Article

Are spatial planning objectives reflected in the evolution of urban landscape patterns? A framework for the evaluation of spatial planning outcomes

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Abstract: The evaluation of spatial planning results, or outcomes, has been rather neglected by scholars and practitioners. The causes of this neglect are linked to the characteristics of the planning systems in use or difficulties in quantifying results. To advance the state of the art of outcome evaluation, this paper focuses on assessing the implementation of national spatial planning objectives in urban landscapes, through the use of an evaluation framework that makes use of spatially explicit information. The framework is built on four dimensions which reflect the main domains of spatial planning: efficient built-up development, conservation of agricultural land, landscape preservation, and human perception. Indicators capable of capturing landscape changes in both time and space are used to verify degree of conformance between adopted objectives and actual development patterns. We make use of spatially explicit data and assess whether and where landscape changes occurred, by integrating the framework into a multi-criteria analysis. In the present study, the framework is tested in two study areas in Switzerland and Romania, and the results are interpreted from the perspective of spatial planning approaches in the two countries. The efficiency and utility of the framework is demonstrated by its ability to provide valuable information facilitating improvement in the performance of planning processes, such as identifying where the implementation of objectives is less effective, and the domains of spatial planning that are affected. Our findings highlight that the distance between objectives and outcomes can be attributed to differences in countries' spatial planning approaches, particularly regarding landscape preservation and management. Our study provides valuable insights for the integration of time series of spatial data into the evaluation procedure.

Key words: planning evaluation; spatial planning objectives; urban landscape; spatial multi-criteria analysis; romania; switzerland.

Highlights:

- We propose a framework to verify conformance between planning intentions and outcomes
- Planning objectives are partially reflected in land change patterns
- The distance between intentions and outcomes is attributed to national planning approaches
- Results show the efficiency and utility of the framework in a case study analysis

1. Introduction

Most countries make firm policy statements at the national level about the need to achieve sustainable development. Policy statements for spatial development are often expressed through enacting laws, and become part of spatial planning objectives at the national level [1]. By enacting them, governments assure that they are binding, and apply to all levels of governance which play a role in managing spatial development [2]. Spatial planning objectives become the basis upon which decisions regarding the actions of governments, the private sector and communities are taken.

Conformity between intended the type of development, as expressed by spatial planning objectives, and actual development is expected [3]. Faludi [4] refers to this as *conformance* between intentions and outcomes. The term outcome is used to express the effects on socio-economic and environmental changes brought about by the planning system and other forces [5].

The degree of conformance between expressed objectives and the actual development pattern is revealed during the planning evaluation procedure [6]. Evaluation plays a key role in the planning cycle as it helps planners assess the progress made through the implementation of the objectives [7,8]. Hence, it is a means to improve the planning process by providing information for further evidence-based policy making [9].

The evaluation of outcomes has been rather neglected by scholars and, especially, by practitioners [10,11]. The causes of this neglect are related to the difficulties in quantifying the results or the characteristics of the planning systems. As objectives are, at times, not clearly defined, or are framed terms of holistic concepts (e.g., sustainable development). the evaluation of outcomes becomes a difficult task. Moreover, development patterns are not only influenced by planning practices, thus any explanation needs to be placed within the broader socio-economic and political context [12]. Even if planning objectives are clearly formulated, it is difficult to establish clear boundaries that delineate the influence of all factors. Outcome evaluations may also be lacking because the planning system is not mature enough to focus on evaluation, or are intentionally avoided because they could highlight failures in the planning process [11]. Most previous research efforts on outcome evaluations focus on individual planning instruments [13], such as conformance of development with urban growth boundaries [14,15] or the distance between planning intentions in local plans and the city's actual development pattern [16]. Less attention has been payed to developing frameworks suitable for large scale assessments, such as the national level. A notable exception to the lack of research in this field is the set of indicators proposed by Hersperger, Mueller, Knöpfel, Siegfried and Kienast [6] to evaluate planning outcomes on landscape characteristics.

Wong and Watkins [5] present an interesting methodology for the evaluation of outcomes of national policy statements in England. The spatial dimension of land-use management is highlighted as the main aspect to be considered in this outcome evaluation, as it lays at the heart of the spatial planning system. For measurement purposes, the authors recommend the use of indicators, based on their ability to capture changes over time. Such indicators can make the link between objectives and both positive and negative outcomes [17].

Although the methodology proposed by Wong and Watkins [5] offers useful information on how evaluation should be performed, it does not explicitly cover the effects of planning practices on landscape patterns, and little information is given on the potential application of the proposed framework in areas outside the British context. Furthermore, as highlighted by Opdam, *et al.* [18], planning evaluation should also make use of spatially explicit tools to assess whether landscape changes have occurred, and where they are located.

