

MATHEMATICAL MODELS USED FOR VISUAL ASSESSMENT OF THE LANDSCAPE *IN SITU* – CASE STUDY SINAIA TOWN

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Abstract

The aim of this study is to modify, to adapt, and to apply to the Romanian urban landscape a quantitative method proposed and applied in Spain by Cañas Guerrero (1995). Several specific parameters and variables of a given landscape are analyzed and assessed. Then, using mathematical formulae, one gets a score which indicates the quality of the studied landscape.

Keywords: *landscape, visual evaluation, landscape mapping*

Rezumat

Modele matematice utilizate pentru evaluarea vizuală in situ a peisajului – studiu de caz orașul Sinaia. Scopul acestui studiu este să modifice, să adapteze și să aplice peisajului urban românesc o metodă cantitativă propusă și aplicată în Spania de către Cañas Guerrero (1995). Sunt analizate și evaluate câțiva parametrii specifici și variabilele unui peisaj dat. Apoi, folosind formulele matematice, se obține un rezultat care indică calitatea peisajului studiat.

Cuvinte-cheie: *peisaj, evaluare vizuală, releveu peisagistic*

INTRODUCTION

During the last decade, in order to analyze and assess landscapes, there had been issued various quantitative methods based on *non-visual mathematical models* – landscape metrics (Botequilha Leitão et al., 2006) or on grilles for *visual evaluation of the landscape in situ* (Kane, 1981; Cañas Guerrero, 1995). The scope of applying these methods was to eliminate the subjectivism and to create the possibility to characterize, to exemplify, and to compare various areas of landscape. The results summed up from these quantitative models are used to rehabilitate and revive the landscape (Pătroescu, 2000) from certain spaces, as well as in adjacent domains (territorial organization, agronomy, ecology, environmental geography, architecture, etc.).

The visual method of landscape *in situ* evaluation is based on a qualitative assessment, as well as on a quantitative one, realized by the addition and mathematical processing of the scores given in the field. As for any method, there can be evidenced both advantages, as well as disadvantages. *The advantages* are, that by using this method, there can be gathered all attributes that we must take into account when we associate the value of a landscape to an area. Thus, we obtain more information regarding the degree of detail of the landscape in the field. *The disadvantages* are linked to the difficulties occurred being connected

with the person's capacity of perception during the assessment (experience), with the degree of subjectivism, with the degree of the landscape to open or to close (it is considered a ray of 1,200 meter starting from an observation point), with the moment when the assessment is made (depending on the season, weather conditions).

The scope of our study is to continue to apply *the sheet of landscape surveying type* (Pătru, 2006) also in the case of an urban space. In order to develop the application, we chose the Sinaia town located in the north of Prahova county (geographical coordinates: 45°21'00" latitude N, 25°33'05" longitude E), in the mountainous sector of the Prahova Valley, which is documented as a spa and tourism resort and a town of the third rank. Thus, in this urban area the variety of landscape elements is high (natural objectives, tourism objectives from the patrimony, architectural and cultural objectives, etc.).

DATA AND METHODS

LoRem The visual assessment in the field (*in situ*) is, first of all, based on a rigorous inventory of the landscape elements, called *parameters*. These elements of the landscape have a variety of the landscape from one areal to another, from one parameter to the other, which is expressed by the notion of *variable*. On the other hand, the parameters can be grouped in three classes, called *attributes*. Actually, we can talk about *physical*,

aesthetical and *psychological* attributes. This methodology was proposed and developed by Cañas Guerrero (1995), being applied in visual assessment for certain regions from Spain (see also Cañas Guerrero & Sanchez Ruiz 2000). For Romania, the inventory method for the elements in the field, as well as the mathematical formulae had been adapted by Pătru (2006), respectively Stupariu & Pătru-Stupariu (2007), aiming at quantifying the landscape characteristics within a rural space. In order to make the application of the landscape surveying sheet type possible in an *urban* area, we inventoried the attributes, parameters and variables specific to an urban landscape:

I. Physical attributes. We take into consideration the following 12 parameters: *types of residences, green areas, the orientation of the streets, transport infrastructure, industrial spaces, cultural endowments, educational equipment, trading spaces, sanitary equipment, sounds* (noise), *smells* (air pollution), *elements that alter the landscape* (waste, deserted buildings, etc.).

II. Aesthetical attributes. There are analyzed two parameters: *the shape* (by evaluating this parameter we understand the aspect of the distinct elements which occupy an extension determined in the landscape higher than 5%) and *the color* (the descriptor which has the highest capacity to draw the observer’s attention, it must be mentioned that it depends on the variability degree of atmospheric conditions).

