MONETARY VALUATION: RESEARCH ON URBAN FORESTS

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ABSTRACT

The use of different methods in monetary valuation of natural assets and environmental resources is an approach that greatly contributes to the planning of land use and to the establishment of priorities for the preservation of natural landscape. In the case of the urban forests, this kind of research can be a useful tool to increase awareness of the society about the numerous services provided by urban forests and their essential role for the urban environment quality. In order to assess how different valuation methods have been used in the world, we selected articles published in eleven international and Brazilian scientific journals, from 2001 to 2011, aiming to create an outlook of the studies on this topic. Most papers published were about research conducted in Europe and North America, with the predominant use of the hedonic valuation method and a tendency, over time, to increase the use of contingent valuation and tree appraisal methods. We concluded that the diversity of research on monetary valuation should be encouraged, particularly in the Brazilian context, once there is no perfect method for the assessment of urban forests due to the multiple attributes and services they provide. The understanding of contexts, objectives and limitations of each valuation method is also essential for their uses.

Keywords: Valuation methods, Economic valuation, Urban trees, Environmental services

VALORAÇÃO MONETÁRIA: PESQUISAS EM FLORESTA URBANA

RESUMO

O uso de diferentes métodos para valoração monetária de bens e serviços ambientais é uma abordagem que pode trazer relevantes contribuições para planejamento de uso e a priorização de preservação das paisagens naturais. No caso das florestas urbanas, este tipo de pesquisa possuem potencial para sensibilização dos diversos setores da sociedade sobre os inúmeros serviços ambientais prestados por estas e seu papel essencial na qualidade ambiental urbana. Para avaliar como os diferentes métodos de valoração vêm sendo pesquisados no mundo, foram selecionados artigos publicados de 2001 a 2010, em 11 periódicos nacionais e internacionais para a confecção de um painel sobre as pesquisas nesta área. A maioria dos artigos publicados teve origem em estudos realizados na Europa e América do Norte, com predominância do uso da valoração hedônica, porém com tendência ao aumento de estudos sobre valoração contingente e dos métodos de fórmula. Concluiu-se que a diversidade de estudos sobre valoração deve ser estimulada, especialmente no contexto nacional, uma vez que não existe um método perfeito para valoração das florestas urbanas, em razão das múltiplas características e serviços prestados por estas. O entendimento do contexto, dos objetivos e limitações de cada método é fundamental para sua aplicação.

Palavras-chave: Métodos de valoração; Valoração econômica; Árvores urbanas; Serviços ambientais.

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INTRODUCTION

Economic valuation of environmental assets and services using economic tools is currently receiving attention from researchers and officials to support their decision-making, evaluating costs and benefits, for a more efficient allocation of resources, for establishing priorities for projects and policies or for calculating payments resulting from environmental damage (MITCHELL; CARSON, 1989; LO; JIM, 2010). From this valuation, we obtain a monetary measure of the benefits provided by environmental assets and natural resources, which are used for managing economic and human activities (MOTA, 2001).

However, this valuation is a highly complex task and even controversial in some respects. A major difficulty in economically valuating assets is attributed to some intrinsic characteristics, given that environmental assets and natural resources do not have a defined or competitive market, are affected by externalities or are public assets, and, therefore, do not have well-defined property rights, which creates market failures (KING et al., 2000; SCHAEFFER, 2008, THOMAS; CALLAN, 2010). Consequently, the market does not often reflect all social costs and benefits of an environmental asset or service, jeopardizing the effective and beneficial use of environmental assets and natural resources (KING et al., 2000). In an attempt to obtain an adequate representation, several studies have focused on the development of various methods of monetary valuation with different approaches that comprise the establishment of values based on respondents' opinions, real estate markets, dendrometric evaluations or cost-benefit analyses, among others.

Research on monetary valuation of urban forests allows to evaluate how these methods are developed, which ones are the most used and the behavior of interest levels in this type of research over time in different countries.

Urban and Suburban areas and Urban Forest

Conceptualization of terms is always a challenge when it is aimed to find a definition that best reflects the way the researcher understands the subject in discussion. When we refer to urban and peri-urban areas, there is a wide range of definitions of their dynamics, delineation and conceptualization. Forman and Godron (1986) defines urban areas as high densely built-up areas, which stretch for miles, even with the presence of small wooded patches in the form of parks spread around within them, while suburban areas would combine rural and urban features, in a heterogeneous mixture of residential, commercial, plantations and natural areas. In general, you can see the differences as gradients, or concentric circles of influence emanating from an urban center, where the landscape is changed because of human interference (ANTROP, 2000). These changes are observed both in the differentiation of space, infrastructure, usage, service availability, as well as in attitude and perception of dwellers.

