

ENVIRONMENTAL VALUATION: EXAMPLES OF ITS WATERSHED APPLICABILITY

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ABSTRACT

At the current sustainable development speech, it's important to develop a better management of water resources to guarantee and ensure life quality to the actual and next generations. The environmental valuation has shown to be an important instrument of applicability about watershed. The environmental valuation is the process of seeking to estimate the economic value of natural resources through the measurement of equivalence of the other available resources inside the economy. The measurement of thesis that assess the valuation applied to watershed is crucial to allow glimpses about the research scenario of the post-graduation programs in Brazil. Therefore, a bibliometric research that allowed the identification of that thesis has been made in Brazil, at the length of time from 2006 to 2012. The thesis concentration about southeast economy programs was observed. However, the existence of other programs studies shows the possibilities of valuation as a capable instrument of providing mechanisms that can assist the development of a good management of water resources.

Keywords: Environmental Valuation; Watersheds; Economy; Management.

VALORAÇÃO AMBIENTAL: EXEMPLOS DE SUA APLICABILIDADE EM BACIAS HIDROGRÁFICAS

RESUMO

No atual discurso de desenvolvimento sustentável é importante que se desenvolva uma melhor gestão dos recursos hídricos para garantir e assegurar qualidade de vida para as gerações atuais e futuras. A Valoração ambiental tem-se mostrado como importante instrumento de aplicabilidade em bacias hidrográficas. A Valoração Ambiental é o processo pelo qual se busca estimar o valor econômico de recursos naturais através da determinação de equivalência de outros recursos disponíveis na economia. A mensuração de teses que versam sobre a valoração aplicada em bacias hidrográficas é importante por tornar possível vislumbrar o cenário da pesquisa nos programas de pós-graduação do Brasil. Dessa forma, fez-se uma pesquisa bibliométrica que possibilitou a identificação no Brasil das teses que versaram sobre este conteúdo, no período de 2006 a 2012. Observou-se a concentração das teses em programas de Economia e concentrados na região Sudeste. Mas a existência de estudos em outros programas mostra as possibilidades da valoração enquanto instrumento capaz de fornecer mecanismos que possam auxiliar no desenvolvimento de uma boa gestão dos recursos hídricos.

Palavras-chave: Valoração Ambiental; Bacias Hidrográficas; Economia; Gestão.

INTRODUCTION

For many, water is an abundant resource, and when the focus is on world availability, the premise of this abundance is apparently true. It is known that Brazil owns about 14% of the surface fresh water of the Planet, however it is poorly distributed.

The Amazon Basin has a water availability of 73,750m³/s, and a population density of about 2.3hab/km². When we observe the Hydrographic Region of Paraná, the most populous of the Hydrographic Regions of the country, its population density is 69.3 hab/km², with water availability of 5.800m³/s (SHIMIZU, 2012).

By analyzing these data, it is possible to perceive the absence in the equilibrium and the distribution of water resources. Therefore, it is possible to perceive the establishment of conflicts in the scarcest areas, leading to the need to develop public policies, with the aim of improving the harmonization of relations of interests towards the environmental good.

Even before the population density formation process was presented, the Brazilian government developed public policies emphasizing the water resources problem. The first of these was the Political Constitution of Brazil in 1824. However, the existing constitutions until the 1940s did not promote the integral management of water, but rather the guarantee of rights for a given sector, such as the hydroelectric, could use it (ARAÚJO, 2012).

The great change in the policies directed to water resources happened in the Federal Constitution of 1988, where it extinguished the private property of the waters in the whole Brazilian territory.

Following this process, observing the demand for better management of water resources, Law 9433/97 was created, whose central objective is "to ensure the current and future generations the availability of water, in quality standards appropriate to the respective uses". Also aiming at preservation and defense against critical hydrological events and sustainable development, through the rational and integrated use of such resources (ANA, 2007).

The National Politics of Water Resources, instituted by Law 9.433, reinforces in its basic principles that water is a public property, establishing that everyone has a right to it and that its management should be decentralized, with the participation of the Public Power, users and communities.

The development of the adoption of principles, laws and concepts that are in harmony with the valorization of water resources, especially in conservation, preservation and sustainable use, is a consequence of the discussion of the need for public policies for environmental preservation.

When it comes to sustainable development, as a way of guaranteeing the quality of life of current and future generations, it is clear the importance of water resources management, ensuring the democratization of access (ABDALLA, 2012).

It is public and legal knowledge that water is essential to life, economic growth and the well-being of society. And its excessive consumption, due to population increase, agribusiness, energy generation, leisure, and the release of domestic and industrial effluents have degraded this resource, once considered as a common good (ARAÚJO, 2004).