III. Psychological attributes. There are included two parameters: *the unit* (defined by the structural lines of the landscape) and *the expression* (the landscapes that get a high scope at this parameter are considered as exceptional).

In the present paper, the explicit formulae for calculating the value of the landscape (Cañas Guerrero, 1995) is adapted and improved: to each considered parameter it is given a maximum score of 100 points and the final value is given by the weighted average of the values obtained for each parameter. For example, P is a parameter and X an associate variable. If we have a type one variable (see, for example, table 1), the corresponding value V_{PX} is equal to the arithmetic mean of the variable values scores registered in the assessment point. If, we have a type two variable, the following formulae is being used:

$$V_{PX} = f_{PX} \cdot \sum_{Y \text{ de tip } 1} V_{PY}$$

where f_{PX} is the *multiplicative factor* of the X variable for the P parameter (see, for example, table

1). For P parameter, the value V_P is obtained by totalizing the values corresponding to the associate variables:

$$V_P = \sum_X V_{PX}$$

Let’s suppose that we took into consideration N parameters. In order to emphasize only some of these parameters, as to have a higher flexibility in establishing the value of the landscape, we will consider that for each parameter it is associated a *share*. So, being μ_1, \dots, μ_N the shares for the N parameters that we considered. The value of the *landscape* V in the working point is the weighted average of the landscape values for the considered parameters, with the system of shares indicated, being given the formulae:

$$V = (\sum_P \mu_P \cdot V_P) / \sum_P \mu_P$$

In case that all shares are equal to 1, we obtain the simplified formulae:

$$V = (\sum_P V_P) / N$$

The obtained value mentions the category where the analyzed landscape is included, established according to the following classification:

$V < 21$	degraded landscape
$V = 21 \dots 35$	mediocre landscape
$V = 36 \dots 50$	ordinary landscape
$V = 51 \dots 65$	landscape in good keep
$V = 66 \dots 80$	landscape in a very good keep
$V = 81 \dots$	remarkable landscape.

We must mention that, in the method presented above, the evaluator has the role to establish the scores for the variable values of type one, the multiplicative factors associated to type two variables and the shares for the considered parameters.

DISCUSSIONS

Using, on one hand, the values established by the evaluator and mentioned before and, on the other hand, the actual observations within the field and the given scores, there had been filled in the landscape survey sheets in several working points chosen in all ten districts of Sinaia town.

Forwards, we give the detailed sheet for one parameter and namely the one for *Type of residences*, and its variables (Tab. 1), as they were filled in the working points in Furnica district. By applying the formulae mentioned before, we obtain the score $V_1 = 39.1$. We mention that when calculating the final score, to this parameter is given a higher share compared to the shares given to other parameters.

Table 1 Landscape surveying sheet – Furnica district, Sinaia

Parameter	Total score of the variable	Variable X	Value (a ₁ , b ₁ ,...)	Score	f _{px}	Type
P=1: Type of residences V₁ = 39,1						
	A V_{1a1} = 9	Category (A)	individual households	9		1
	A V_{1a2} = 10		villas	10		
	A V_{1a3} = 10		new residential complex	10		
	A V_{1a4} = 7		collective block of flats	7		
	B V_{1b1} = b₁ x a₁ + b₁ x a₂ = 9.5	Construction material (B)	wood, stone		1	2
	B V_{1b2} = b₂ x a₁ + b₂ x a₂ + b₂ x a₃ = 4.85		brick		0.5	
	B V_{1b3} = b₃ x a₄ = 0		BCA		0	
	C V_{1c1} = c₁ x a₄ = -7	Degree of degradation (C)	high		-1	2
	C V_{1c2} = c₂ x a₁ + c₂ x a₂ = 4.75		medium		0.5	
	C V_{1c3} = c₃ x a₃ = 0		low		0	
	D V_{1d1} = d₁ x a₁ = 9	Visibility (D)	reduced		0.5	2
	D V_{1d2} = d₂ x a₂ + d₂ x a₃ + d₂ x a₄ = 9		normal		1	

By applying this sheet and by calculating the value of the landscape we obtained a differentiation for the visual assessment of the landscape (Fig. 1) at the district level in Sinaia town which classifies the landscape from this town in different categories of landscape. Thus, the maximum value of 81.43 obtained in Furnica district is explained by the accumulation of the score resulted from the high values obtained for green areas, sounds, smells, historical and architectural monuments (the Peleş Castle, the Pelișor, the Turret, the Hunting House). Also, the Center, the Oppler and Tir cu Porumbei districts obtained high values due to the existence of historical and architectural monuments, green spaces or to the type of residential spaces (villas, new residential complexes).

