], two main challenges inherent to the use of a theory-based approach apply to this study and may lead to (i) finding evidence supportive of that theory and (ii) overemphasizing the theory by ignoring contextual information. We attempted to address these challenges by determining conditions to the identification of ES mentions. For example, we excluded general statements about environmental

protection, landscape preservation or building green areas. In addition, the scores were cross checked by all the authors of this research [27–29].

Kolbe and Burnett [74] recognized the potential methodological problems associated with directed content analysis and stressed the need to assess the nature of past applications. Based on previous work [75–77], we argue that it is a valuable and appropriate approach to conduct this type of study. It is powerful tool to perform in more in-depth analysis as it facilitates understanding between the relations between implicit and/or explicit mention of a concept [2].

5. Conclusions

The concept of ES is regarded as an increasingly important framework and tool to support spatial planning. While quantifying ES trade-offs and synergies is key for policy-makers, it is also necessary to understand the implementation of the concept at an operational level, through spatial plans. The focus on the regional scale has been considered important to including ES knowledge into planning but most work focused on the urban scale. This study aimed to assess how ES were integrated into spatial planning at the regional scale in Switzerland.

The first objective was to evaluate how ES were covered in various section of the structural plan. All categories of ES were found in each section of the structural plans (i.e., strategical section and four operational subsections). However, their presence was not equally distributed across sections, with a strong focus on provisioning ES that may omit the importance of other services. However, the integration of CES tends to follow the one of provisioning ES, proportionally. An explanation may be the relationship between agricultural landscapes and CES. This is in accordance with federal guidelines and research in other contexts, but recent work in Switzerland questioned the strength of the relationship between both elements. Further research is needed to adjust the prominence given to this relationship in spatial planning.

The second objective was to explore the differences in the level of ES integration into structural plans across cantons. A lower integration of RES was also detected, while provisioning ES were most represented followed by CES. However, strong discrepancies also existed, which may demonstrate the lack of coordination between cantons to integrate ES. The integration of ES in structural plans appeared to be related to the level of urbanization, as cantons with the largest shares of agricultural, wooded, or unproductive surfaces integrated ES better as a binding element.

The final objective was to evaluate the potential differences in the integration of ES in binding and nonbinding parts of the operational section. The concept of ES was more embedded in nonbinding operational sections than in binding section. We believe that the limited number of federal requirements to be included in cantonal structural plans provides the opportunity for cantons to take up the concept into the binding parts of their structural plans. However, promoting the concept at the national level could be the key to facilitate the integration of ES at lower scales. To further emphasize this, conducting a similar type of analysis on German-speaking cantons, and comparing the results would be a valuable addition.

Overall, directed content analysis was a valuable tool to understand how ES were integrated into spatial planning across regions. It provided the flexibility to cope with the lack of consistency in ES terminology and linguistic preferences in cantonal structural plans. The main inherent challenges of a theory-based approach are overemphasizing the theory and ignoring contextual information, as well as finding more supportive evidence of that theory. Future research may focus on further addressing these potential biases by combining content analysis with a keyword-based approach and comparing the results.

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