In order to contribute to the literature on outcome evaluation, this paper focuses on assessing the implementation of spatial planning objectives in the urban landscape. In particular, we examine the conformance between adopted objectives and observed development patterns. We begin by proposing an indicator-based framework for outcome evaluation. We then explore the integration of the framework into a spatial multi-criteria analysis. Finally, the framework is tested in two study areas in Romania and Switzerland, paying particular attention to understanding the results from the perspective of spatial planning approaches in the two countries. Since the two countries have similar landscape characteristics but different planning approaches, the case studies should provide useful insights on how to apply the framework and interpret the results based on concrete situations. Moreover, findings are expected to improve our knowledge of the relationship between landscape patterns and spatial planning objectives on sustainable development.

Spatial multi-criteria analysis "transforms and combines geographical data and value judgments (the decision-maker's preferences) to obtain information for decision making" [19]. It is a method used by spatial planners to help decide which alternatives to implement [20], evaluate the quality of decision-making processes [21], or evaluate the consequences of implementation, such as potential land-use conflicts [22].

The two case studies selected to test the proposed framework are located in countries with different attitudes towards planning evaluation. In Romania, evaluation procedures implemented over the last two decades have been inconsistent and inconstant [23]. Only recently have studies been conducted to verify the outcomes of the planning process, with a focus on trade-offs between public and private interests in urban planning [24], and between-countries policy transfer on flood-risk planning [25]. Given the pressure put on the planning system by private actors, and the poor coordination among planning [26], it is useful to see the extent to which actual results are in conformity with adopted objectives. In contrast, in Switzerland the evaluation procedure, known as *controlling*, was initiated in the 1990s, and has constantly been improved [9]. The analysis of the Swiss case could highlight those aspects that lead to the conformance between intentions and development patterns. To facilitate the understanding and interpretation of the two case studies, a comparative analysis of the Swiss and Romanian planning approaches was conducted through a review of legislative and planning practices.

2. Framework for evaluating the implementation of spatial planning objectives

We propose a framework for evaluating the implementation of spatial planning objectives in the urban landscape (Figure 1). The framework has four dimensions — efficient built-up development, conservation of agricultural land, landscape preservation, and the human dimension — which reflect main domains of spatial planning. The dimensions were conceptualized based on the national spatial planning objectives of Switzerland and Romania (i.e., stated in the national legislation, as of December 2013), and represent common concerns of spatial planning. We limited their selection to include objectives that have direct impact on the spatial development patterns in urban areas, and could be spatially quantifiable (Table 1).