At the opposite pole are the districts appeared during the communist period in the south of the town (Platoul Izvor, Izvorul Rece), where the given score was diminished by the presence of industrial spaces, pollution (phonic, olfactory) associated to them, as well as because of the type of existing residences (collective block of flats).

This landscape typology is used by local actors. In this respect, in Sinaia town, pursuant the assessments of the landscape had been issued proposals for the organization of the limestone quarry, the Serb's Tavern in the touristic village.

In the present, the landscape of the quarry is deeply affected by the presence of waste and industrial deposits and by the present processes which make the quarry slope to be instable.

With the project proposed by the House of Architects in Sinaia (Fig. 2), is intended to realize a pleasure and sport touristic area on this side of the quarry, which should respond to the high requests needed for the organization on the European Youth Olympic Festival of 2013.

The proposal for ecological construction of the quarry by the organization of a touristic village is based on: the reconstruction of the landscape; the use of ecological materials (wood, stone, grass); the consolidation and exploitation of the excavation as a background; the insurance of a step-up constructive system with a maximum height regime of G+3+A; PTO maximum = 50%

and $CTU = 1.5$; the provision of insolation and visibility; the use of a waste recycling system and waste water treatment plants.

CONCLUSION

The performed study shows the fact that between the assessment of the urban and rural landscape there are significant differences in inventorying the elements of the landscape (parameters, variables) which compose the landscape survey sheet, and that the share method is an adequate one, as it also allows to analyze mixed landscapes, those with a high degree of complexity, as well as to adapt the set of parameters depending on the actual characteristics of the landscape faced *in situ*.

In addition, the values of the shares can be chosen by the evaluator depending on the nature of the studied problem and the type of performed analysis. In other words, taking into consideration the high degrees of the landscape dynamics in the area in question, it is highly requested to mention two facts. First of all, it is desired that the new urban organizations to take also into account the assessments of the landscape in order to avoid the excessive degradation of this resource.

Besides, it is necessary to update the survey landscape sheets periodically, in order to monitor the evolution of various parameters, variables and the landscape as a whole.