However, these definitions are still not widely discussed, especially in relation to suburban areas, since some of their characteristics, dynamics and shapes vary from one location to another and are affected by certain phenomena, such as urbanization processes (NORONHA; HESPANHOL, 2008). In Brazil, we can find areas that range from suburban neighborhoods with high population density and poor conditions to those where we observe more clearly the transitions from rural to urban settings.

Given that forests cross political boundaries, being located in urban, suburban and rural spaces and sometimes in more than one city, and that the space considered as suburban changes rapidly with the growth and expansion of urban centers, in this review, we adopted for the definition given by Moll (1995), where an urban forest involves areas where there are trees already planted or with potential to have them, within an urban and suburban area.

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Methods of monetary valuation

According to Moll (1995), administrators and public policy makers still do not have an accurate idea of the monetary value provided by trees when considered as part of urban infrastructure and not just mere "aesthetic enhancement". The economic value of trees does not comprise their role in flood mitigation, control of heat islands, improvement of air quality, among other phenomena. For this reason, recently, the use of monetary valuation in urban forests has gained strength, and the methods used are the hedonic valuation, the contingent valuation and the valuation methods by formulas (*tree appraisal methods*).

Hedonic valuation takes into account the effect of a given environmental benefit on the price of an asset that has a real market value. Specifically in the case of urban forests, several studies have used the value of real estate, i.e., how the value of a property can be influenced simply due to the proximity to a well-afforested area using formulas that take into account certain characteristics of market assets and information of their market (SANDER et al., 2010). The basis of this method is the value given by consumers to certain environmental features and services, more than the asset value itself (assets that have market quotes) (KING et al., 2000). This method allows to compare market prices, but it is a method whose results are dependent on the formula adopted and its interpretation is relatively complex.

The contingent valuation method (CVM) is a direct method, based on the value of passive use, which has been used more often in recent decades especially in the valuation of natural resources and public assets (CARSON, 2000; MOTA, 2001). These assets can be valued by the manifested "willingness to pay" or the "willingness to receive". In the case of "willingness to pay", the objective is to identify the maximum amount that an individual is "willing to pay" to have access or use of an environmental asset or service as the "willingness to receive" seeks to know the minimum amount that an individual is willing to accept to give up an asset (LO; JIM, 2010).

Flexibility is one of the main advantages of this method, as it can be used to appraise values of use and non-use. It is usually more used in the second case, because this type of method allows to create a hypothetical market for environmental assets or services to be evaluated (KING et al., 2000). However, this method receives severe criticism because it uses respondents' direct view and there are uncertainties of their real understanding about the values asked.

Watson (2002) presented the methods of formula (*tree appraisal methods*) divided into two types. The first comprises formulas that establish an initial value based on the tree size and are adjusted by factors such as the tree condition, location, species, quality and special situations. The second determines values by points for classification factors (multiplied or added) with the monetary factor introduced at the end (usually linked to market factors such as seedling prices and planting prices or consensus).

Therefore, this study aimed to quantify and obtain distribution of appraisal methods for urban forest that have been reported in the literature in the last 10 years (2001-2010), and in which countries the studies have been performed based on a selection of 11 journals of national and international scopes.

MATERIALS AND METHODS

We collected papers on monetary valuation of urban and suburban forest from issues between January 2001 and December 2010 published in the following international and national journals: Journal of Environmental Management, Ecological Economics, Urban Forest and Urban Greening, Landscape and Urban Planning, Sabrina Mieko Viana et al..

Forestry, Revista Brasileira de Arborização Urbana (REVSBAU), Árvore, Scientia Forestalis, Ciência Florestal, Scientia Agricola and Cerne .

The choice for five international journals was based on the relevance of their publications of research focused on urban environment and forest. We also collected studies published in five national journals with the greatest impact on the study of Forest Science (Árvore, Scientia Forestalis, Ciência Florestal, Scientia Agricola and Cerne) and REVSBAU as one of the few publications focused exclusively on the study of Urban Forests.

The papers were divided into four categories according to criteria described below:

1. **Valuation method**

   ▪ Hedonic valuation: papers on the valuation of urban forest focused on its relation with commercial values of assets, such as the sale price of a real estate;

   ▪ Contingent valuation: this category comprised studies that used valuation methods and contingent choice;

   ▪ Travel cost: when costs involved in the transportation to park, green area, etc are taken into account;

   ▪ Cost-benefit: research papers that studied benefits of urban forests in terms of costs on management and maintenance;

   ▪ Tree appraisal formula: studies that used methods based on formulas to estimate individual values of trees based on planting and management costs or in relation to the tree characteristics;

   ▪ Review: review papers on varied methods of monetary valuation;

   ▪ Others: this category included papers that used valuation types that did not fit into the other categories, such as the multicriteria analysis and analysis of implementation costs in relation to fines applied.