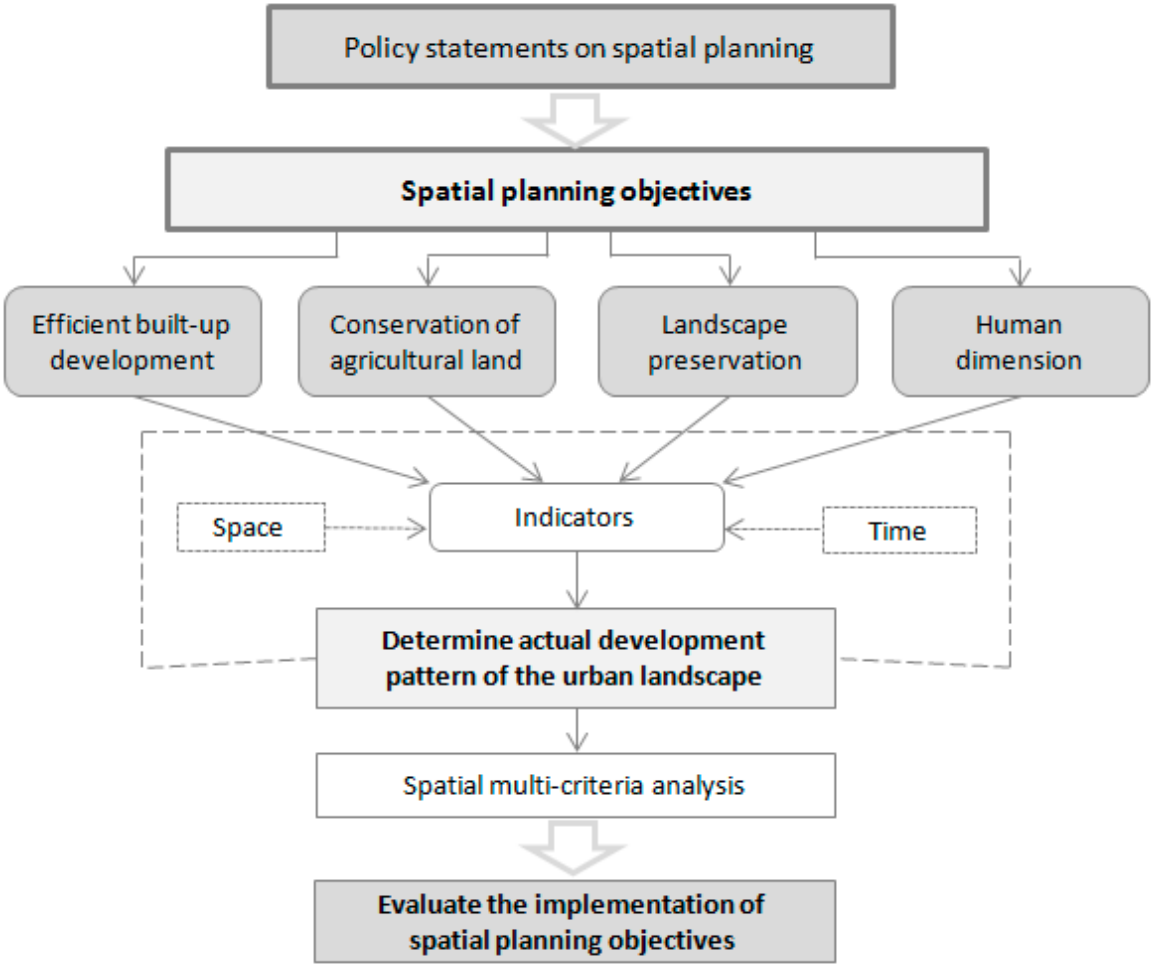

Figure 1. Framework for evaluating the implementation of spatial planning objectives

Following the recommendations of Wong and Watkins (2009), we made use of indicators capable of capturing both spatial patterns and dynamics over time to measure outcomes. For each dimension, we proposed a set of 2 - 4 indicators as recommended by Kienast, *et al.* [27] for landscape assessments (Table 2) and by Hersperger, Mueller, Knöpfel, Siegfried and Kienast [6] for evaluating planning outcomes. Indicators quantify changes between two moments in time and represent unique information at the grid/raster level.

Table 1. Dimensions for the assessment of the degree to which spatial planning objectives are reflected in the actual development pattern

Dimension	Planning objectives as expressed in spatial planning laws	Category of indicators	Indicator
A. Efficient built-up development	Rational use of land, through controlled built-up development (RO [a]) and restricted land consumption (CH [a]); orientation towards desired spatial development (CH)	limit land uptake by built-up development	A1. built-up development rate due to private initiative A2. built-up development rate due to public initiative
		limit scattered built-up development	A3. changes in fragmentation of built-up areas
B. Conservation of agricultural land	Protection of cultivable land (CH) and conservation of fertile agricultural land (RO)	reduce loss of agricultural land	B1. rate of loss of arable land B2. rate of loss of permanent crops
C. Landscape preservation	Preservation of landscape through maintaining public recreational areas (CH, RO); conservation of natural landscapes and recreational areas (CH)	conserve natural landscapes and recreational areas	C1. forest area changes C2. loss (gain) of public open space [b] C3. loss (gain) of public green areas [c]
	Elimination of land-use conflicts (RO); appropriate location of homes and workplaces (CH); protection of residential areas against pollution (CH)	avoid land-use conflicts	C4. changes in adjacencies between conflicting land uses [d]
D. Human dimension	Good accessibility of public and leisure facilities (RO, CH); ensure a good human habitat (RO); improve quality of life (RO)	improve communities' quality of life	D1. changes in accessibility of nearest recreation areas D2. changes in share of urban derelict land D3. changes in landscape diversity [e]

[a] The letters in brackets represent the country where the objective was adopted: CH - Switzerland; RO - Romania

[b] River banks and other small open spaces which are not considered urban parks

[c] Urban parks and public gardens

[d] Potentially conflicting land uses considered within the analysis: industrial - residential, derelict land - residential

[e] The indicator was calculated as changes in the number of patches representing different land uses, within a 500 m radius

The *Efficient built-up development* dimension addresses sprawling built-up development in a direct manner, as it has been identified as one of the pressing issues affecting the European urban landscape [28-30]. The differentiation between built-up dynamic indicators (i.e., A1 and A2) was made in order to draw attention to the driving forces behind landscape transformation. The two indicators highlight the capacity of public and private actors to support urban development. Indicator *A3. changes in fragmentation of the built-up areas* was introduced to evaluate the dispersed pattern of urban expansion.

The *Conservation of agricultural land* dimension is complementary to the expansion of built-up area. The two indicators on agricultural land dynamics (i.e., B1 and B2) capture the way diversity of agricultural activities is affected. Moreover, the two indicators can be used to assess which agricultural land uses are more vulnerable to loss, as studies have pointed out that urban expansion affects them differently [31].