Seeking to contribute to the management of water resources, economic science has sought to understand how and why individuals and groups of individuals make decisions about the use and distribution of valuable human and non-human resources, which, linked to environmental issues, form the concept of Environmental Economics (FIELD and FIELD, 2014)

Where it applies the principles of economics to the study of the management of environmental resources. Serving as a possibility for the creation of public policies aimed at improving environmental quality.

A public policy is a set of interrelated decisions made by a manager or by a group of managers about objectives and goals outlined a priori by public managers, aiming to operationalize a course of action (HOWLETT and RAMESH, 1995). Environmental public policies are formulated by public managers in order to guarantee the sustainability of environmental resources.

For the environmental economy, natural resources are not commodities, since they do not have fixed prices in the market, but they are essential assets for the preservation of the life of all beings. The systemic focus of environmental economics helps in understanding how important it is to understand the value of the environment to the survival of species on earth.

To improve and contribute to this problem, the Environmental Economy developed methodologies that sought the economic evaluation of the environment, thus arising as a possibility of technical instrument for the management of resources. As a result, the "Environmental Valuation" method, understood by Motta (1997) as the determination of a monetary value for environmental goods and services, was created through the correlation with other goods and services available economically through the real or hypothetical market.

Where monetary value does not seek to transform environmental goods and services into simple market products, but rather to measure how the change in these goods and services influences individuals' preferences (MAIA, 2002).

"As markets are inefficient in valuing environmental services, the role of valuation as an instrument of environmental public policy is of vital importance. An environmental service is not a purely economic good, but it has several characteristics of similarity with economic goods, since it has consumption and value "(MOTA, 2001).

However, as much as this methodology may seem to be the commodification of nature, the purpose is to estimate the price of certain goods and services in the environment, serving as tools for planning Public Policies that seek environmental improvements (MOTTA, 1997). Thus,

environmental valuation is developed by economic scientists, who seek to stop the degradation of natural resources, serving as a mechanism that establishes limits for unrestrained and irreversible development (MATTOS and MATTOS, 2004).

Given the relevance of the subject, we ask how the Environmental Economy, through the technique of Environmental Valuation, has been developing its academic work, having the Hydrographic Basins as a scale of analysis? The general objective is to identify the elaboration of theses that have worked the Environmental Economy under the perspective of the hydrographic basins, in the postgraduate programs, which have concepts from 4 to 7, in the Coordination of Improvement of Higher Level Personnel (CAPES), according to Triennial Evaluation 2013.

The use of the Hydrographic Basin cut-off as an analysis scale is a result of the National Water Resources Policy, Law Nº. 9.433/97, which incorporates principles and norms for the management of water resources, adopting the definition of river basins as a unit of study and management (ARAÚJO, 2012). Specifically, we intend to: apply bibliometric techniques for the quantification of theses that deal with the environmental valuation of watersheds and qualitatively analyze the data extracted from the quantitative analyzes.

BIBLIOMETRICS

Bibliometry is methodologically understood by Guedes and Borschiver (2005), as a field of information science that applies statistical and mathematical methods to analyze the course of written communication of a given subject.

For Vanti (2002), bibliometry presents three fundamental laws, being: a) Bradford's Law, which measures the degree of attraction of periodicals on a certain subject; B) Law of Zipf, measures the number of occurrences of the appearance of the words in several ceilings, generating an ordered list of terms of a certain theme, used to verify which scientific topic is treated in the publications; C) Lotka's Law, which governs the growth of literature produced through a size-frequency distribution model and authors' productivity in a set of publications.

Its emergence dates back to the beginning of the 20th century, given the need to study and evaluate the activities of scientific production and communication (ARAÚJO, 2006). In 1922 it was referred to as "statisticalbibliography" by E. Wyndham Hulme, where the term was consolidated by Pritchard's studies in 1969, which defined bibliometrics as the application of mathematical and statistical models to books and other written means of communication (ALVARADO, 2007).

In 1970, bibliometric studies began to be elaborated in Brazil mainly by the Brazilian Institute of Bibliography and Documentation (IBBD), now Brazilian Institute of Scientific and Technological Information, IBICT (ARAÚJO, 2006).

According to Araújo (2006), it is only in the 90's that the greatest development of bibliometrics is due to the expansion of computer use. However, these works were not strictly quantitative, since it was observed that bibliometrics is also a method that presents concern in the development of richer readings of reality (ARAÚJO, 2006).