2. **Location of the valued forest**

   ▪ Urban forest;

   ▪ Suburban forest, in which the concept of urban forest is included, but quantified based on the papers analyzed.

3. **Year of publication**

   This category was used to distinguish the temporal frequency of methods used for forest valuation.

4. **Place of research**

   We also selected papers according to the countries where the research project on forest valuation was conducted.

RESULTS AND DISCUSSION

A total of 37 papers were analyzed in terms of valuation of urban forests, being six of them from Brazilian journals and 31 from international journals. Most studies used hedonic methods of valuation, contingent valuation methods, followed by the methods of formula and the cost-benefit analysis (Figure 1).

An analysis of the temporal frequency of papers published reveals an increase in studies on monetary valuation from 2006 to 2010, with the predominant use of hedonic methods and contingent valuation. However, it is noted in this time interval, a considerable increase in studies using tree appraisal formula (Figure 2).

Figure 1. Percentage of papers published regarding the valuation method employed in the research. Legend: HV=hedonic valuation, CV=contingent valuation, MF=tree appraisal formula, CB=cost-benefit, Re=review, TC=travel cost
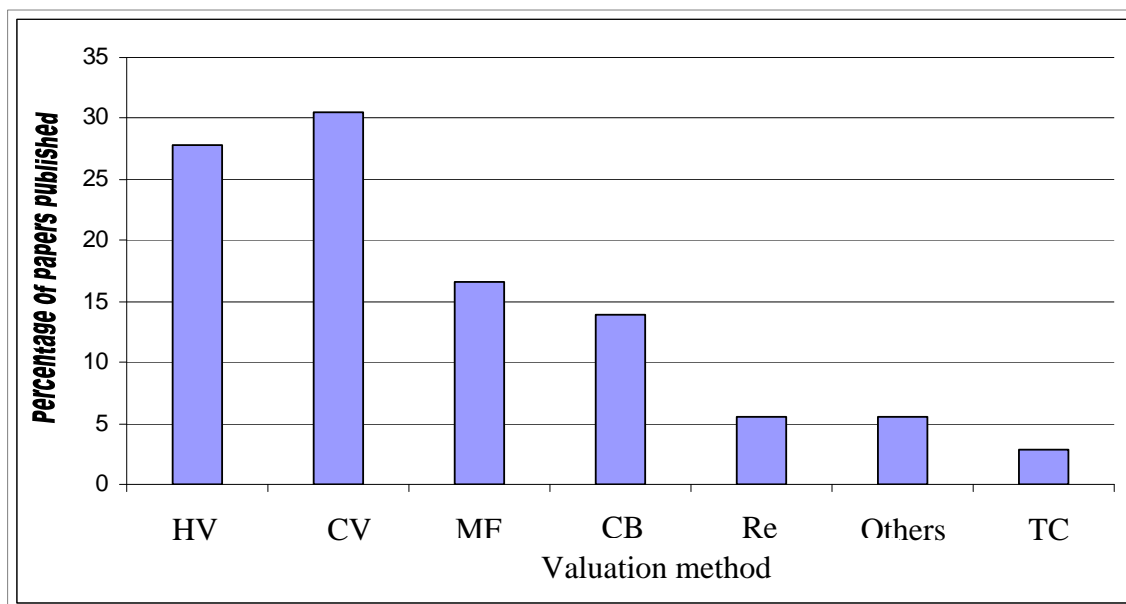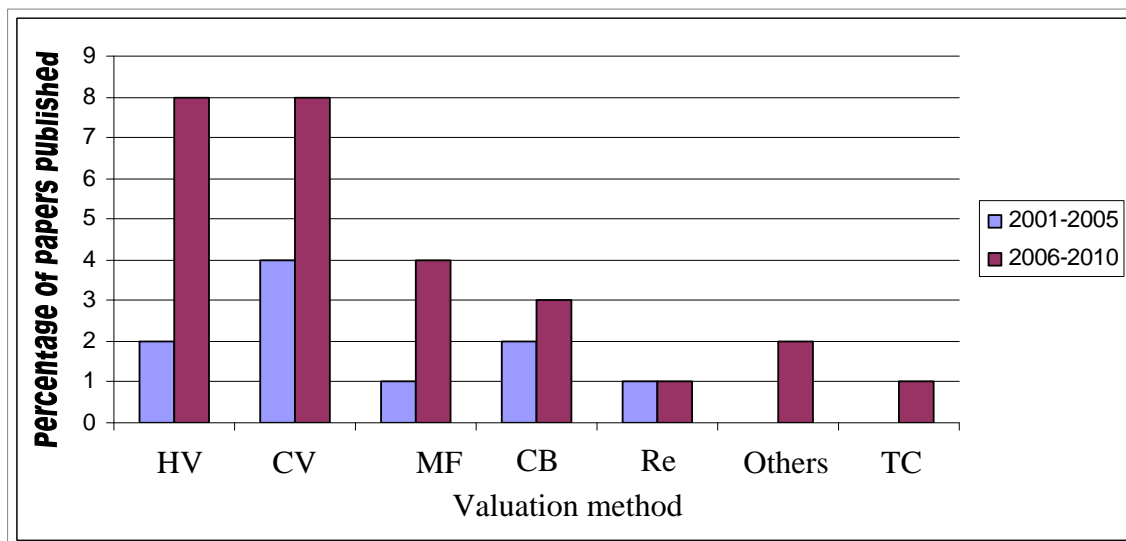