Landscape preservation dimension addresses the management of green and open spaces, and potentially conflicting land uses. Urban forests and public green spaces are landscape features that provide a wide range of urban ecosystem services, such as climate regulation, heat island reduction [32] and the provision of leisure facilities for the local community [33]. Moreover, their protection is closely related to the sustainability of cities [34]. In urban environments, the presence of open spaces indicates the potential for nature-oriented recreation, and increases the perceived naturalness of the landscape [35]. Management and avoidance of potentially conflicting land-use adjacencies are important aspects of spatial planning [36]. Cities which experience a rapid increase in built-up areas are even more exposed to the occurrence of conflicting situations [37].

We considered it necessary to include the *Human dimension* because the way people use and perceive urban landscapes should be an important component of spatial planning [38,39]. The role of planning is to increase the quality of landscapes, including ordinary landscapes where communities carry out their daily activities [40]. The D1 indicator refers to the availability of recreational areas. These areas are connected to nature experiences [41,42], and provide a wide range of psychological and physical health benefits. Indicators D2 and D3 indicators address landscape perception which is evolutionarily determined [27,43], the two indicators being independent of cultural influences. Presence of derelict land is perceived as being associated with desolation and a lack of activity [44], and landscapes which are more diverse receive higher scores in landscape-preference ranking [45]. The D2 and D3 indicators were chosen because they express the preferences of both residents and experts.

3. Integration of the framework into a spatial multi-criteria analysis

In this section, we describe the integration of the developed framework (Figure 1) into a spatial multi-criteria analysis. As decisions on how development should be performed may involve the management of conflicting goals, multi-criteria analysis has proven to be a good method for exploring and solving complex problems [20]. In multi-criteria analysis, a criterion expresses the degree of achievement of an objective. Criteria are therefore measurable parameters, and their analysis can be supported by resorting to indicators [46]. For urban areas, these indicators should measure the functional and liveable dimensions of an area [47]. We assigned the criteria of the spatial multi-criteria analysis as defined by the indicators of the framework (Table 1).

3.1.Criteria weights

To determine the weights of the criteria, we performed a pair wise comparison using Saaty's [48] nine point scale. To assign weights, we addressed the following question: given a pair of criteria, which criterion has been identified in case studies as having more negative effects on efficient implementation of spatial planning objectives? For example, when criteria *A1. built-up development rate due to private initiative* and *A2. built-up development rate due to public initiative* were compared, a higher weight was

given to the A1 criterion, as studies [49,50] have shown that urban sprawl is mostly triggered by private initiative.

We performed the pair wise comparison of the criteria within each dimension. We considered this approach appropriate because the dimensions represent different aspects of spatial planning policy. The sum of the weights was set to equal a value of 1 for each of the dimensions.

3.2.Calculation and standardization of indicators

Indicators were calculated as change rates between two moments in time. We used a 100 m × 100 m cell grid to calculate values, as this method has proven to be effective in avoiding redundancy in spatial-based multi-criteria analysis [46]. Moreover, the cell size is reasonable when capturing urban landscape characteristics.

As the selected indicators have different measurement scales and ranges, they cannot be compared directly. A standardization to a dimensionless value is required. We used *Mathematical Programming* [51] to transform the values to percentages. The worst values are set to equal 1 and the best values equal to 100. The standardized values were calculated using the following formulas:

$$f(Z_i) = \frac{1-100}{\max - \min} * Z_i + \frac{(100*\max)-(1*\min)}{\max - \min}, \quad (1)$$

when the maximum expresses the worst value, and

$$f(Z_i) = \frac{100-1}{\max - \min} * Z_i + \frac{(1*\max)-(100*\min)}{\max - \min}, \quad (2)$$

when the minimum expresses the worst value. Z_i represents the value of a criterion for cell i, *max* represents the maximum value for the criterion, and *min* the minimum value for the same criterion [22].

4. Testing the proposed framework

4.1. Selection of test areas and analysis period

We screened for potential study areas to test the proposed framework, by focusing on common physical features. The common features of the case studies enable generalization [52] and allow for the comparison of results. The following features were taken into consideration: relief, land use, functionality of built-up areas, presence of public green areas and water bodies. Two cities – Zürich and Bucharest – were chosen due to their relative importance at the national level, and high urbanization in the past decade. An area of 33 km^2 was chosen at the periphery of Bucharest, and an area of 42 km^2 in Zürich's suburbs (Figure 2.). Boundaries of the study areas correspond to administrative borders and water bodies.

Data on land cover/land use was obtained at the patch level by digitizing aerial images from Google Earth, representing the years 2003 and 2012 for Zürich, and 2005 and 2013 for Bucharest. In addition, we consulted urban plans and GIS information on land use provided by the Canton of Zürich [53] and the Municipality of Bucharest [54], and conducted field visits.