From the insertion of qualitative analyzes to the fundamental methods of bibliometry (Bradford Law, Zipf's Law, Lotka's Law), it became possible to elaborate methodological proposals that sought to enrich new analytical methodologies. Where, it would allow bibliometric studies to comprehensively visualize the bibliography of a certain thematic field, allowing to discover its intellectual structure (ANÉGON, 2005).

In addition, following this trend, we sought in this study to use bibliometrics as a possible tool to quantify and interpret the production of theses that cover the theme of Environmental Valuation aimed at case studies in Hydrographic Basins.

METHODS AND MATERIALS

Following a proposal used by Mill (2013), theses of programs and postgraduate studies were collected at the PhD level, with concepts from 04 to 07 at CAPES (Coordination for the Improvement of Higher Level Personnel). A total of 18 large areas of knowledge were surveyed by CAPES, which presented a scientific correlation with the environmental theme. The main areas chosen were: Administration; Accounting and Tourism; Biodiversity; Engineering I; Engineering II; Engineering III; Engineering IV; Geosciences; Geography; Interdisciplinary, Chemistry; Sociology and Animal Science.

With the establishment of the large areas to be researched, we sought to standardize the selection of the works versed in Environmental Assessment. Such selection was made through research of linguistic radicals that established relation with the subject. The selected radicals were: ambi, paid, service, echo and value. In addition, these radicals were chosen because they enabled a range of words that relate to each other, thus allowing, together or individually, to find papers that dealt with environmental issues, considering the words present in the title, abstract and keywords of the academic productions In Environmental Economics.

With the use of the aforementioned radicals, it was expected to find works with words such as: environment, environmental, environmentally, environment, payment (s), serviço (s), economy, economic, ecosystem, valuation, value, values.

The search for doctoral studies took place in the electronic collections of each program present in the large areas of knowledge listed by CAPES. Where, the works were selected as to the degree of correlation with the environmental bias. When not found, it was verified in the Thesis and Dissertation Database (BDTD) system of each institution in which the program was linked.

Some institutions used other storage systems, other than BDTD. Thus, in these cases, the surveys took place in the institutions' own database, such as the Minerva of the Federal University of Rio de Janeiro, the Athena of the Universidade Estadual Paulista (UNESP), the Lume of the Federal University of Rio Grande do Sul (UFRGS), The Digital Library of the University of São Paulo (USP) and the Digital Library of the Federal University of Minas Gerais (UFMG). The total amount surveyed was of 718 programs, being these of the most varied Brazilian academic institutions that offered doctoral courses.

DISCUSSIONS AND RESULTS

In order to select the works, the researches were carried out in two different dates, in order to solve problems such as collections from the air and documents that were not possible to open at that moment. The first search occurred during the period between September 1, 2014 and September 15, 2014. The second survey occurred between January 20 and 27, 2015, making up, thus, the total of 7 theses that fit the perspective proposal, dealing with Environmental Assessment in Hydrographic Basins.

The analysis focuses on the brief presentation of the works found that deal with Environmental Assessment in Hydrographic Basins, being presented in chronological order. Thus, the first thesis found is entitled "Analysis of sustainability in the Corumbataí River Basin (SP), written by Sidnei Lopes Ribeiro, in 2006, in the Regional Geology program of UNESP, which has concept 04 until the date researched.

Ribeiro (2006), created an Environmental Assessment and a Socioenvironmental Sustainability Index (ISS), aiming at environmental education and quality of life in the Corumbataí River basin. The area was in financial loss because social and environmental liabilities were larger than economic and environmental assets.

As demonstrated in Ribeiro (2006), the ISS revealed some progress in education (decrease in illiteracy) and in income; Increase of the poor in Charqueada and Itirapina; Concentration of income, (except in Santa Gertrudes); The longevity needed to improve, reflecting problems in the health of the population, due to environmental degradation; The financial sustainability of the municipalities, reached average rates in Analândia, Itirapina and Ipeúna and bad indexes in the others, for administration of resources. The ISS, was average for the basin, but the municipality of Santa Gertrudes was the only one to obtain bad ISS.

The thesis of Flávio Luiz Silva Jorge da Cunha (Valuation of ecosystem services in hydrographic basins), defended in 2008, in the Program of Post-Graduation in Economics of UNICAMP (State University of Campinas / SP), program with concept 04, aimed to Present and discuss the valuation of ecosystem services, based on the concept of ecosystem functions and services and the application of economic valuation methods in the hydrographic basin according to the occupation governed by agricultural business.

Cunha (2008), showed that valuation is one of the important instruments to be mobilized for environmental preservation. In addition, it is very important for the social recognition and acceptance of the need to manage natural environments, based on the sustainable use of resources.

