Valuation Methods of Landscape

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ABSTRACT

The environmental issue can be regarded as a major landscape concerns. Literatures focus on the preservation and enhancement of the landscape that is considered as social, cultural and economic resources in communities. Landscape analysis has become an essential tool in the landscape of Sciences. This paper explores various methods of assessing landscapes that are in used to date. Several schools differ in their approaches. One school uses method which relies on the system of socio-cultural values of individuals and their own experience with the landscape regardless of spatial data. The Zube method, for instance, uses quantitative survey that is appropriate to certain landscape features. While the Brush and Shafer method combines visual appeal with a mathematical model. Clark's method is based on the assessment of the value of a landscape from polls. Another evaluation method proposed by Kiemstedt based on the quantification of regional characteristics in view of many ecological factors. Finally a new scoring method developed by Neuray assesses the quality of components or groups of components of a view. It uses values perspectives that require prior quantification of several parameters. The landscape specialist selects a method according to the typology and intended use of the landscape.

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1. INTRODUCTION

The evaluation of landscapes is a delicate and complex undertaking due to various methodologies available in the field. One approach may be classified as an objective approach. An objective approach is based on a value scale that reflects the quality of the landscape. The scale is quantifiable

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evaluation criteria that can be mapped into a two dimensional space plane. These quantifiable criteria led to an evaluation based on three approaches or methods that are: (i) approaches or methods based exclusively on landscape criteria taking into account the visual appearance (Gaudreau *et al.*,1984; Dahany, 2001; and Fortin, 2002), (ii) Other approaches based solely on socio-cultural value system of individuals and their own experience with the landscape seen regardless of spatial data (Shafer *et al.*, 1977); and (iii) The last category of approach that best suits the landscape concept puts it in direct relationship with the viewer or observer who seeks to understand the relationship between the shapes of the landscape and its social representations (Domon *et al.*, 2003; and Fortin, 2008).

In this paper, we present the assessment methods classified by different authors under the category of "objective method." We describe several methods that are based on known parameters of the different components of the landscape and the sensitivity of each viewer. These methods are most commonly used in the estimation of landscapes.

2. METHODOLOGIES IN LANDSCAPE VALUATION

2.1. Qualitative method called "subjective pole"

2.1.1. Visual method

The visual approach highlights the links between the object and the subject. The object is the landscape under analysis. The subject is the viewer. A typical visual method takes into account the current land space or study area. All valuable items and curiosities are likely to remain unaltered in the landscape; these objects will be recorded in order to be evaluated. This approach is also employed in sites that are exceptional fragile or "sensitive areas." Sensitive areas are the landscapes which any small amount of alteration of the space leading to an extensive visual mood alteration in the viewer.

The visual method is based on a zoning of the space or the territory into several landscape units defined by the following criteria: (a) topography; (b) vegetation cover; (c) habitat; (d) artificial, humanization; (e) hydrography; and (f) visual quality (Davodeau, 2005; Fadel *et al.*, 2013) .

The visual method was commonly used for visual studies of landscapes (Davodeau, 2005; Badouna *et al.*, 2014; and Fadel *et al.*, 2016). After highlighting large groups of landscape, an internal analysis is used to identify components of different subunits. The external analysis, performed upon neighboring areas allowed the agent to structure the landscape. These components are called sub-assemblies. The necessary criteria for the understanding of sub-assemblies are: (i) discovery ground, accessibility, natural accident or human action; (ii) variation of the visual field; (iii) identification of significant factors (strengths) to be taken into account in the development of the study area; and (v) inventory of areas in which the characters are to strengthen to-value elements and to minimize the degrading elements (Badouna *et al.*,2014).

The study of visual perspectives is critical in landscape planning. They allow an observer to appreciate the overall value of the landscape. The location and number of landscaping depend on the degree of openness of the visual field and the size of the territory or space studied. A photographic support is indispensable under such a method (Domon *et al.*, 1997; and Griselin *et al.*,1999).

2.2. Quantitative methods called "objective pole"

2.2.1. Zube *et al.* Method (1973-1974)

Zube and others in the objective line of literature proposed a method based on surveys. They established comparative results of quantitative surveys ranging from unsightly to beautiful landscape. These quantitative surveys employed to thirteen different landscape features which had been quantified and mapped. These features include:

1. Relief - measuring the height difference or differences in altitude.
2. Distribution of average slope; slope at random.