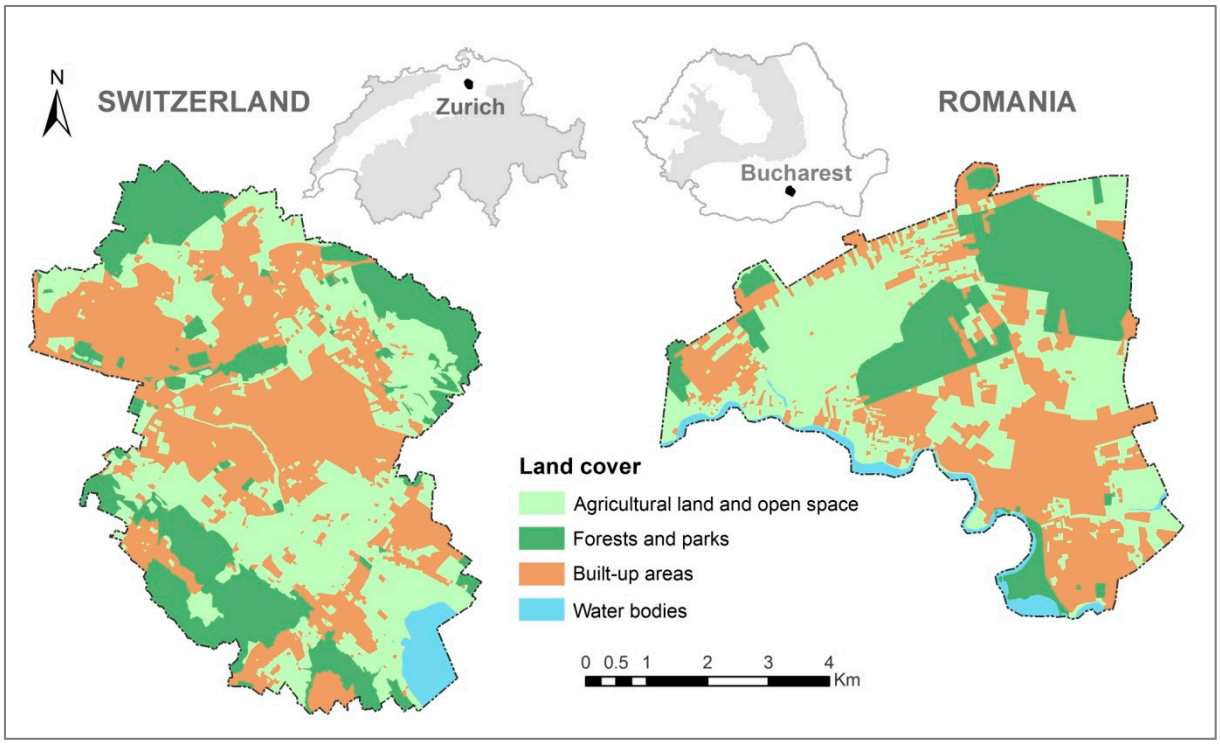

Figure 2. Land cover of study areas in Switzerland (year 2012) and Romania (year 2013)

The analysis period was set so that it could be meaningful in terms of outcome evaluation. I was necessary to take into account changes in spatial planning legislation, while maintaining similar timeframes for the two countries. Baseline years (2003 – Switzerland, 2005 – Romania) were selected based on planning legislation stability (i.e., no major planning legislation changes before or after the selected years). Final years were chosen to be as close to the present as possible, and based on aerial image availability.

4.2 Comparison of planning approaches in Romania and Switzerland

We compared Swiss and Romanian planning approaches in order to facilitate the understanding of the results from the test areas. The comparison was conducted by analysing the legislation and planning practices of the two countries. Although both countries have common objectives (as outlined in the Table 2), information on how planning is performed could provide details regarding the reasons behind the success or failure of the implementation.

5. Results

5.1 Results of the spatial multi-criteria analysis

Within the timeframes under study, built-up area developed due to private initiative increased significantly in both study areas, whereas public built-up increased slightly in Switzerland and decreased in Romania (Table 2). Fragmentation of built-up areas was rather similar in the two study areas. Both study areas registered a reduction in agricultural land, notable being the dramatic loss of arable land in Bucharest as agricultural activities were abandoned. There were no significant changes in forest area, public open spaces or public green areas. However, there was a significant increase in adjacencies between conflicting land uses in Romania. Accessibility of recreation areas, overall higher in Switzerland, remained constant in both countries. Derelict land expanded significantly in Bucharest,

and overall the areas are much larger than in the Swiss case study. Landscape diversity decreased slightly in Switzerland, but the amount of diversity is still higher than in Romania. Criteria weights were assigned after a pair wise comparison, within each dimension. Higher weights were attributed to criteria on fragmentation of built-up areas, changes in areas of permanent crops, and accessibility of recreation areas (Table 2).