Figure 2. Temporal evolution of the frequency of papers published in relation to valuation method applied in the research. Legend: HV=hedonic valuation, CV=contingent valuation, MF=tree appraisal formula, CB=cost benefit, Re=review, TC=travel cost

McPherson and Simpson (2002) indicated that both contingent and hedonic valuations capture the value of the set, however, they are limited for obtaining the individual cost/benefit value of each tree.

Papers that used methods for valuation of urban forests mostly compare urban forests with suburban ones or in some cases, the valuation comprises the two types of forests (Table 1).

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Table 1. Frequency of use of different methods of monetary valuation, in relation to the forest type studied

Valuation method	Forest type			TOTAL
	Urban	Suburban	Urban and Suburban	
Travel cost	0	0	1	1
Cost-benefit	4	0	1	5
Tree appraisal formula	4	1	0	5
Contingent valuation	10	1	1	10
Hedonic valuation	8	1	1	10
Review	0	1	1	2
Others	1	1	0	2
TOTAL	**27**	**5**	**5**	**37**

Regarding the study sites, most studies were conducted in Brazil (5, 13.51%), United States (11, 29.73%) and China (3, 8.11%). The significant number of studies in Brazil is attributed to the contribution of national journals. In the category "Others", we included countries where the frequency of papers published was equal to or smaller than two, namely: UK, Switzerland, Denmark, Japan, Chile, Hong Kong, Spain, Holland, Australia, Finland, New Zealand and Italy.

Monetary valuation of urban forests can be a means of sensitizing the public and private sectors, as well as city dwellers to the great magnitude of the presence of forests in urban centers, indicating the benefits and services they provide. For example, McPherson and Simpson (2002) reported that their study on cost-benefits of urban forests of the American cities of Santa Monica and Modesto, besides sensitizing the population to the importance of the preservation of trees on public streets and parks, it was also used as an argument to keep funds to care for the trees, in contrast to other cities where these funds were cut.

However, when it comes to a controversial subject such as appraising natural assets and services, we should consider that subjective factors like symbolism and feelings associated with certain natural resources could make the economical appraisal of these services and assets impossible, as in the example given Schaeffer (2008), valuation of a territory considered sacred by Native Americans. Furthermore, in some cases, the loss of certain economic efficiency for the management of environmental assets and services is highly justified, for example, political measures the affect their management and enjoyment.

Understanding these techniques and the different forms of valuation, their properties and the philosophical and theoretical basis for monetary valuation is important, since they are the aspects that limit each method (SCHAEFFER, 2008). Therefore, there is no perfect method for valuating all the many features and services provided by urban forests and the application the methods will depend on the objectives and contexts of the site.

CONCLUSIONS

Among the papers analyzed, there was predominance for the use of contingent and hedonic valuation methods, but with a certain tendency towards the use of tree appraisal formulas. Much of contribution for urban forest valuation is still concentrated in countries in North America and Europe, and the few studies conducted in Brazil have been published, only in journals of national scope.

We conclude that a diversity of studies on forest valuation should be encouraged, since there is no perfect method for appraising urban forests and they provide a variety of features and services. The understanding of the context, objectives and limitations of each method is essential for its application.

Appraising urban forests in economic terms can be a tool for sensitizing the public and private sectors, as well as city dwellers to the great importance of forests in urban centers, indicating the benefits and services that they provide and ensuring their space amidst other urban structures.

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