3. Topographic texture, dissection of the land surface.
4. Spatial definition index.
5. Diversity of land use.
6. Contrast in land use (altitude difference of texture)
7. Index of the natural landscape.
8. Density banks: shoreline length per unit area.
9. Density of the waters: surface proportion of water per unit area.
10. Length of maximum view.
11. Surface covered by the view - dimension of the perceived surface.
12. Density margins due to various land uses.
13. Edges Index according to land use diversity. The variety of soil indicated by the number of different types of edges uses (pressure fields, woods meadows, woods, etc.).

The quantitative value of landscape characteristics are set for each in aerial photographs and topographic maps at large scales by planning and landscape professionals (Zube *et al.*, 1973 & 1974). These topographic maps are compared to the results of surveys from photographs across the site that had been submitted to the public or users of a territory. The 13 characteristics listed above are positively or negatively noted depending on the appreciation of each person sampled according to their appreciation of aesthetic beauty.

2.2.2. Brush and Shafer's Method (1975)

Bush and Shafer (1975) had developed a method to note the visual beauty of the landscapes from photographs. It is a method that employs a mathematical model. It involves photographing the landscape. Landscape photography is then squared to determine the different planes of the landscape. It also helps to highlight the beauty of the area or areas of different landscapes. The parameters related to photography are inserted into a mathematical model:

$$Y = 184.8 - 0.5436X_1 - 0.09298X_2 + 0.002069X_1X_3 + 0.0005538X_1X_4 - 0.002596X_3X_5 + 0.001634X_2X_6 - 0.0008441X_4X_6 - 0.0004131X_4X_5 \quad (1)$$

where Y = appointed measure of preference (more the result is more low preference is strong); X_1 = perimeter of the nearest vegetation (foreground); X_2 = perimeter of the non-plant portion (intermediate zone); X_3 = perimeter of vegetation (background); X_4 = the growing surface of the intermediate area (closest); X_5 = water surface; and X_6 = non-plant area not visible (background). The Bush-Shafer model is based on linear-multiple regression modeling. Note that IV X_1 and X_2 are truly independent while the remaining IV: X_3, X_4, X_5 and X_6 are interactive; hence, the interactive terms: X_1X_4, X_3X_5, X_2X_6, X_4X_6, and X_4X_5. The inclusion of these interactive effect terms are obtained through the interaction effect test statistic:

$$T_{b_i} = \frac{b_i - b_j}{\sqrt{\frac{n_1SE_1^2 + n_2SE_2^2}{n_1 + n_2 - 2}}} \quad (2)$$

The factor loading for each interaction term is obtained by:

$$b_{ij} = \hat{b} - b_1 - b_2 - b_0 \qquad \text{where } \hat{b} = \bar{Y} - (b_2 + b_0) - b_1 \quad (3)$$

This method of quantification provides a partial answer to quantitative modeling of landscape studies. It was criticized by Craik (1975) and Carlson (1977) that such an approach minimizes the influence of the use of photography in the evaluation of a landscape. Indeed photography is a way of framing the space in a two dimension space-plane. It means that three-dimensional natural space is reduced to two-dimensions through photographical layout. The latter is representative of shapes, lines, masses and colors but does not entail the landscape in all its dimensions. This method was adapted by Mirenovicz (1978).

2.2.3. Clark's Method (1973-1974)

The evaluation of a landscape by Clark is based on a user survey by emphasizing three essential points: (i) survey to reveal all the details of user unconsciousness; (ii) survey franchises distances by the public to see a landscape; and (iii) an economic survey in linking the public and the financial aspect necessary to see the landscape.

2.2.4. Kiemstedt's Method (1967)

The Kiemstedt valuation method is one of the oldest (Neuray, 1982). It is based on the estimated value of a territory with an area of one square kilometer (01 square kilometers) allocated to leisure and relaxation which requires a large diversity of ecological components (Kates, 1970; and Clark, 1975**).** Kiemstedt includes in its formula a several factors, such as edges, topography and land use Kates (1970). Each factor is then integrated into a pattern reflecting a value of "multiplicity" per unit area of one square kilometer (01 square kilometers):

$$V = \frac{\left(R_w + 3R_g + R_e + N\right)K}{1000} \quad (4)$$

where V = coefficient of multiplicity; R_w = length in meters of forest edges; R_g = length of the banks in meters; R_e = effective relief; N = land use; and K = climatic factor.

2.2.5. Neuray's Method (1982)

In 1982, Neuray introduced a new method (Fadel *et al.*., 2010; 2012). The Neuray method is used to quantify rural landscape groupings. This is descriptive and statistical method. It also can be dynamic and forward looking to allow us to analyze the influence of any anticipated changes. It is representative to determine the impact of the development of an area or site quality views of the landscaped clusters and its integration into the surrounding landscape. The method described by Neuray aims to assess the quality of components or groups of components of a landscape view. It uses the views of values that require pre-listing of certain parameters which are: (i) views of length (L); (ii) calculation of the vertical dimensions of the
views (R); (iii) calculation of the valuation factors (S); and (iv) calculating the sum of the value of items (e) quantified before or after development proposals.