The average standardized scores show that there are not large discrepancies between the two study areas (Table 3). However, the scores for each of the dimensions and their total value highlight that the implementation of spatial planning objectives in Romania is less effective than in Switzerland (i.e., indicated by the lower average scores). The higher standard deviation of standardized scores in Romania also indicates the presence of areas with more extreme values (e.g., areas prone to experience situations where actual development patterns are not in conformance with adopted objectives).

Partial score maps (Figures 3a and b) show, in a spatially explicit manner, the evaluation of the implementation of spatial planning objectives. High scores (light colours) indicate a good fit between policies and outcomes. The efficiency of built-up development was evaluated based on *Dimension A* scores. The results show that the Bucharest study area (Figure 3b) has was highly dynamic in terms of built-up development. Compared to the Swiss study area (Figure 3a), development and fragmentation rates were much higher. The conservation of agricultural land was affected in large compact areas in Bucharest (Figure 3b) and small scattered areas in Zürich (Figure 3a), as indicated by the low scores in *Dimension B*. Landscape preservation was under pressure in attractive areas nearby water bodies and forests —in Bucharest (Figure 3 b), and in small and dispersed areas in the Swiss study area (Figure 3a)—as reflected by the distribution of *Dimension C* scores. The way in which people potentially use and perceive the landscape is reflected in the scores of *Dimension D*. Although the study areas register both high and low scores, the extent of lower scores is greater in Bucharest. Total scores reflect the overall conformance with adopted spatial planning objectives. Compared to the Swiss study area—which exhibits only values of greater than 30—values of less than 30, and a few cells with values of less than 20 were found in the Bucharest study area. In other words, these lower scores suggest that adopted spatial planning objectives had less impact on actual urban area development in Romania.

138 **Table 2.** Values of the corresponding indicators for each time step, and weight within the spatial multi-criteria analysis

Analysed aspect	Measurement unit	Values for				Corresponding indicator/ criterion	Weight of the criterion
		Switzerland		Romania			
		2003	2012	2005	2013		
built-up area due to private initiative	m²	3901.548	5809.234	1690.427	4279.347	A1	0.218
built-up area due to public initiative	m²	3096.057	3439.260	2758.007	2218.891	A2	0.091
fragmentation of built-up patches	no. of edges	0.004	0.004	0.003	0.004	A3	0.691
area of arable land	m²	2781.178	2686.142	2503.651	266.024	B1	0.355
area of permanent crops	m²	87.328	83.922	687.418	434.389	B2	0.645
forest area	m²	2009.594	2009.594	1935.586	1917.426	C1	0.323
area of public open spaces	m²	298.839	288.008	61.059	59.538	C2	0.108
area of public green areas	m²	0.000	0.000	147.078	147.078	C3	0.341
adjacencies between conflicting land uses	meters	8.054	8.789	4.590	12.946	C4	0.228
accessibility of nearest recreation areas	meters	190.126	190.126	290.505	290.405	D1	0.683
area of urban derelict land	m²	64.174	35.369	712.648	2568.961	D2	0.200
landscape diversity	no. of patches	13.139	12.676	9.333	10.366	D3	0.117

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140 **Table 3.** Descriptive statistics of standardized scores per dimension

	Switzerland		**Romania**	
	Average score	Standard deviation	Average score	Standard deviation
Dimension A	77.744	4.794	74.947	17.706
Dimension B	18.453	1.146	14.291	3.140
Dimension C	31.148	1.762	29.671	3.668
Dimension D	78.858	15.249	72.458	18.714
TOTAL	51.067	3.981	47.355	7.369