Therefore, his work was based on presenting the theoretical possibilities from the traditional visions and the environmental economy, where an anthropized environment and its characteristics were presented, always trying to highlight the issues of occupation and environmental impacts.

Cunha (2008) also carried out a study in the Mogi-Guaçu, Pardo and Baixo Grande river basin, hereafter referred to as the Mogi-Pardo basin, in the State of São Paulo. In order to determine the willingness to pay for clean water with the population of the municipalities that are part of the basin. However, even with its limitations, it concluded that valuation can contribute as a measure of value to assist in the decision-making process.

Milton Marques Fernandes defended the thesis "Valuation of the environmental services of the Mata Atlântica Forest associated with the quality and quantity of water in the APA do Sana", by the Graduate Program in Agronomy (Soil Science), Federal Rural University of Rio de Janeiro, at the time concept 06 CAPES.

Fernandes (2009) evaluated the relationship between soil cover, water quality and quantity in watersheds, in order to evaluate the ecosystem services of the Mata Atlântica Forest. This analysis was carried out in two microbasins (Palmital and Glória), located in the Protection Area (APA) of Sana, municipality of Macaé (RJ). The evaluation and comparison of the services provided by the Atlantic Forest in water quality were based on the cost of water treatment.

The environmental valuation of Fernandes (2009) was based on the cost of water treatment, revealing that the Palmital microbasin was able to maintain good quality without the need for physical or chemical treatment for consumption.

In the Glória microbasin, treatment was necessary. The aforementioned author concluded that the valuation of environmental services in Sana APA would allow the recovery of the ciliary band, with users' collaboration, in a period of approximately 2.2 years.

Alba María Guadalupe Orellna Gonzalez, author of the thesis "Dynamic simulation model for ecological valuation of ecosystemic water services in the Piracicaba, Capivari and Jundiaí 2010 river basins", allocated in the Postgraduate Program in Ecology concept 06 CAPES, at the University of São Paulo (USP), defended the thesis that had as main objective, to develop a model of dynamic simulation, for the ecological valuation of ecosystem services.

The basic hypothesis of Gonzales (2010) was that the ecological valuation of ecosystem services must have an integrative tool for the elements involved in ecological modeling, and has

as basic requirement the understanding of ecosystem dynamics, which generates flows of Ecosystemic Hidric Services (SEH).

The SEH are benefits generated from complex interactions among the components of the hydrological cycle that are related to the preservation of both quantity and quality of water supply (GONZALES, 2010). The model was developed through a systemic analysis of the ecosystem processes, understood within the hydrological cycle that the main variables and their respective interrelations were determined, according to the structure of this cycle.

Gonzales (2010), standardized its model in the Posses sub-basin, Extrema municipality, Minas Gerais. Thirty - six scenarios were examined in order to evaluate the impact on the following variables: soil texture, vegetation height, leaf area index and groundwater depth, in the generation of SEH flows in water on the infiltrated and stored surface.

However, it was assessed how these are quantitatively affecting the maintenance of available water supply. For Gonzales (2010), the developed model allowed to increase the understanding of the SEH flows, which represents a tool of high potential of application, be it in the phases of definition of scope, evaluation of alternatives and monitoring of payment schemes by SEH in Brazil.

Economic valuation of the sediment reduction service of the forests of the Panama Canal basin", was the title of the thesis of Eustorgio Jaén Núñez, defended in 2011, at the University of São Paulo (USP), in the Postgraduate Program in Sciences (Applied Economics), concept 05 (CAPES).

According to Núñez (2011), the sedimentation and silting process reduces the depth and the capacity of the water storage lakes in the Panama Canal, thus requiring sediment removal by periodic dredging, which increases operating costs. These processes are accelerated because there is great loss of vegetation cover in the basin.

In his study, Núñez (2011), aimed to estimate the economic value associated with the reduction of sediment of the forest in the vicinity of the Canal basin, through the method of avoided cost of dredging.

According to Núñez (2011), it was observed that for each hectare of forest, it can be reduced by 14.76 t.year⁻¹ of suspended sediments. Adding bottom sediment corresponds to 14.32 t.ha⁻¹.no⁻¹ and at an economic value of USD 197.40 per hectare per year.

Thus, the author concluded that the forests contribute significantly to mitigate the process of sedimentation of water storage lakes for the operation of the Panama Canal. Whereas, this contribution can be valued at USD 39.640,091 per year, for the whole forest of the basin.

Raquel de Souza Pompermayer, in 2012 defended the thesis "Economic valuation of environmental services for protection of water quality", in the Postgraduate Program in Forest Sciences concept 04 CAPES, offered by the University of Brasília (UNB). The author

investigated the economic valuation of the environmental service of water quality protection in hydrographic basins of urban abstraction.