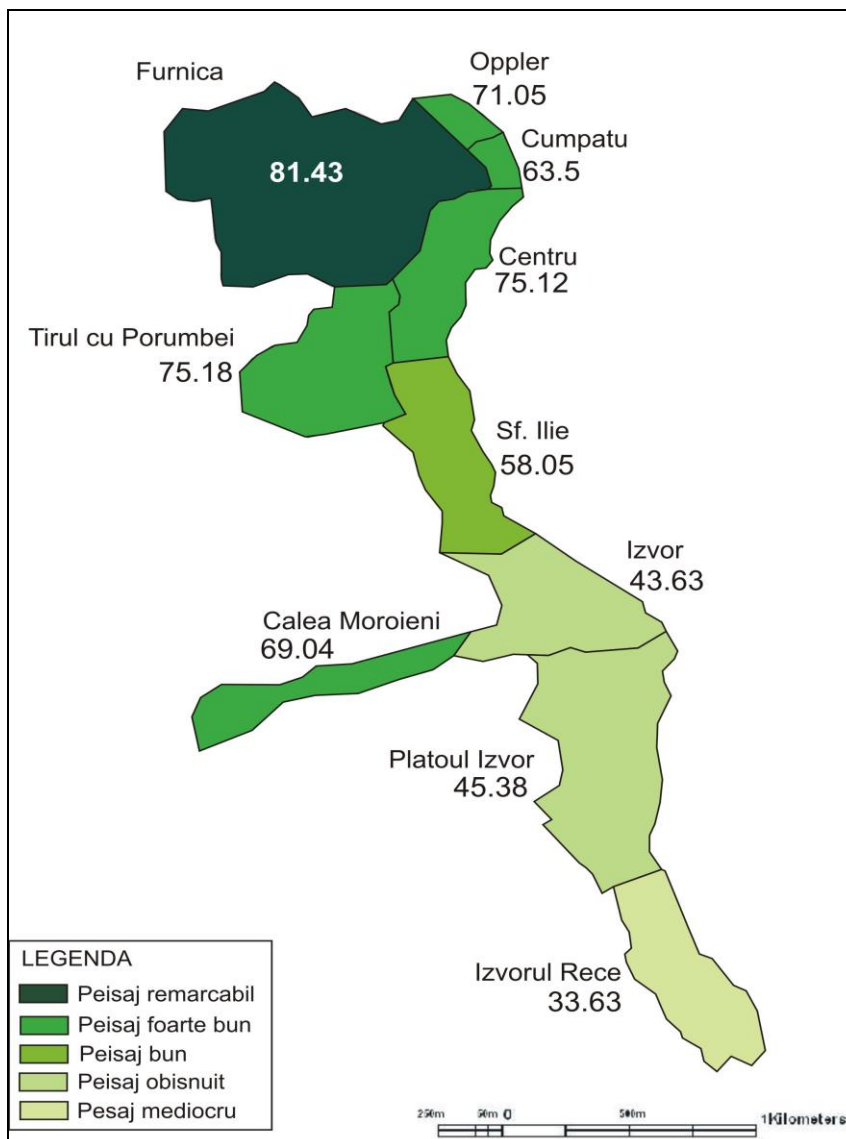


Fig. 1 The map of landscape value – Sinaia town

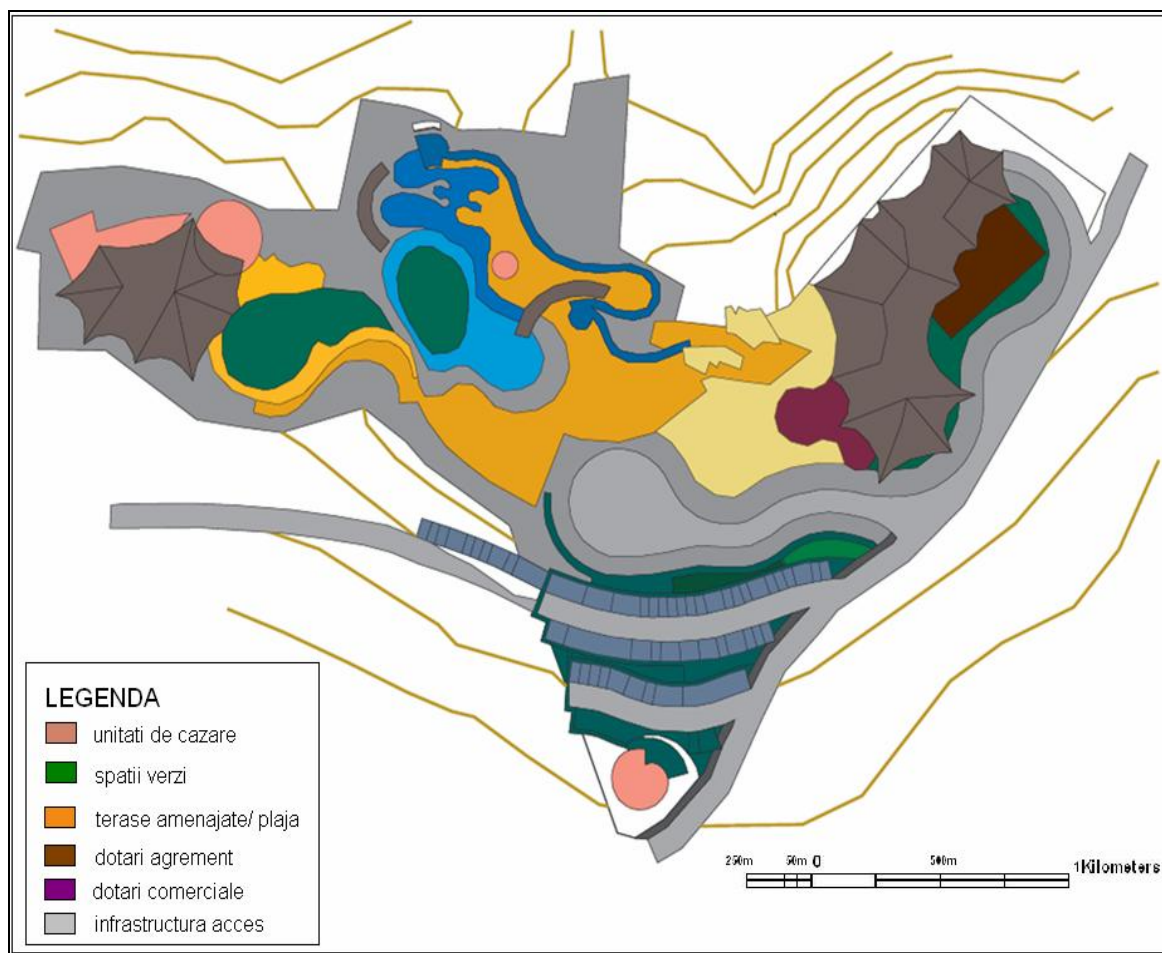


Fig. 2 The ecological reconstruction of limestone exploitation quarries from the Serb's Tavern.
Source: The House of Architects in Sinaia

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