2.2.5.1 Calculation of basic parameters views of values

Length of sight (L)

The length of sight is calculated using the logarithmic function formulated below:

$$L = \frac{1}{2} 10 \log 10 \cdot 1 \quad (5)$$

where l: length of the views expressed in hectometer. Note that when the eye can reach very far, we can assign the value of 1000 meters or 10 hectometers to the length of the landscape (long sight).

Calculation of vertical dimensions views

The vertical components of the view are the terrain and the elements (buildings, trees, etc.) that can create, reduce or increase the vertical dimension. The vertical dimensions of the order are calculated using a formula that takes into account both the inclination of the slope in front of the viewer, the slope actually received, up to the horizon and the relative size elements (buildings, trees, etc.) capable of varying the vertical dimensions of the landscape (Fig.1).

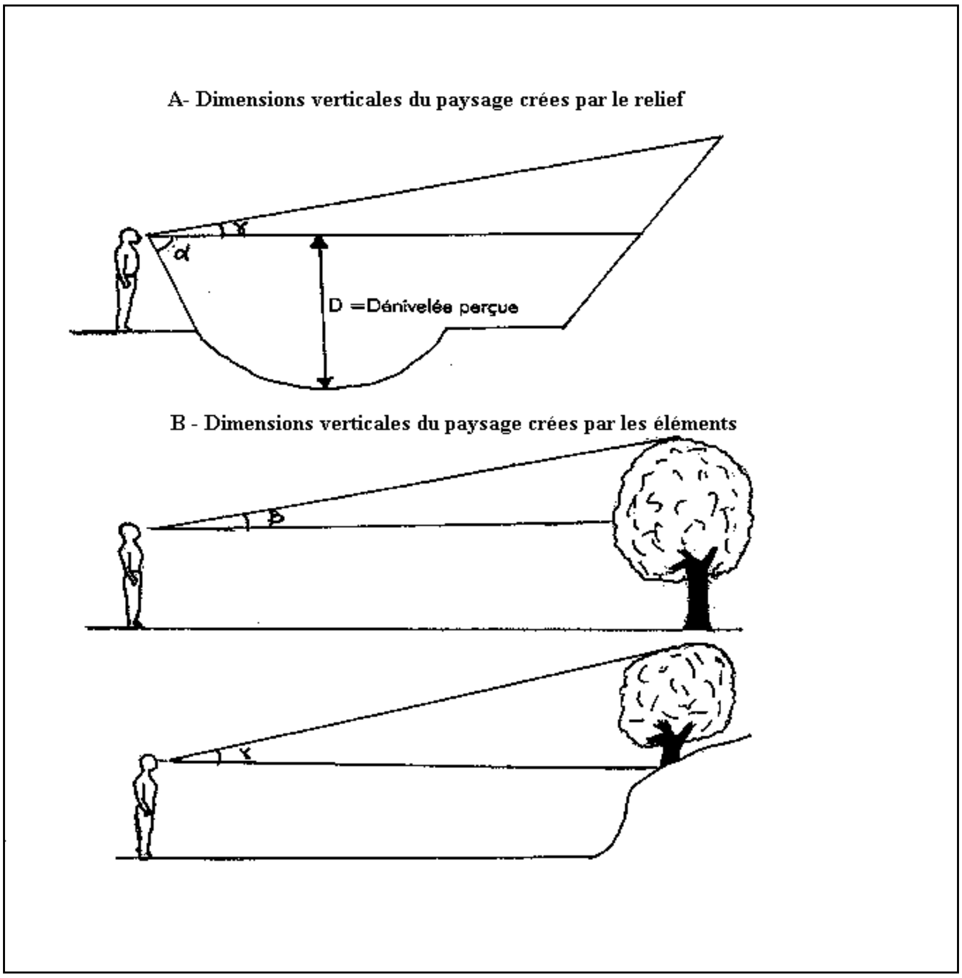

Fig.1. Views and vertical dimensions

The calculation of vertical dimensions is expressed by the following formula:

$$R = 1 + \sin\alpha + \sin\beta + \sin\gamma + d/100 \qquad (6)$$

where α : angle between the horizontal and the foreground of 30 meters; β : angle between the horizontal and a line tangent to the highest part of the front - plan; γ : angle between the horizontal and a tangent line at the top of the elements located more than 50 meters; and d : actually perceived drop in meters.