Pompermayer (2012), sought to quantify the social costs of water quality degradation. The area covered by its study was the Federal District, whose sources are used for the urban supply of the administrative regions. In the light of international experiences, it sought to elaborate an economic valuation procedure that allows the magnitude of the impacts and the loss of forest cover on social welfare (POMPERMAYER, 2012).

In general, the results of the research by Pompermayer (2012), pointed out that the social costs of water quality degradation reach consumers. Since variations in consumer economic surplus levels provide a measure of the social cost of loss of environmental service to protect water quality.

Pompermayer (2012) estimated that the impacts of degradation of water quality were on two classes of consumers of the public supply system. In the popular category (low income), the social cost was estimated at R \$ 7.0 million per year, which represented 8.9% of total expenses with water, from January 2003 to December 2008. In The social cost was estimated at R \$ 12.9 million per year, equivalent to 6.8% of the total water expenses of consumers in the period studied.

The last thesis published according to the methodological parameters of research, was titled Júnior Ruiz Garcia, as the "Valuation, collection for the use of water and the management of the upper Iguaçu river basins and tributaries of the Upper Ribeira: an ecological economic approach", defended In the Graduate Program in Economics, concept 04 CAPS, in the year 2012.

Garcia (2012), who was troubled by the water problem in the current context, thought about systems implementation methods and watershed management, whose objective was to promote the rational use, preservation and improvement of the quality of water resources.

Thus, it was possible to apply new procedures for the economic and ecological valuation of the ecosystem services responsible for the provision of quality water in the Upper Iguaçu and Upper Ribeira Basins, located in the Metropolitan Region of Curitiba. The objective was to subsidize the construction of a water pricing policy, as well as the establishment of Payment for Environmental Services (PES) schemes.

As a result, Garcia (2012) showed that the recovery of the riparian forest deficit, the adequacy of land use according to its agricultural aptitude and the adoption of conservation practices by the rural producers, could increase water availability by 878 million cubic meters per year. Consumption was reduced by 330 million cubic meters per year, reducing soil loss by almost 80 million tons / year and raising total carbon stock by 36 million tons, in addition to improving water quality.

In short, intervention to improve the quality of water resources will also affect the provision of other ecosystem services, so river basin management can not be considered in isolation, analyzing not the components of the ecosystem, but the ecosystem as A whole (GARCIA, 2012).

FINAL CONSIDERATIONS

The discussion of the environmental problem by the Stockholm Conference in 1972 marked the insertion of the entire society in the search for preservation of environmental resources, because of the management of water resources. Therefore, the development of environmental policies and the promotion of discussion by various social agents.

Environmental Valuation emerged as an alternative to the process of environmental degradation. The methods of Environmental Assessment are intended to provide information on the economic importance of the environment using real or hypothetical market or through phenomenology, seeking to understand the degrees of importance that individuals attach to environmental goods in their subjectivity.

To understand the assessment scenario applied to the management of water resources, it was important to use bibliometric techniques, to make it possible to measure the theses that have been discussed on the subject, and thus to understand how these researches are developed at the doctoral level. And through this methodology, which was born in the scope of studies in Information Science, it was possible to glimpse the occurrence of the theses in the graduate programs.

It was verified that the first theses developed in Brazil, according to the methodology proposed, date from the year 2006 to 2012. The presence or not of theses of later years can be justified by the date of formation of the database of the present article, And the need for time for postgraduate programs to make available the theses defended in their electronic portals and BDTD of the institutions to which the programs are part.

The theses found are concentrated in postgraduate programs in the Southeast region, leaving only the thesis of Pompermayer (2012) as outside this region, being UNB. The theses are concentrated mainly in the universities installed in the state of São Paulo. This is an occurrence that is not restricted only to the production of research in Environmental Valuation aimed at the management of hydrographic basins, but also to the other academic research at the doctoral level aimed at Environmental Valuation in general. It is important to understand that there is a concentration of graduate programs in the Southeast region, which reflects the great geographical vacancies of the postgraduate program.

With the bibliometric inferences, it was possible to verify that the programs in Economy presented the highest number of theses, having a total of three. But since Environmental

Valuation is a subject that is not restricted to the area of studies in economics, it was possible to find theses in agronomy, geology, ecology and forest science programs.

Thus, the Environmental Valuation focused on hydrographic basins is not a discussion restricted to economics programs or based on economic analysis. The existence of studies in other programs shows the possibilities of valuation as an instrument capable of providing mechanisms that can help in the development of a good management of water resources.

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