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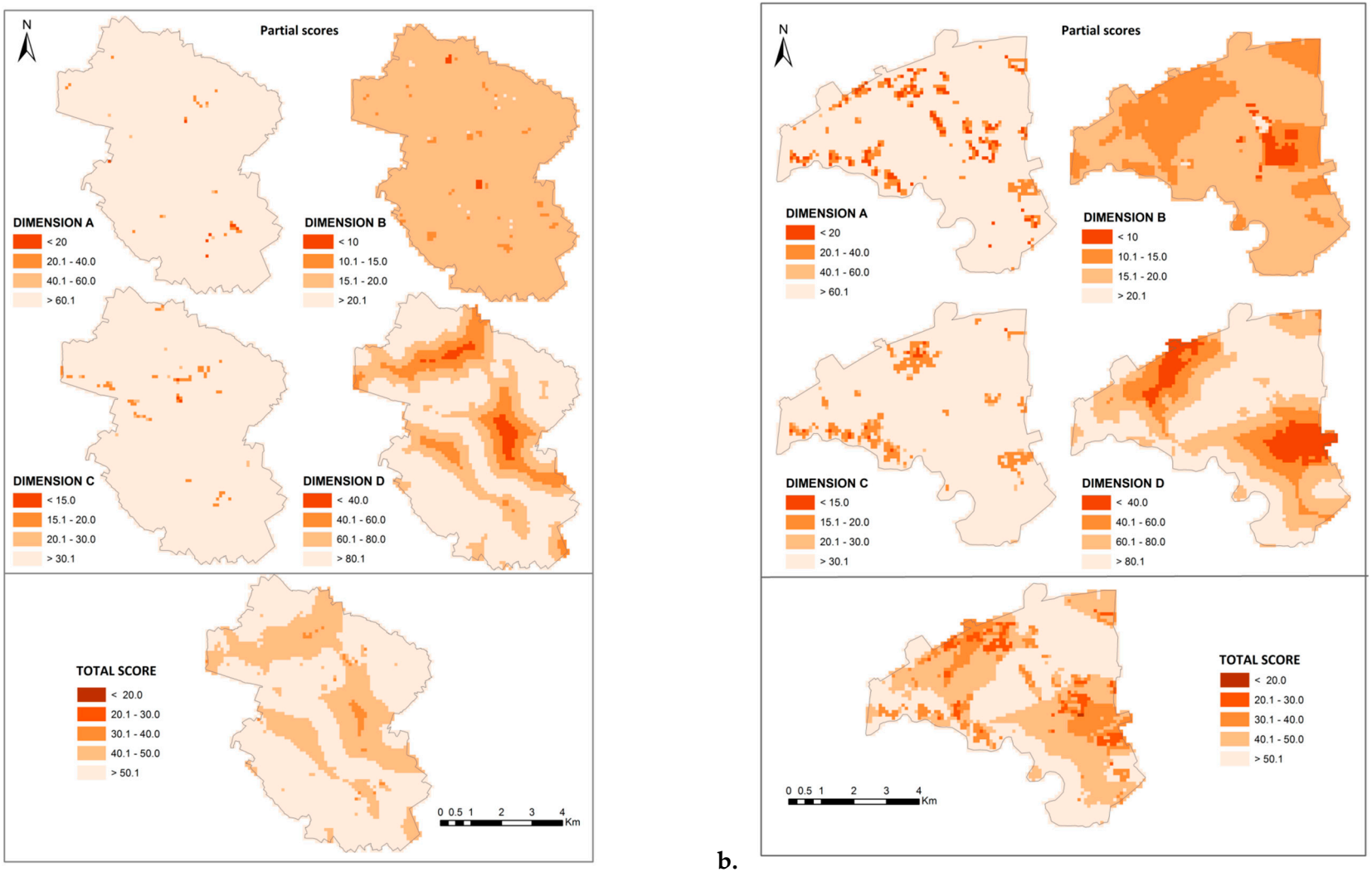

Figure 3. Partial scores for each dimension and total score for study area in **a.** Switzerland, and **b.** Romania. The lower the scores (and the lighter the colours), the more development patterns are in conformance with planning objectives. Values can range between 0 and 100.

5.2 Planning strategies in Romania and Switzerland

Based on the Ahern's [55] classification of planning strategies, we identify Romania as having a defensive planning strategy, as it seeks to react to the negative effects of spatial development. In contrast, Switzerland has a more protective planning strategy, since planning is used as an instrument to guide or orient development towards a desired spatial pattern. Through its legislative framework and planning practices, Romania promotes development while trying to control the negative outcomes of urban landscape change. The Romanian planning system attempts to arrest processes such as landscape fragmentation or urban sprawl, rather than to prevent them. A certain difference exists between what the legal framework's aims are—in terms of landscape conservation, urban built-up containment, and preservation of recreational facilities and green areas—and how the legislation is enforced. In contrast, in Switzerland, space is considered a limited resource and its efficient management plays a central role in the planning system. Spatial planning aims to foresee urban dynamics and develop strategies to adapt to societal changes. Landscape preservation, urban sprawl prevention, and conservation of recreational areas are at the core of the planning system. If we could summarize each of the planning approaches in only two words, for Switzerland we would choose *anticipate and protect*, whereas for Romania, *develop and control*.

6. Discussion

The present paper aims to contribute to the literature on the evaluation of planning outcomes. We developed a framework to evaluate the implementation of spatial planning objectives, with the use of spatially explicit information.