Through numerous studies (Fadel, 2010, 2012 & 2016), the impact of the vertical dimensions and choice of views of the scenic quality of the landscape had been demonstrated. One may notice an uneven landscape due to the different terrains offering a viewer an open field from a highest point of view. The viewer is both dominant and dominated by a landscaped portion, the vertical dimensions (R) has the highest value (Fig.2).

Fig. 2: Impact of vertical dimensions

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Factors valuation

The enhancement factors are determined subjectively despite their integration into a mathematical formulation. They have an important role on the visual quality of a landscape. The main factors are: (i) presence of water; (ii) presence of rocks, rocky points, acute mountain; (iii) size and quality of open space in front of the observer; (iv) presence of successive plans; (v) distribution of elements in the landscape area within 1,000 meters; (vi) distribution of elements in the background to over 1000 meters; (vii) accentuation of natural landforms; (viii) visual quality; and (ix) integrity of the landscape.

They are rated positively or negatively from 1 to 10 for additionally obtain the T. The latter factor is inserted in the manner shown in the equation below:

$$S = 1 + 0.T \qquad (7)$$

Calculation of the basic value views

The base value of the order depends on three factors: length of sight, vertical dimension, valuation factor involved is inseparable. This is the reason why the base value of the view shown in the formula below is product of different factors but not their sum.

$$V = L \times R \times S \qquad (8)$$

where L: length of sight; A: vertical dimensions of sight; and S: valuation factors;

The base value of the order represents a situation of a landscape seen from a point of view without taking account of existing elements or to introduce into the landscape in a possible development. Thus, the real value of the order (V') is obtained after adding the sum of the element values to the base value of the view that:

$$V' = \mathrm{V} + \sum e = L \times R \times S + \sum e \qquad (9)$$

where V': actual or total value of sight; V: basic value of sight; and $\sum e$: sum of the value of the elements.

2.2.6. Other landscape assessment methods

Other landscape assessment methods exist. Thus, De Veer and Burrough (1978) used a valuation method based on different unit in the landscape division taking into account the topographical criteria and visual field. This approach is contrasted with that adopted by Beckett (1974) which posits that the assessment of the landscape and its aesthetic appreciation requires knowledge of the rural economy. Different interpretations of the concept of landscape as the bio-ecological planning, social and economic prompted us to opt for a method of a combined assessment including both qualitative and quantitative approach. In the alternative, there is a qualitative approach based on an assessment of the visual field by appealing to the viewer impressions on elements that shape the landscape according to the criteria: topography, visual quality, agricultural fabric, vegetation, artificial. This qualitative assessment remains subjective and incomplete if we do not complement it with quantitative variable. A well-balanced approach must take into account all relevant points of views in identifying the landscape in all directions, *see* (Fadel, 2012 and 2013).

3. DISCUSSIONS

Landscape studies had become an essential component in the integrated management of resources and territories. Like all environmental impact studies that fit into the environmental management certification for standard setting, landscape analysis serves as a strategic tool for claims relating to the protection of the environment and preservation of the heritage of living environments. Landscape analysis is classified as landscape issues which can be subdivided into: (i) Landscapes valued for reasons of environmental protection and / or property; (ii) Landscapes valued for reasons of development and enhancement; and (iii) Landscapes valued for mixed reasons integrating strategic logic for their protection and recovery.

Towards the end of the 1990s, the practice of assessing landscape qualities evolved into different methods. They used separately or in combination quantitative and qualitative data that are of importance in the decision making process. They are based both on quantitative descriptive inventories aim to categorize a landscape and its evolution in terms of their structural components or elements. Thus, all qualitatively or quantitatively parameters may be catalogued cartographically. It must be emphasized that in the future, changing tools such as simulations in three-dimensions (3D) associated with databases, and regardless of the method used, will allow a better understanding of landscape dynamics under natural or man made constraints. They will undoubtedly be a promising way in the dialogue between managers of local resources and citizens. These simulations will show to the public the changing dynamics in the landscape management method.

4. CONCLUSION

From our work on landscape valuation estimates, we cannot conclude that one is better than the other. Each method has its application and utility. Which method is applicable depends on the desired type of problem and also to nature and the landscape level under study. In this study we made comparisons between different approaches through the joint use of qualitative and quantitative methods. These methods have a similarity if used not by a layman but by landscape professionals. It would be interesting to compare all the methods for estimating landscapes geographic information systems where the viewer's eye is replaced by satellite technology. In time, we may anticipate that such technology could substitute human subjectivity guided by experience and perception with technological objectivity.

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