The framework and its integration into a spatial multi-criteria analysis allowed us to verify the conformance between adopted objectives and actual development patterns. Since most European countries have adopted similar spatial planning objectives [2], the framework can be used to extend between-states comparisons. Furthermore, the framework can be downscaled to within-state analyses (e.g., of cities or regions).

The indicators met the requirements identified by Opdam, Foppen and Vos [18], Wong and Watkins [5], and Wong [17] as being essential in outcome evaluation. They were able to capture landscape changes over time and space, and reflect both positive and negative aspects of these transformations. Since objectives are mostly expressed in terms of outcomes which are desired [17], the use of change indicators helped us overcome issues related to expressing only positive aspects. This way, indicators can be better used to track progress made, and signal issues regarding policy implementation [6].

The efficiency and utility of the framework was demonstrated by testing it in two study areas. The results provided valuable information that can be used to improve the performance of the planning process, such as locating where implementation of objectives is less effective, and domains of spatial planning which are affected. The use of the framework may increase planners' accountability during the planning process, and strengthen public confidence in public institutions [56].

The scores of the spatial multi-criteria analysis showed that the implementation of spatial planning objectives is more convincing in Switzerland. Observed data can be explained by the protective planning strategy adopted in Switzerland. In contrast, the Romanian planning strategy encourages development, but the planning system is not very effective at controlling its negative impact. The dissimilarity between the planning approaches of the two countries has also been observed by Tudor, *et al.* [57], who point out that in Switzerland, land-use conflict resolution is more successful due to the focus on economic sustainability and equity among the actors involved, whereas in Romania conflict resolution is oriented towards landowner benefit, and planning regulations are poorly enforced. Particularly for Bucharest, our results are similar to those of Ianoş, Sorensen and Merciu [26] who note that land changes overrun the planning process.

In Switzerland, the efficient expansion of built-up areas and the conservation of agricultural land are considered priorities of the planning system [58], as space is a limited resource. The Romanian planning system is not mature enough [59] to enable efficient control of urban sprawl, and to avoid

fragmentation of agricultural land. Moreover, national policies sometimes contradict the objectives of spatial planning [60], as the need to encourage and support economic development could override other land management strategies.

The difference in scores on landscape preservation can be explained by the distinct approaches of Romania and Switzerland. Switzerland first adopted a law on landscape protection over 40 years ago [61], and has recently developed policy documents, such as *Landscape 2020*, to establish its landscape management vision [62]. Moreover, changes are monitored under the *Swiss Landscape Monitoring Programme*, as they are considered decisive in natural resource management and spatial planning [27]. In contrast, in Romania landscape protection is closely linked to the ratification of the Landscape Convention in 2002 and the designation of protected areas included in the Natura 2000 Network. Romania did not adopt policies that explicitly address landscape protection and management, and does not use landscape management plans.

The areas with low scores in the *Human dimension* in Bucharest are consistent with those identified by Grădinaru, Iojă, Onose, Gavrilidis, Pătru-Stupariu, Kienast and Hersperger [31] as being prone to experience land abandonment, and by Iojă, *et al.* [63] as having low accessibility to public green areas. In the Swiss study area, the low scores resulted mainly from the fact that recreation areas are located further away from the settlements. However, during the evaluation process, one should take into account that, in Switzerland, the network of trails and roads in agricultural areas are often used for recreational purposes [27].

For the evaluation procedure to be reliable and valid, certain aspects should be taken into consideration. Using spatially explicit indices to analyse landscape change patterns has proven useful, and their integration into a spatial multi-criteria analysis allowed us to evaluate conformance with desired outcomes. However, researchers and practitioners should be cautious in characterizing landscape functions, as a clear understanding of the relationship between the value of indicators and ecological processes is needed [64]. Planning evaluation should rely on additional measures of landscape performance, such as field observations and landscape perception surveys. Moreover, it should be taken into consideration that within this study, the criteria weights were subjectively assigned based on the authors` experience and knowledge. To improve this analysis step, further research could include the opinions of planning theoreticians and practitioners or the public.

7. Conclusions

We have shown that the developed framework is a powerful evaluation method. The results highlighted the framework's ability to verify the conformance between spatial planning objectives and actual development patterns of the urban landscape. Due to the focus on spatial planning objectives—which are common to most European countries—the framework could easily be applied in both between-states, and between-cities outcome evaluations.

The results of the spatial multi-criteria analysis revealed a greater distance between objectives and outcomes for Romania, compared to Switzerland. These observations were attributed to the planning approaches of the two countries and to the different way they deal with landscape preservation and management.

Our study contributes to the current debate on the use of spatially explicit data for the purpose of verifying the degree of conformance between intentions and outcomes. As the volume and detail of available spatially explicit datasets is increasing, future research could focus on methodological advances for the integration of GIS and spatial information into the planning evaluation procedure, with a focus on various landscape scales and time series.

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